SECTION 3 STUDY APPROACH

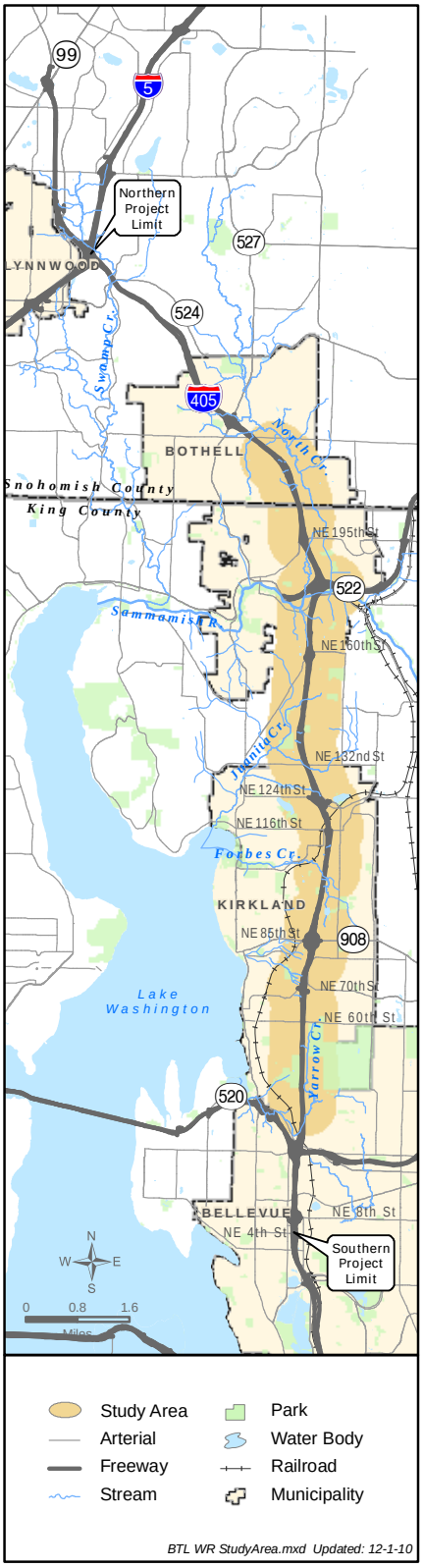
What is the study area and how was it determined?

The I-405 Team identified areas where surface water, floodplains, groundwater, and water quality could be affected from the project's highway construction and operation. These areas were designated as the study area (see Exhibit 3-1). Groundwater conditions within one-half mile of the highway right-of-way, or the maximum distance anticipated for effects due to construction, were included in the study.

The study area is limited to the area from SR 520 to one mile north of NE 195th Street, because the project proposes no new pavement or earthwork activities beyond those limits. Restriping the existing roadway will have no affect on water resources. The I-405, SE 8th Street to SR 520 Braided Ramp Project will complete roadway widening between the southern project limit and SR 520.

I-405 intersects and/or discharges stormwater runoff to Sturtevant Creek, Yarrow Creek (KL1), Forbes Creek, Juanita Creek, Sammamish River, North Creek, Swamp Creek, and tributaries to these streams. This study area omits Sturtevant Creek, Swamp Creek, and tributaries to these streams because there is no potential for impact to those basins in the Bellevue to Lynnwood Improvement Project.

Exhibit 3-1: Water resources study area



What policies or regulations are related to effects on water resources?

Surface water, floodplains, water quality, and groundwater are regulated and protected by federal, state, and local laws because of their importance to public and environmental health. The laws, regulations, and associated government agencies that manage these elements of the environment are listed in this section.

Surface water and floodplains

Numerous federal, state, and local policies and regulations apply to surface water and development near floodplains. These policies and regulations include:

Federal

- National Flood Insurance Act of 1968;
- Flood Disaster Protection Act of 1973; and
- Floodplain Management, Presidential Executive Order 11988 (May 24, 1977).

Washington State

- Flood Control Management Act of 1935, Revised Code of Washington (RCW) 89;
- A Memorandum of Agreement (MOA) on work in state waters between the Washington State Department of Fish and Wildlife (WDFW); Washington State Military Department, Emergency Management Division; Washington State Association of Counties; Association of Washington Cities; Ecology; and WSDOT, as described in the WSDOT *Environmental Procedures Manual*, Section 431.04 (WSDOT, 2010a); and
- WSDOT *Hydraulics Manual M 23-03* (WSDOT, 2010b).

King County

- King County floodplain measures, including Title 21A of the King County Code (KCC) and the Surface Water Runoff Policy in Chapter 9.04 of the KCC;
- King County *Flood Hazard Management Plan* (King County, 2006b); and
- King County *Surface Water Design Manual* (King County, 2009).

Snohomish County

- Snohomish County Code, Chapter 30.65, Special Flood Hazard Areas.

City of Bellevue

- Bellevue regulations for floodplains (Land Use Code 20.25 H).

City of Kirkland

- Kirkland regulations for floodplains (Zoning Code, Chapter 90, Municipal Code Chapter 21.56).

City of Bothell

- City of Bothell regulations for floodplains (Title 14 Environment, Chapter 14.04, Critical Area Regulations).

Water quality and groundwater

The Clean Water Act (CWA) regulates discharge of pollutants into United States Waters and sets water quality standards for all contaminants in surface waters. It addresses not only the water quality of discharges from sewage plants and industrial facilities (point sources), but runoff from streets and construction sites (non-point sources). The U.S. Environmental Protection Agency (EPA) grants a designated state agency the authority to implement the CWA. Ecology is the designated agency in Washington.

The primary policies and regulations related to water quality and groundwater include:

- Federal CWA – Ecology and U.S. Army Corps of Engineers (Corps);
- State of Washington Surface Water Quality Standards (Washington Administrative Code [WAC] 173-201A) and Groundwater Standards (WAC 173-200);
- Endangered Species Act (ESA) – NOAA Fisheries Service and U.S. Fish and Wildlife Service (USFWS);
- Joint Aquatic Resources Permit Application (JARPA)consisting of the following:
    - Hydraulic Project Approval (HPA) – WDFW;
    - 401 Water Quality Certification – Ecology;
    - Aquatic Resources Use Authorization Notification – Washington State Department of Natural Resources (WDNR);
    - Section 404 and 10 – Corps; and
    - Bridge Act Permit and Private Aids to Navigation – Coast Guard.
- Washington State Shoreline Management Act;
- King County Critical Areas Ordinance for Shorelines and Wetlands;
- King County Floodplain Ordinance; and
- Snohomish County Critical Aquifer Recharge Areas Ordinance.

How did we collect information on water resources for this report?

We collected information from the sources described below.

Surface water and floodplains

The I-405 Team acquired information from FEMA Flood Insurance Rate Maps (FIRMS, 1999), and the FEMA Flood Insurance Study (FIS) for King County and Incorporated Areas (FEMA, 2001), aerial photographs, agency websites, and regulatory guidance. Information from the WSDOT I-405 Team hydraulic engineers was also incorporated in this analysis.

The FEMA FIS (FEMA, 2001) and (FIRMS, 1999) (FEMA, 1995a; 1995b) for King County and incorporated areas were used to identify the location of 100-year floodplains on major rivers, lakes, and streams in the study area.

In addition, the I-405 Team consulted the most current versions of the following published guidelines:

- *Stormwater Management Manual for Western Washington* (Ecology, 2005);
- *Highway Runoff Manual M 31-16* (WSDOT, 2010c);
- *Hydraulics Manual M 23-03* (WSDOT, 2010b);
- Washington Administrative Code (WAC) 173-270-050, Puget Sound Highway Runoff Program;
- Manuals and guidelines of local jurisdictions, including King County's *Surface Water Design Manual* (King County, 2009)[1];
- Snohomish County Drainage Needs Report (Snohomish County 2002); and North Creek
- City of Kirkland Surface Water Master Plan (Kirkland 2005).

Water quality

To collect information about water quality, the I-405 Team reviewed basin plans, topographic and resource maps, geographic information system (GIS) maps and databases,

[1] *Most local jurisdictions have their own manual or have adopted Ecology's Stormwater Management Manual for Western Washington.*

aerial photographs, water quality studies, agency websites (including Washington State's 303(d) list of impaired water bodies), recent water quality data, and information from the WSDOT I-405 hydraulic engineers.

Groundwater

Information about groundwater was obtained from the following sources:

- EPA Sole Source Aquifer website; and
- Ecology resources, including the database of water well logs on Ecology's Groundwater Resource website, the *Stormwater Management Manual for Western Washington* (Ecology, 2005), and the Water Rights Application Tracking System (WRTS) database.

For information on groundwater use, we consulted the Washington State Department of Health (DOH), King County Water Resource Department, City of Kirkland Department of Public Works, Northshore Utility District, and Snohomish County.

How did we evaluate effects on water resources?

Surface water

The I-405 Team assessed baseline conditions to identify tributaries to Lake Washington and highway runoff within the study area. We assessed and reviewed: current flow patterns, land use, and peak flow conditions; steep slopes; wetlands and other water bodies; and human-made drainage and/or treatment systems. Effects on surface waters were determined by comparing baseline conditions with an estimate of future conditions that will occur after completion of the project.

Floodplains

We also identified and evaluated baseline conditions for major floodplains in the study area. Our assessment of baseline conditions included a review of baseline floodplain characteristics and land uses, pertinent regulations, peak flow estimates, and any historic flooding problems. Effects on flood plains were determined by comparing baseline conditions with an estimate of future conditions that will occur after completion of the project.

Potential floodplain changes that could occur during project construction and operation were addressed qualitatively, and included the following considerations:

- Would the proposed project affect floodplain function by changing how water and sediment are conveyed during flood events?
- Would the proposed project likely result in increased damages associated with flooding to areas upstream or downstream of the project corridor?
- Is the proposed project consistent with applicable regulations for development within floodplains or areas of special flood hazard?

The following design information was used:

- Preliminary stormwater management facility siting options;
- Baseline stormwater management facilities, and deficiencies in baseline drainage systems (identified by state and local agencies);
- Drainage areas and outfall locations for highway runoff that occur with baseline conditions and for the Build Alternatives;
- Estimates of the amount of proposed new and reconstructed impervious areas;
- Temporary erosion and sediment control performance objectives and a list of best management practices (BMPs); and
- Survey mapping, aerial photography, proposed roadway geometry, and an inventory of baseline stormwater features.

The I-405 Team reviewed and summarized the project's general plan for stormwater collection, conveyance, and treatment *(I-405, Bellevue to Lynnwood Improvement Project Conceptual Hydraulic Summary* [WSDOT, 2011]), as well as the discharge points. This plan includes collection and treatment of all highway runoff generated from new impervious surfaces, and runoff from some of the replaced impervious surfaces.

Water quality

Potential effects on water quality during construction were addressed qualitatively. Potential effects on water quality during operation were based on comparing annual pollutant loading of target contaminants for the No Build and Build Alternatives.

What is pollutant loading?

Pollutant loading is the quantity of a pollutant that discharges to a given point in a drainage area (e.g., to a stream) over a set period of time.

Our assessment of potential effects on water quality was primarily based on the following consideration: Would the proposed project result in an increase in the amount of pollution within the nearby surface water bodies? Increases in pollution are considered to be a problem if water quality standards are violated or the beneficial uses are impaired as a result of the proposed project.

Groundwater

The methods we used to evaluate the project's potential effects included:

- Reviewing the proposed project design concept and likely construction methods; and
- Evaluating the potential effects of the project on groundwater based on baseline conditions and standard WSDOT practices.

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SECTION 4 BASELINE CONDITIONS

The baseline conditions for the I-405, Bellevue to Lynnwood Improvement Project (Bellevue to Lynnwood Improvement Project) assume completion of the improvements that have already been environmentally cleared and permitted as a part of the I-405, SR 520 to SR 522 Kirkland Nickel Improvement Project (Kirkland Nickel Project), Stage 1 and Stage 2, the I-405, NE 195th Street to SR 527 Auxiliary Lane Project, and the I-405, NE 8th Street to SR 520 Braided Ramps Project. The conditions described in this section are what will exist after these projects are built.

What are baseline conditions?

Baseline conditions describe what will exist in the future after a project that has already been approved and funded is completed. The baseline condition is a snapshot of expected conditions. It provides an important point of comparison for understanding the effects of the proposed Build Alternatives.

The Kirkland Nickel Project includes the following:

- Water quality facilities that treat 381 percent of the new impervious surfaces;
- An improved fish passage structure on Forbes Creek; and
- Stormwater detention systems to protect downstream water bodies from excessive flows.

The I-405, NE 195th Street to SR 527 Auxiliary Lane Project includes the following:

- Water quality facilities that treat 192 percent of the new impervious surfaces; and
- Stormwater detention systems that are forward compatible to protect downstream water bodies from excessive flows for the NE 195th Street to SR 527 Auxiliary Lane Project plus the new impervious area proposed for this Project.

The NE 8th Street to SR 520 Braided Ramps project will provide water quality facilities that treat 310 percent of new impervious surfaces (Atkinson, 2010).

What surface water bodies exist in the study area?

Within the study area, I-405 intersects and/or discharges stormwater runoff to the following streams and rivers and their tributaries within the study area (from south to north):

- Yarrow Creek;
- East Lake Washington

- Forbes Creek;
- Juanita Creek;
- Sammamish River; and
- North Creek.

North Creek discharges to the Sammamish River, a tributary to Lake Washington. The remaining streams listed above are tributaries to Lake Washington. Exhibit 4-2 shows the location of these water bodies, their tributaries, and their associated drainage basins. The surface waters are located within the urbanized and suburban areas of King and Snohomish counties and have been extensively modified as a result of development. We summarize the characteristics of these surface water bodies and watersheds in Exhibit 4-1, and describe them in more detail in the sections below.

Although the northern limit of the project extends into the Swamp Creek drainage basin, the project includes only minor disturbances, such as the installation of signs and gantries that do not have the potential to substantially impact water resources in the Swamp Creek basin. Therefore, the Swamp Creek basin is not discussed in this report (see Exhibit 3-1).

The following basin plans have been prepared for these water bodies:

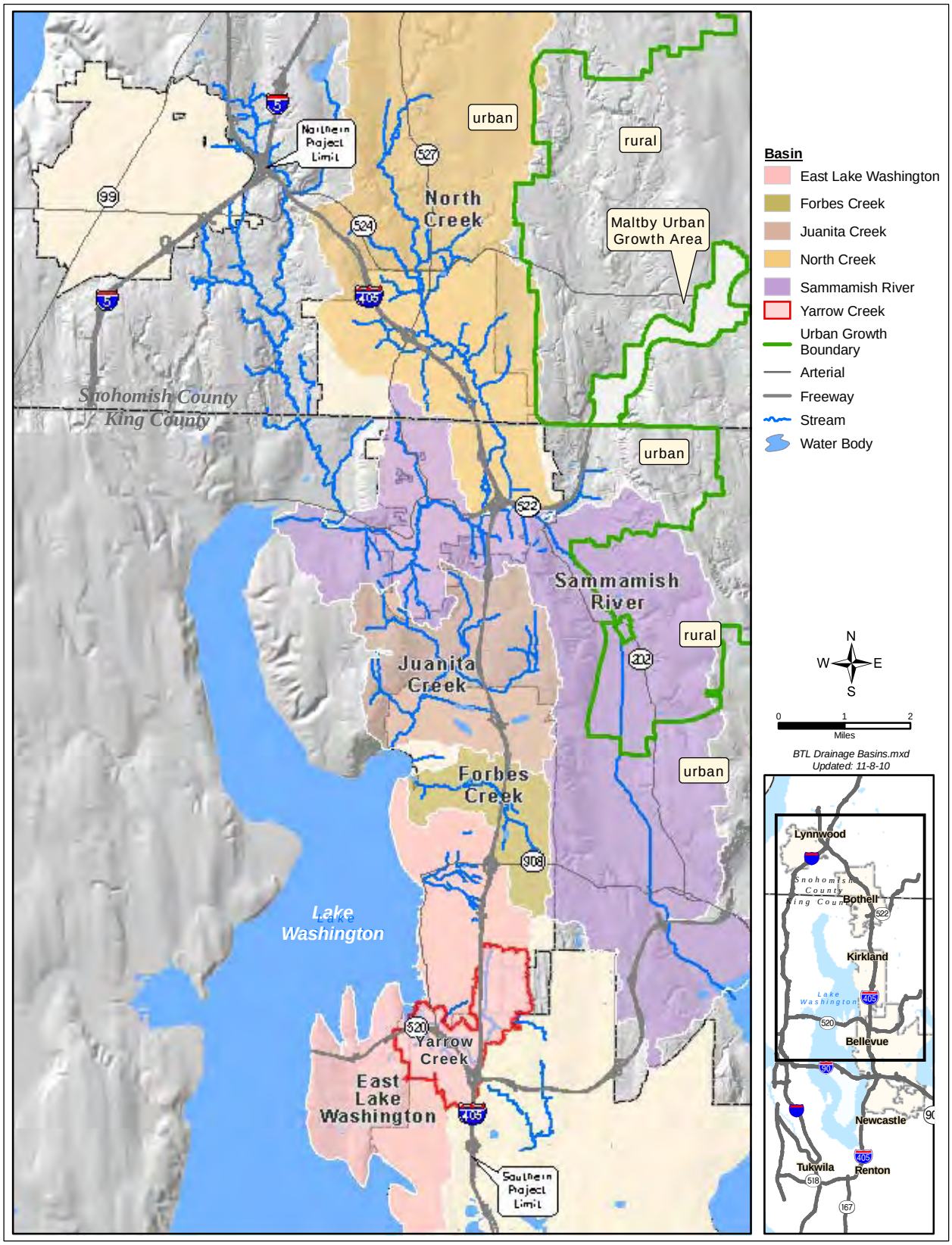
- Sammamish River Corridor Action Plan (King County and Corps, 2002);
- North Creek Drainage Needs Report (Snohomish County, 2002); and
- City of Kirkland Surface Water Master Plan 2005 (Kirkland, 2005).

Exhibit 4-1: Characteristics of the major receiving surface waters

	Yarrow Creek[4]	Forbes Creek	Juanita Creek	Sammamish River	North Creek
Basin size (sq mi)	2.3	2.8	7	25.5	29.3
Average Annual Discharge (cfs)[1]	No data	No data	14.1	338.5	59.3
Streamflow Range (cfs)[1]	No data	No data	2.8 - 42.3	45.7 - 1,216.3	30.3 – 115.5
Tributary to	Lake Washington	Lake Washington	Lake Washington	Lake Washington	Sammamish River
Length (miles)	3.0	1.8	5.0	13.8	12.6
Crosses I-405 at MP[3]	15.2 to 15.3	18.9 to 19.2	20.4 to 20.5 21.9 to 22.0	23.6	24.3 to 24.4
Ecology Classification Aquatic Use	Core Salmonid Habitat	Core Salmonid Habitat	Core Salmonid Habitat	Core Salmonid Habitat	Core Salmonid Habitat
Water Quality Limited Parameters[2]	fecal coliform; dissolved oxygen (in Yarrow Bay Creek vicinity)	none	fecal coliform; dissolved oxygen; temperature	fecal coliform; dissolved oxygen	dissolved oxygen (Snohomish County) temperature (King County - downstream of project)
TMDL Developed[2]	none	none	none	none	fecal coliform (King and Snohomish County), dissolved oxygen (King County - downstream of project)

[1] *King County, 2007*
[2] *Ecology, 2009a*
[3] *See Exhibit 2-2, Sheets 1 through 16*
[4] East Lake Washington, includes Yarrow Creek

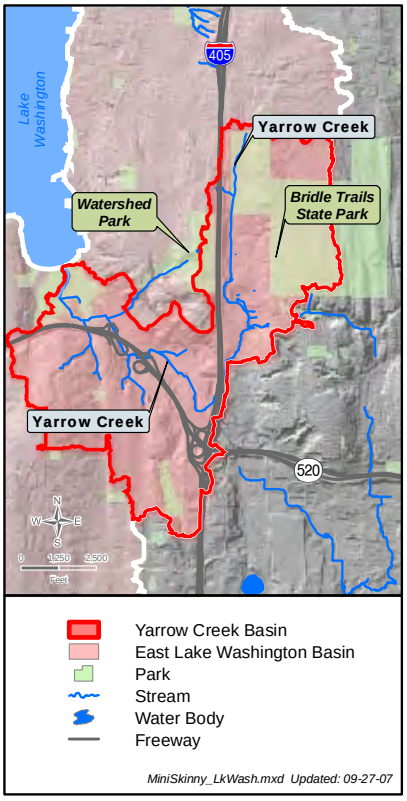
Exhibit 4-2: Drainage basins



Yarrow Creek

Yarrow Creek originates in the Bridle Trails State Park at an elevation of 400 feet above mean sea level (MSL) and flows approximately 3.0 miles before entering Lake Washington's northeastern shoreline (Exhibit 4-3). Much of the stream is channeled through pipes, although several straight sections of the creek run in an open channel between culverts. Land use in the Yarrow Creek basin includes recreational (the Bridle Trails State Park), commercial, multifamily, and single-family development. From its headwaters, the creek flows primarily along streets and through residential areas (The Watershed Company, 1998). Downstream of 116th Avenue NE, the creek flows through a narrow, well-forested corridor until it crosses I-405 just north of SR 520. Downstream of I-405, the creek flows through a Burlington Northern Santa Fe (BNSF) Railway corridor, a business parking lot, and several culverts before entering a section of wooded ravine upstream of Northup Way. Along Northup Way, the creek flows north through a narrow roadside ditch. Yarrow Creek flows under SR 520 in pipes; a portion of the stream flows through an open channel located in the cloverleaf at the Lake Washington Boulevard off-ramp from SR 520 as it passes through the SR 520 interchange with Lake Washington Boulevard.

Exhibit 4-3: Yarrow Creek

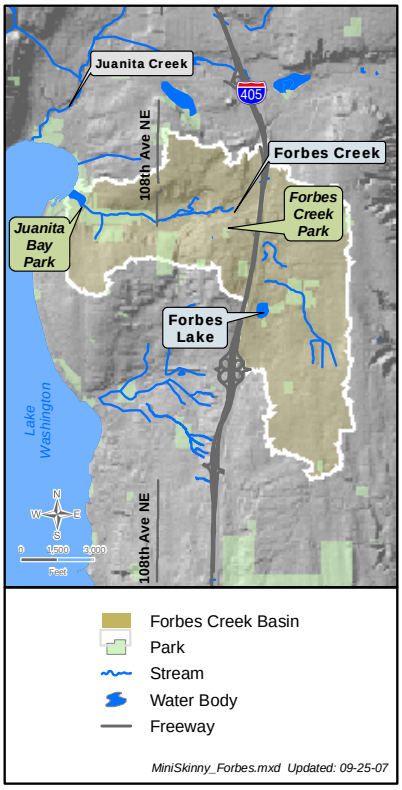


Forbes Creek

Forbes Creek (Exhibit 4-4) originates at an elevation of 240 feet above MSL and flows approximately 2.0 miles through Kirkland and a wetland area before entering Lake Washington at the south side of Juanita Bay (see Exhibit 4-1). Land use in the Forbes Creek basin is urban/suburban, with portions in commercial and industrial land uses (King County, 1987).

About one-half of the stream is located upstream of I-405 where three major tributaries drain from east to west into the main stem of Forbes Creek (C18, C19, and an unnamed tributary). A new 320 foot, 78-inch-diameter steel culvert was recently installed at Forbes Creek at the I-405 crossing to meet current WDFW fish passage requirements. In addition, approximately 250 feet of natural stream habitat was created. Downstream of I-405, Forbes Creek flows between various industrial land uses and a railroad (The Watershed Company, 1998). Immediately downstream of I-405, Forbes Creek flows within a wooded ravine until it reaches a parking lot

Exhibit 4-4: Forbes Creek



What is riprap?

A human-made armoring, facing layer, or protective mound of rocks placed to prevent erosion or sloughing of a stream bank or structure due to flow of surface and stormwater runoff.

approximately 1,100 feet downstream. The creek is contained in pipes for a few hundred feet under the parking lot, with the outfall discharging to a steep slope covered with riprap.

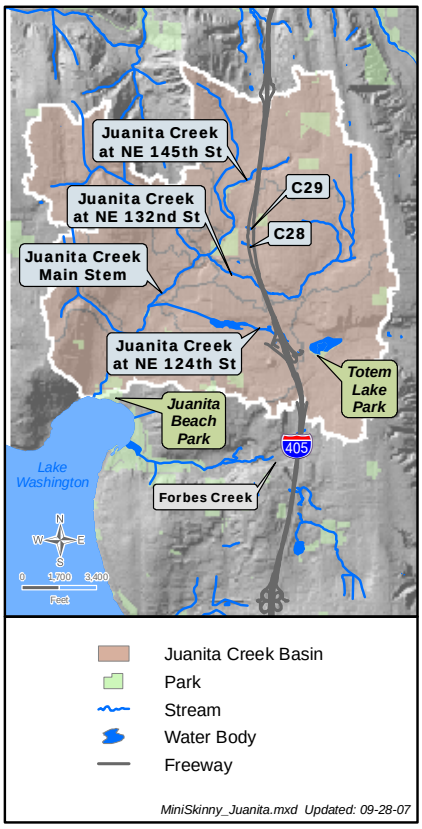
Juanita Creek

Juanita Creek[2] at NE 145th Street (Exhibit 4-5) originates east of I-405 and flows for approximately 5.0 miles west and south, entering Lake Washington on the west side of Juanita Beach Park. The watershed covers approximately 6.6 square miles (4,000 acres) and is dense with residential and commercial development.

There are two primary tributaries that cross I-405 and eventually flow into Juanita Creek. They include the tributary at NE 124th and the tributary at NE 132nd Street. In addition, two smaller tributaries cross I-405 and flow into the main stem of Juanita Creek. See Exhibit 4-5 for tributary locations.)

Juanita Creek is one of the primary habitats for cutthroat trout and coho salmon within the city of Kirkland. Channel complexity and connectivity with the Juanita Creek floodplain have been reduced by stream bank armoring. Sediment deposition from the creek is evident in the Juanita Bay Park at the mouth of the creek.

Exhibit 4-5: Juanita Creek



Sammamish River

The Sammamish River (Exhibit 4-6), the major outlet of Lake Sammamish, enters the north end of Lake Washington. The Sammamish River is a major inflow to Lake Washington, providing about 30 percent of the lake's water flow. The Sammamish River basin is approximately 212 square miles.

The Sammamish River's floodplain varies from a width of about 1,000 feet to about one mile. The floodplain is contained within the channel at the I-405 crossing. Historically, the floodplain was a diversely vegetated wetland containing many channels, sloughs, and oxbows, and the lower half of the corridor flooded to an average depth of two feet. Much of the river has been dredged, straightened, and leveed for flood protection, and most of the larger riparian vegetation has been removed. In 1962, the Corps began to dredge and channelize the river, primarily as a flood control project. The Corps

What is an oxbow?

An oxbow is a type of lake that is formed when a wide meander from a stream or a river is cut off to form a lake. They are called oxbow lakes due to the distinctive curved shape.

[2] *Also referred to KL13.*

project deepened the river five feet throughout most its length, hardened the river's banks, and dramatically decreased its remaining connection with the floodplain, cutting off most of the smaller tributaries to the river (Martz et al., 1999; Kerwin, 2001).

Land use surrounding the Sammamish River near I-405 is primarily urban and residential. Much of the floodplain is developed to within 100 feet of the river's edge and there are several areas of impervious surface adjacent to the channel (King County and Corps, 2002).

Tributaries to the Sammamish River within the project study area include Stream 42 and KL14 (See Exhibit 2-2, sheet 10). Stream 42 originates in the area just east of I-405 and south of the interchange with SR 522. A steep ravine carries flow from the upper hillsides and neighborhoods to the north and south into the channel. The channel passes under the I-405 north and southbound lanes at MP 23.2 through culvert 41. A steep hill slope is located above the outfall of culvert 41, and it is assumed that the stream channel travels through a steep area. Sediment from the hillsides has been carried down the ravine from storm events and has created sand deposits along the stream banks.

KL14 originates west of I-405 at MP 22.8 and is a tributary to the Sammamish River. This stream receives flow from a series of wetlands and stormwater catch basins. King County considers the upper portion of the creek basin a landslide hazard.

North Creek

The North Creek basin (Exhibit 4-7) drains approximately 28.5 square miles and discharges to the Sammamish River. The creek's headwaters originate in the Everett Mall Way area of south Everett. The creek flows to the south for 12.6 miles before discharging into the Sammamish River (Ecology, 2002). The stream gradient is flat, decreasing from about 50 feet per mile in the upper basin to less than 20 feet per mile near the mouth. The watershed is nearly 10 miles long, 3.0 miles wide, and encompasses an area of about 19,000 acres (King County, 2006a).

Exhibit 4-6: Sammamish River

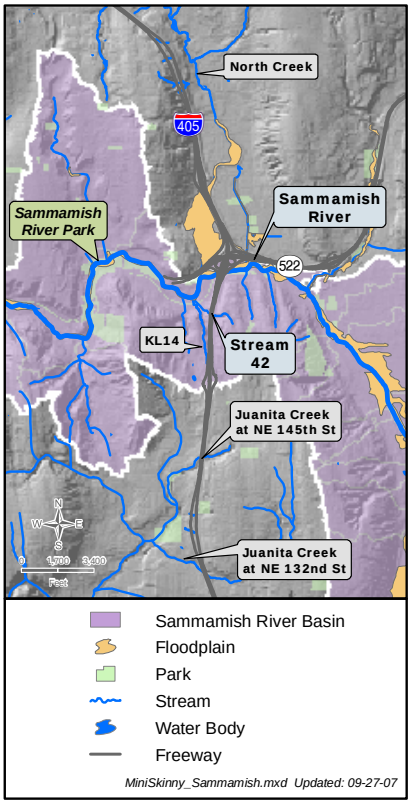
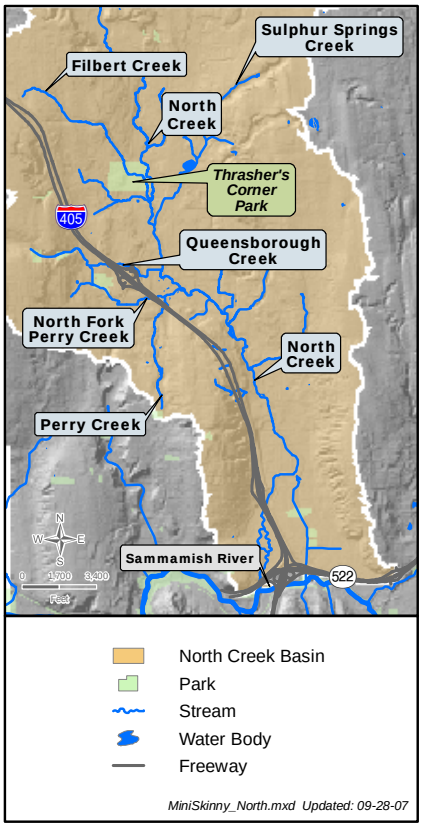


Exhibit 4-7: North Creek



Land use within the basin is primarily urban or suburban, with some remaining areas of rural and forested land. The basin is being rapidly developed for residential and commercial use. The trend toward urbanization continues today, with emphasis on commercial, light industrial, and business parks.

Tributaries to North Creek in the project study area include: Stream 64, Stream 66, Stream 70/71, Stream 75/76, Perry Creek and North Fork Perry Creek. Queensborough Creek and Filbert Creek tributaries are north of SR 527 and the proposed roadway widening, so they are beyond the project study area. Refer to Exhibit 2-2, sheets 12 and 13, for locations of these streams and the Ecosystems Discipline Report for additional information on these tributaries.

What is the water quality of these surface water bodies?

All the water bodies within the study area are part of Water Resource Inventory Area (WRIA) 8, Lake Washington/Cedar River. The WRIA boundaries represent the administrative basis for Ecology's regulatory activities and were established by Ecology, the Washington Department of Natural Resources (WDNR), and the Washington State Department of Fish and Wildlife (WDFW) in 1970. Ecology was given responsibility for the development and management of these administrative and planning boundaries.

The study area creeks and the Sammamish River are designated as Core Summer Salmonid Habitat under Chapter 173-201A-600 of the Washington Administrative Code (WAC), as adopted by Ecology. Numeric water quality criteria have been established by Ecology to support the Core Summer Salmonid Habitat Use. The classification does not indicate whether criteria have been attained, only that they must be achieved to support the designated uses. Designated uses for the water bodies in the study area include: core summer salmonid habitat, extraordinary primary contact recreation,[3] water supply (domestic, industrial, and agricultural), wildlife

[3] *These waters have the highest standards for bacteria to protect primary contact (for example swimming and commercial shellfish harvesting). According to the state's water quality standards, "Extraordinary primary contact means waters providing extraordinary protection against waterborne disease or that serve as tributaries to extraordinary quality shellfish harvesting areas."*

habitat, recreation (swimming, fishing, and aesthetic enjoyment), and navigation.

In addition to numeric water quality criteria, the surface water quality standards include an anti-degradation policy (WAC-173-201A-300). The anti-degradation policy states that: "Existing and designated uses must be maintained and protected. No degradation may be allowed that would interfere with, or become injurious to, existing or designated uses, except as provided for in this chapter."[4] The anti-degradation policy does not mean that discharges of pollutants are not allowed to the waters of the state; but rather that discharges to water bodies must not impair the beneficial uses.

The purpose of the 303(d) list is to allow the State to rank water bodies for protection. A water body on the 303(d) list is required to undergo a "total maximum daily load" (TMDL) study that leads to an allocation of the allowable input of the pollutants so that water quality standards can be achieved. A TMDL study documents existing water quality conditions, quantifies the sources of pollution, develops procedures to improve water quality, and allocates pollutant loads among the sources. Following the results of the TMDL study, increased controls to meet water quality standards could be required for pollution sources within a watershed. The Environmental Protection Agency (EPA) approved Category 5 of the Water Quality Assessment on January 29, 2009. Category 5 represents the state's 303(d) list of impaired waters and Category 4A represents the waters with TMDLs. The *Statewide Water Quality Assessment 303(d) List* (Ecology, 2008a) indicates that Yarrow Creek (at Yarrow Bay), Juanita Creek, the Sammamish River, and North Creek are water quality limited (see Exhibit 4-1). North Creek is listed as water quality limited because of low levels of dissolved oxygen in Snohomish County and because of temperature downstream of the project in King County. The Sammamish River is listed because of elevated fecal coliform and low levels of dissolved oxygen. Juanita Creek is listed because of elevated temperatures, elevated fecal coliform, and low levels of dissolved oxygen. Lake Washington is also listed on the 303(d) list because of elevated fecal coliform at the

[4] *Chapter 173-201A WAC*

downstream end of Forbes Creek, the NE 85th Street storm drainage system, and Yarrow Creek. Yarrow Bay Creek is also listed due to low levels of dissolved oxygen. Water bodies that are water quality limited do not meet state water quality standards for one or more parameters, and technology-based controls are not sufficient to achieve water quality standards.

There have been no TMDL studies conducted for the project water bodies, except for the fecal coliform TMDL study recently completed for North Creek (Ecology, 2002) and for low levels of dissolved oxygen in North Creek downstream of the project within King County (Ecology 2009b).

Yarrow Creek

Since 1976, King County has been conducting monthly water quality monitoring at one site at the mouth of Yarrow Creek, about 1.8 miles downstream of I-405 (King County, 2004a). Water quality effects common to a developing area have been observed. Fecal coliform levels have consistently exceeded state criteria. However, bacteria counts were relatively low in Yarrow Creek compared to other creeks in the monitoring program. Metals measured in filtered stormwater samples did not exceed state criteria.

Forbes Creek

Since 1976, King County has conducted monthly baseline water quality monitoring in Forbes Creek at one site near the mouth of the creek (King County, 2004b). The monitoring indicated that Lake Washington, at the vicinity of the Forbes Creek discharge, does not meet fecal coliform standards. During the period from 2001 to 2004, King County rated Forbes Creek as a “high concern” creek using the Water Quality Index rating system developed by Ecology. This rating was primarily due to high fecal coliform bacteria counts, low dissolved oxygen concentrations, and high phosphorus concentrations. None of the dissolved metals measured in Forbes Creek exceeded state criteria.

Juanita Creek

Storm and base flow water quality sampling was conducted between 1997 and 2002 at the mouth of Juanita Creek and about 1.0 miles upstream (King County, 2004c). Measurements showed that metals generally met the state's

metals standards and nutrient levels were typical of urban streams. However, some of the temperature, dissolved oxygen, and fecal coliform levels did not meet state criteria.

Sammamish River

The Sammamish River contributes to the degraded water quality in the north end of Lake Washington (Ecology, 1995). The Sammamish River has impaired water quality because of past modifications of the river channel. Since settlement of the watershed, logging and dredging have influenced a change in the water quality of the Sammamish River. Efforts to deepen and straighten the river were made to counteract negative effects caused by completion of the locks and the Lake Washington Ship Canal. Dredged material from the river channel was relocated to low elevation floodplain areas next to the river, and riparian vegetation was replaced with grasses (Ecology 1995).

Elevated temperatures in the Sammamish River during the summer are due in part to the warm surface temperatures of Lake Sammamish, rather than the lack of shading along the river. It is likely that elevated temperatures contribute to limiting salmon species in the Sammamish River. Similarly, dissolved oxygen levels in the river often do not meet water quality standards; however, a TMDL is not recommended for this parameter because the violations "…are a natural condition with no direct human-caused influence" (Ecology, 2006a).

North Creek

Fecal coliform bacteria counts and temperatures at upstream sampling sites in North Creek have consistently met state water quality standards (Snohomish County, 2000). Snohomish County found that levels of dissolved oxygen (Ecology 2009a) and concentrations of lead, mercury, copper, and zinc in water samples were in violation of state standards (Snohomish County, 2000). Ecology has implemented a TMDL for fecal coliform loading in North Creek in the project area and for temperature downstream of the project area (Ecology, 2009a). Many areas of the watershed have poor soils for locating on-site septic systems. These poor soils may have resulted in failing or inadequate septic systems, which could

contribute significant amounts of bacterial and nutrient pollutants to North Creek (Ecology, 2002).

How has urbanization affected surface water?

Within the project study area, the streams and their associated basins reflect moderate to highly urbanized conditions. Exhibit 4-8 presents matrices for the streams and their drainage basins in the study area. These matrices indicate the degree of urbanization for these water bodies. As population growth occurs, new infrastructure must be constructed to support that growth, which includes housing developments, roads, shopping areas, and commercial and industrial facilities. This construction disturbs the landscape and can affect water resources.

Exhibit 4-8: Indicators of urbanization by water body basin

Water Body	Percent Total Impervious Area in Basin (Current)	Percent of Basin Area in Urban Growth Area	Percent of Area in Forest Cover[1]	Benthic Index of Biotic Integrity[2] Rating
Yarrow Creek	37	100	30	No data
Forbes Creek	44	100	17	Poor (14-20)[3]
Juanita Creek	46	100	14	Poor (14-22)[3]
Sammamish River	39	80	25	No data
North Creek	41	99	24	Fair (30) to Poor (16)[4]

[1] *Source: Molash, 2006.*
[2] *The Benthic Index of Biotic Integrity (BIBI) measures the health of the insect community in a stream. The Index is used to assess the relative degradation in an ecosystem.*
[3] *Source: Parametrix, 2005*
[4] *Source: Snohomish County, 2002*

What is turbidity?

Turbidity is a condition caused by suspended sediments or floating material that influences how or whether light passes through water. Turbidity can make water appear cloudy or muddy.

Large-scale development often involves land clearing and grading, which can lead to soil erosion during storm events. If not properly mitigated, eroded soil from construction sites may be carried to water bodies, thereby increasing turbidity.

When areas are urbanized, much of the vegetation and topsoil are removed and replaced by impervious surfaces such as roads, parking lots, and pavement. These surfaces do not

allow for absorption of rainfall into the ground, thereby increasing surface runoff to water bodies.

Stormwater runoff can contain contaminants such as motor oil, garbage, chemicals, and biological contaminants such as fecal coliform bacteria. When stormwater comes from rural areas, it may carry wastes from domesticated animals. Stormwater from urban areas is likely to carry pet wastes to nearby streams. These wastes can contribute contaminants such as nitrogen, phosphorus, and waterborne pathogens to receiving water bodies.

How is stormwater currently managed in the study area?

The federal Clean Water Act requires that highway runoff be managed. The federal government has delegated the authority to implement the Clean Water Act to Ecology. To ensure that highway runoff is managed properly, Ecology requires WSDOT to obtain permits through the National Pollutant Discharge Elimination System (NPDES). These NPDES permits require that highways be designed and maintained to minimize pollution and potential damage to downstream water resources and properties. Among other things, the permits require WSDOT to:

- Build stormwater treatment facilities to clean runoff;
- Maintain highways to keep runoff clean;
- Monitor program effectiveness in eliminating pollution;
- Coordinate with others to develop watershed-scale solutions;
- Prevent construction projects from polluting water;
- Educate employees and others on how to protect water quality; and
- Track stormwater-related expenses.

WSDOT submits annual reports to Ecology about the progress the agency has made toward protecting water quality. The annual NPDES reports include water quality data from stormwater runoff and water quality treatment facilities. The data for the NPDES reports are collected by WSDOT from several highways. Additional information about highway runoff management can be found in the *I-405, Bellevue to*

Lynnwood Improvement Project, Conceptual Hydraulic Summary (WSDOT, 2011a).

What are small watercourses?

Small watercourses consist of ditches, open channels, and other systems that convey small amounts of flowing water.

Numerous small watercourses or storm drain systems cross I-405 within the study area (see Exhibit 4-10). Some of these small watercourses drain into Yarrow Creek, Forbes Creek, Juanita Creek, the Sammamish River, or North Creek. The remaining small watercourses independently drain into Lake Washington through small, modified natural stream channels and urban storm drains. These small watercourses or storm drains carry runoff from areas upstream of I-405; many also receive runoff from the freeway itself. The runoff in small watercourses and storm drains that cross I-405 is conveyed beneath the highway in concrete culverts or corrugated metal or concrete pipes (collectively referred to as culverts). Some of the culverts are open at each end and some are completely contained within an enclosed storm drain system.

What is a threshold discharge area ?

The entire project area is divided into areas based on drainage. Each area with a discrete stormwater discharge location, separatated by one-quarter mile or more, is defined as a threshold discharge area (TDA). Stormwater control facilities for the project are designed to control drainage in each TDA.

Exhibit 4-9 presents a summary of the threshold discharge areas (TDAs) included in each drainage basin. The entire project area is divided into areas based on drainage. Each area with a discrete stormwater discharge location is defined as a TDA, and stormwater control facilities are located and sized to control drainage in each TDA.

Exhibit 4-9: Summary of threshold discharge areas by drainage basin

Drainage basin	Total Threshold Discharge Areas	Contributing area (acres)
Yarrow Creek	4	47.5
East Lake Washington	5	92.4*
Forbes Creek	4	50.9*
Juanita Creek	6	137.9
Sammamish River	6	107.7
North Creek	3	56.7*
Total	28	493.1

* TDAs without pavement widening or drainage improvements are not included in the contributing area.

Exhibit 4-10: Stormwater details - sheet 1 of 6

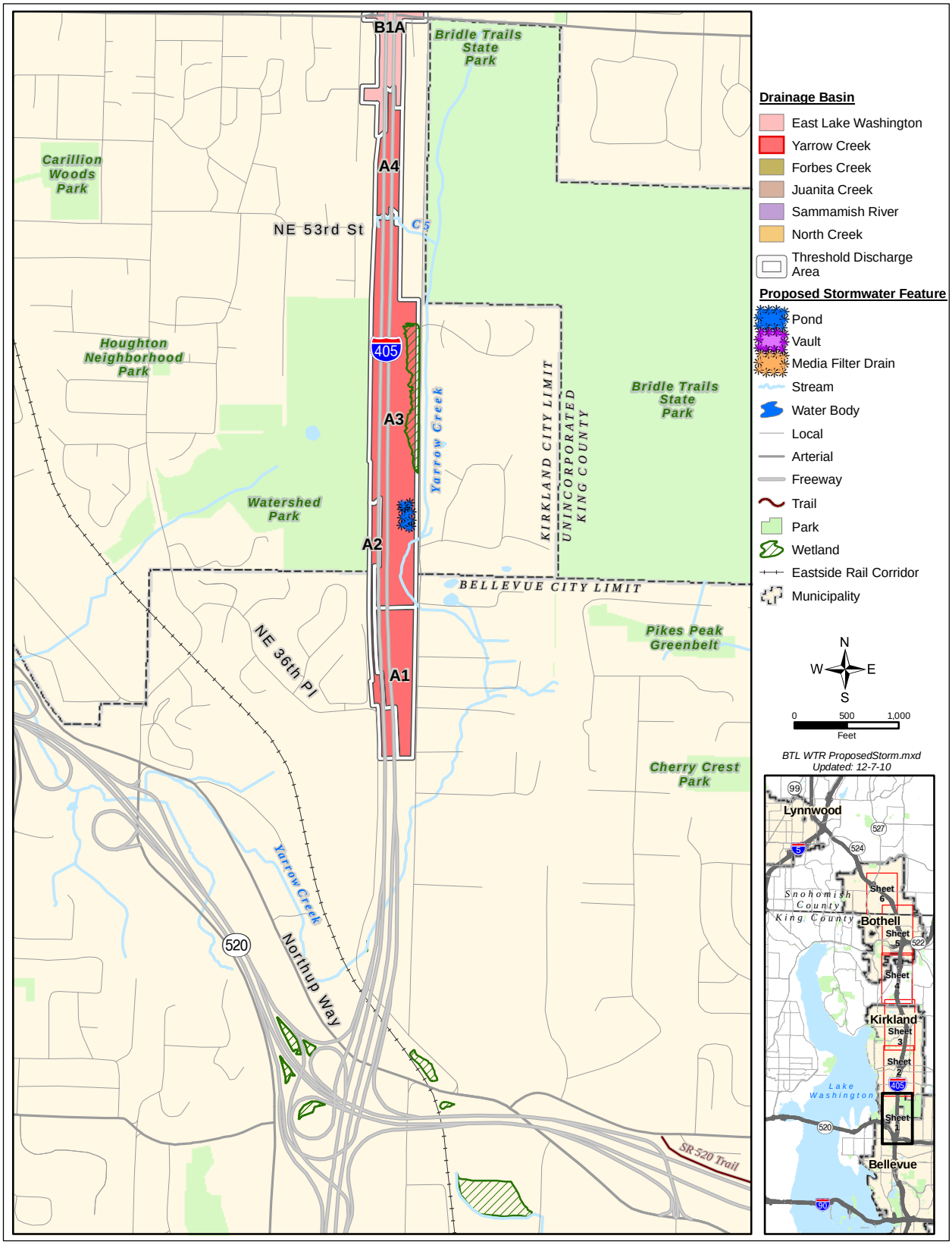


Exhibit 4-10: Stormwater details - sheet 2 of 6

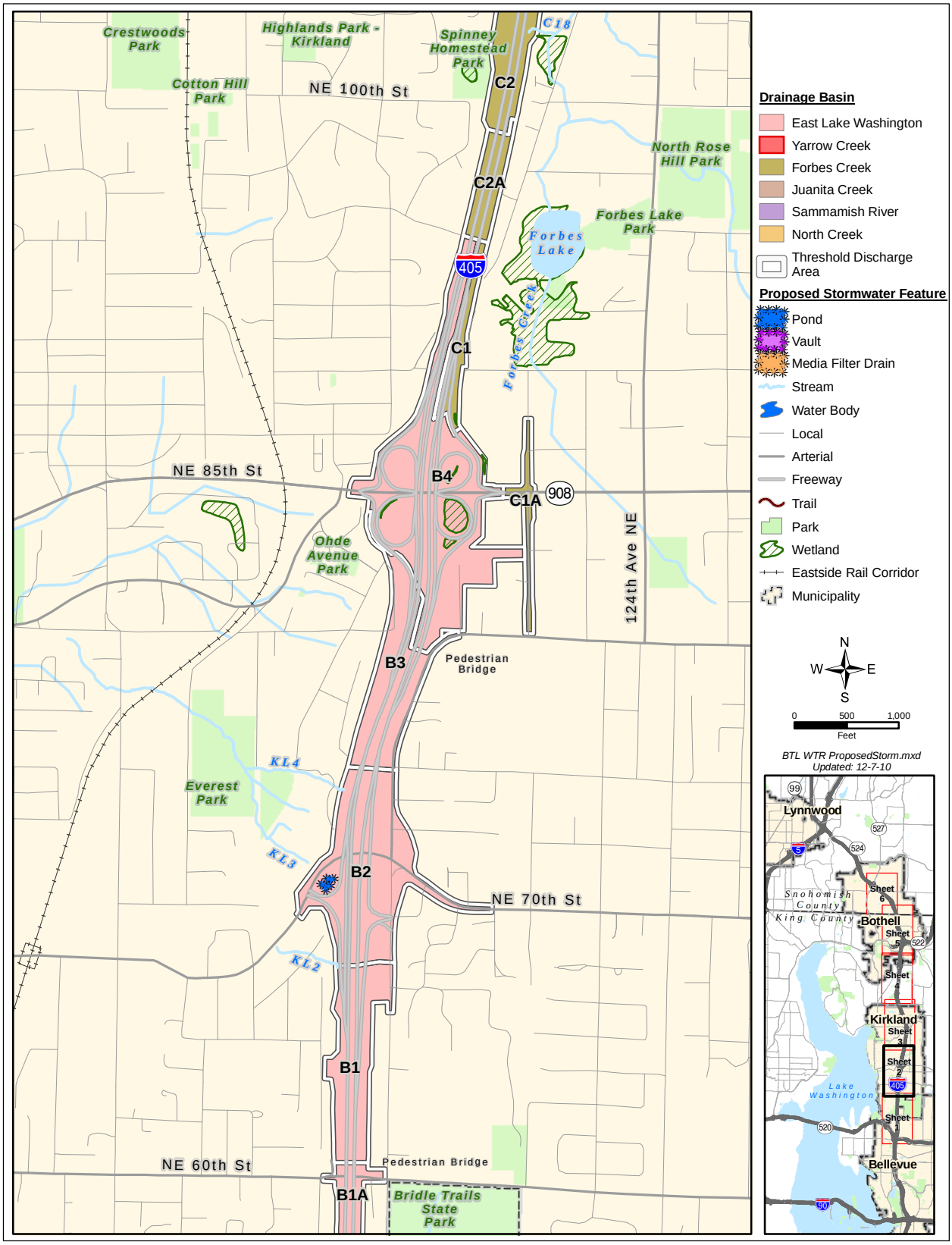


Exhibit 4-10: Stormwater details - sheet 3 of 6

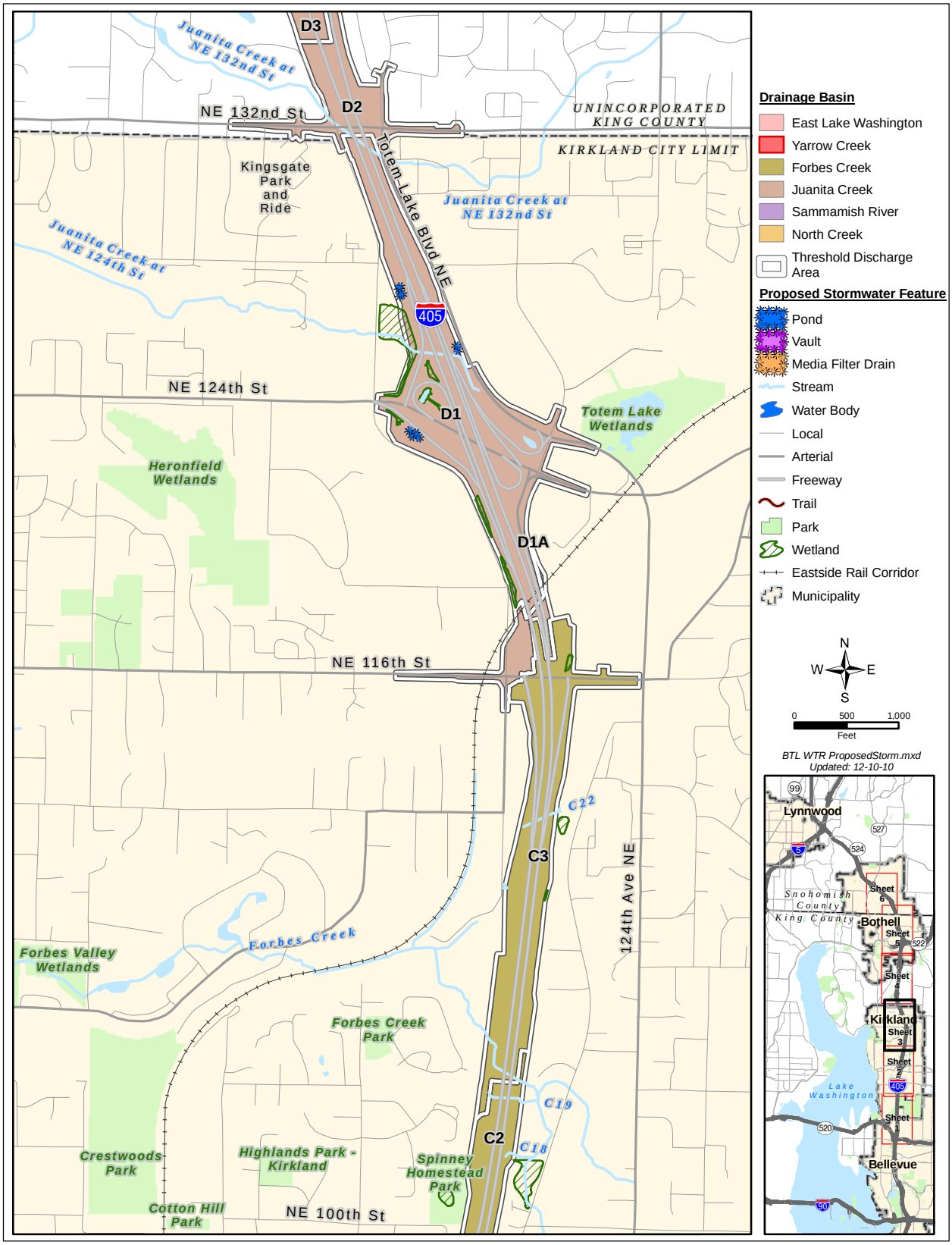


Exhibit 4-10: Stormwater details - sheet 4 of 6

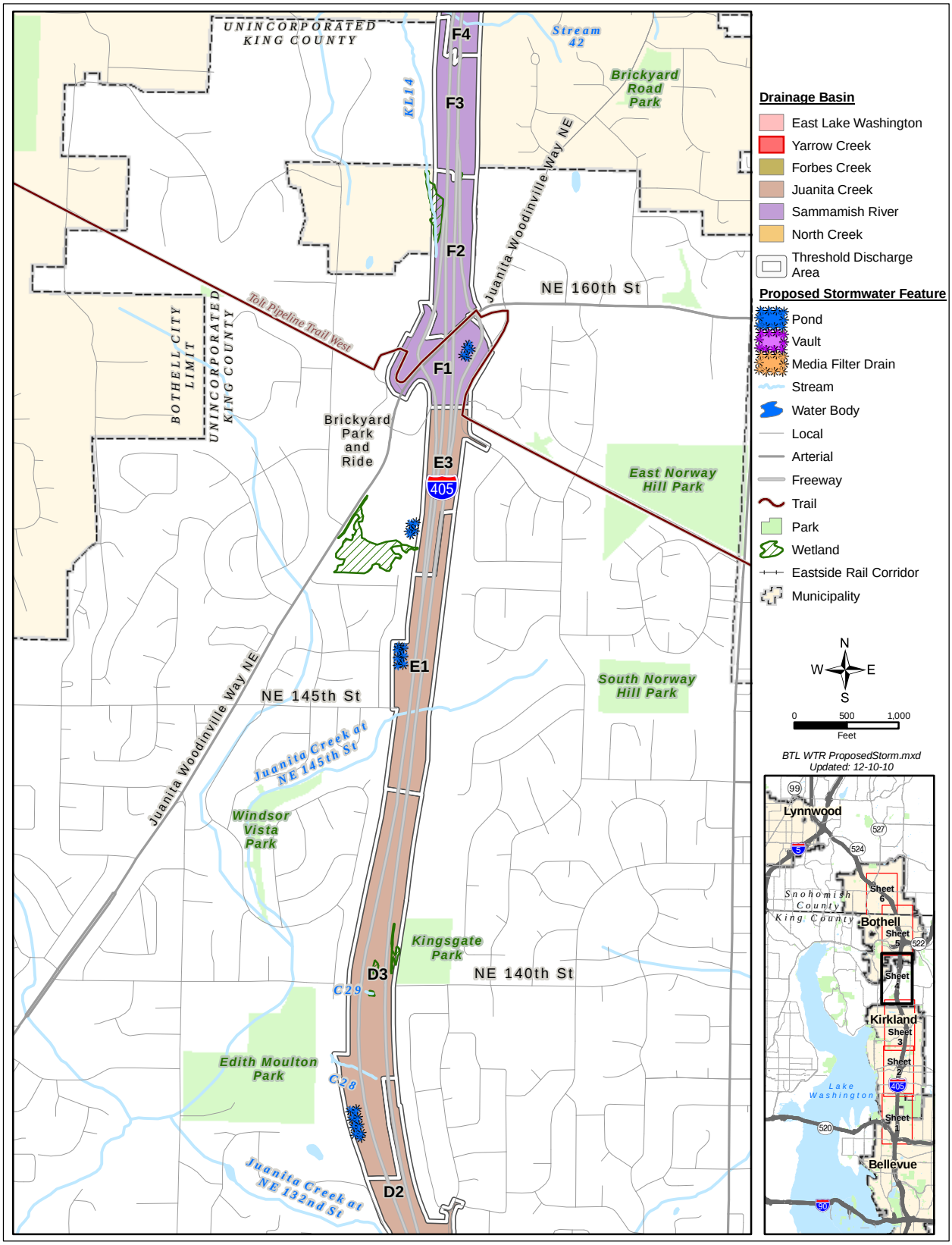


Exhibit 4-10: Stormwater details - sheet 5 of 6

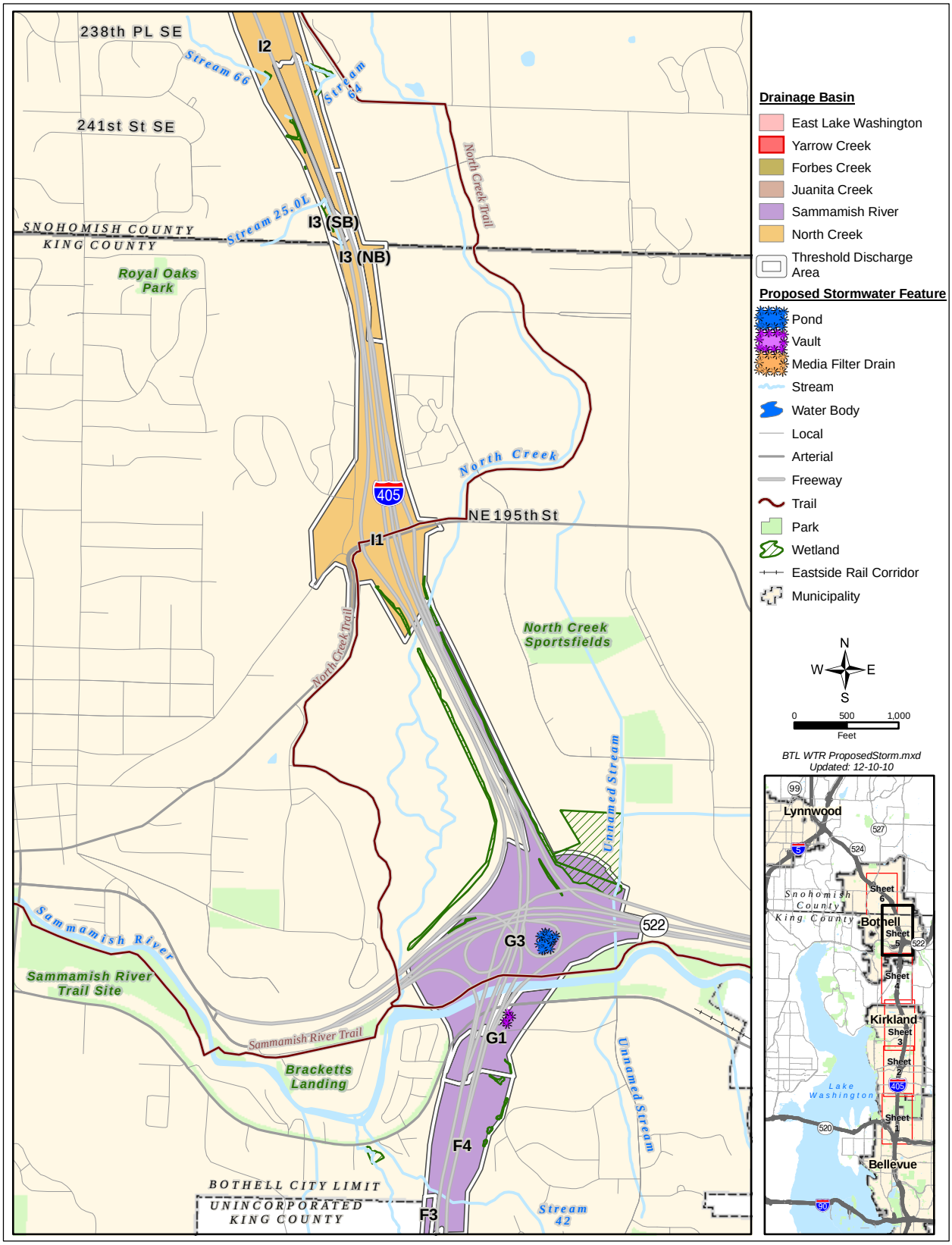
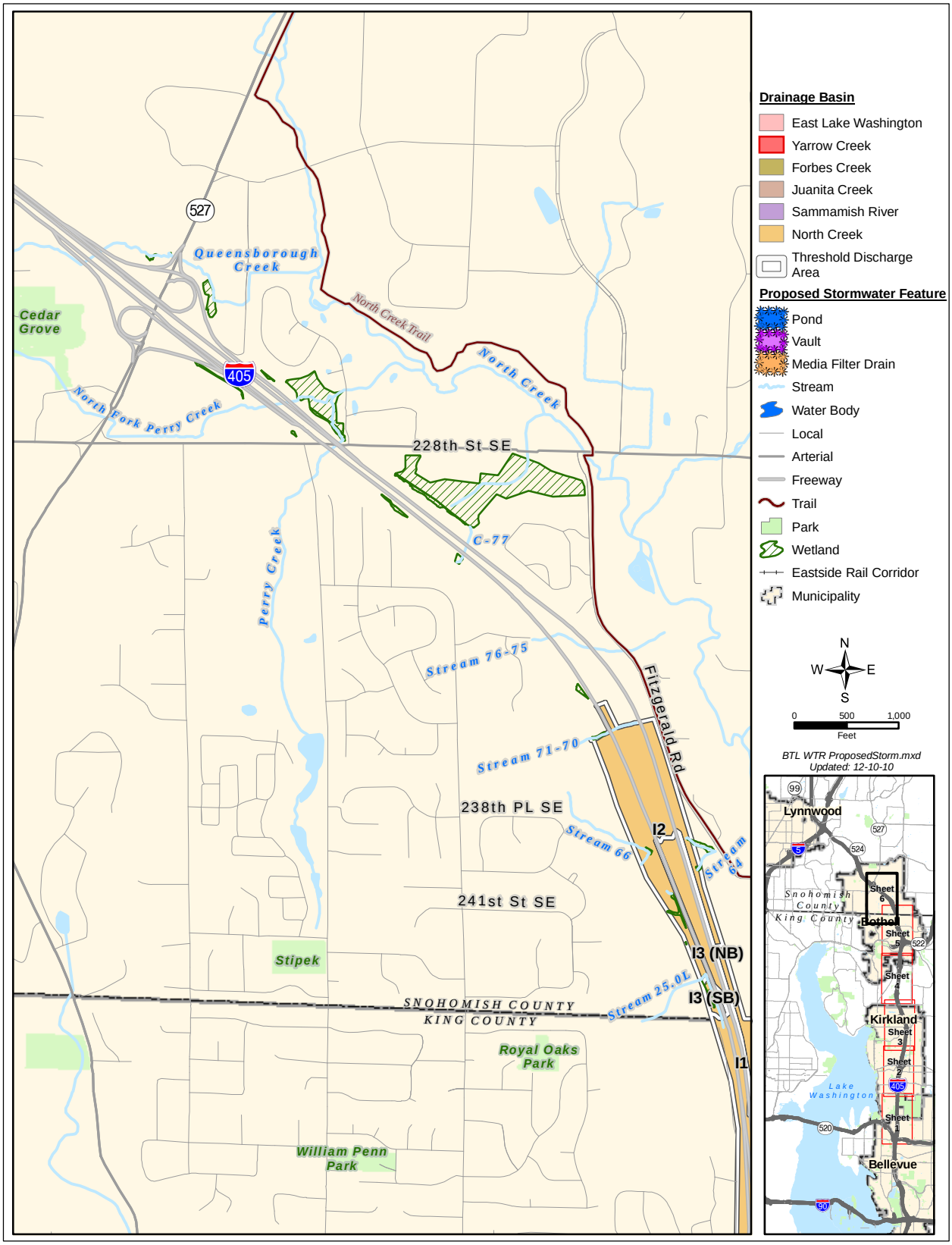


Exhibit 4-10: Stormwater details - sheet 6 of 6



Yarrow Creek and East Lake Washington basins

A portion of the stormwater runoff from I-405 within the East Lake Washington basin flows through closed pipes and open ditches, and discharges to Yarrow Creek near the SR 520 interchange. Some of this runoff travels through an existing wetland before entering Yarrow Creek. Another portion of the stormwater runoff from the East Lake Washington basin flows west through open and closed conveyance systems before draining directly into Lake Washington.

Forbes Creek basin

Stormwater runoff from the I-405 portion of the project within the Forbes Creek basin flows through a series of closed pipes and open ditches into the Forbes Creek system. Runoff from the southern end of the drainage basin flows east into Forbes Lake and/or Forbes Creek. South of Forbes Creek, runoff water travels northward into Forbes Creek, which flows west through a series of culverts and ravines, eventually discharging into Lake Washington. A portion of the highway runoff is detained in a small detention pond before discharging to the creek. Stormwater in the northernmost section of the drainage basin drains to a tributary (C19) of Forbes Creek, which intersects I-405. A large detention tank just west of the highway detains highway runoff. Media filter drain BMPs treat a portion of highway runoff in this basin.

Juanita Creek basin

Stormwater runoff from the study area within the Juanita Creek basin flows through several different sub-drainages, which include open ditches, wetlands, a retention/ detention pond, closed pipes, and a Juanita Creek tributary. One culvert crossing near NE 145th Street includes a control structure at the upstream end and works in combination with the highway embankment to provide regional flow control for Juanita Creek.

Sammamish River basin

Stormwater runoff from the project within the Sammamish River basin is divided into six TDAs.

Within the southern TDA of the project's Sammamish River basin, stormwater runoff flows from I-405 through an existing detention pond in the southeast quadrant of the NE 160th

Street interchange. Runoff from the detention pond discharges to the north under NE 160th Street to an open conveyance ditch that runs north along the freeway corridor.

Stormwater from the middle two TDAs flows through ditches and pipes into a ravine, which discharges through a culvert into the Sammamish River. The ravine becomes steeper and deeper as it extends down to the Sammamish River. Portions of the ravine are heavily eroded and incised by stream flows and are designated as erosion and seismic hazards. Flows enter a roadside conveyance system along the south side or Riverside Drive (Stream KL14), and flow east for approximately 600 feet until they enter a culvert crossing at Riverside Drive, just north of the outfall to the Sammamish River.

The northern two Sammamish River TDAs include an area of freeway section that is elevated above the Sammamish River. Freeway runoff is conveyed by sheet flow to median shoulder gutters or to roadside ditches, then collected in drainage structures and conveyed north. Terrain to the east consists of steep cut sections created during freeway construction. Slope drains have been installed at intervals along this stretch to collect surface and subterranean flows, thus helping to stabilize the slope. These drains convey water to the roadway ditch and pipe network. Along the freeway's western edge, stormwater from the roadway shoulder is collected at intervals and conveyed north to a closed pipe system parallel to the freeway. These flows converge at a catch basin and discharge through a closed pipe, mingling with the roadway conveyance system for Riverside Drive, and then discharging to the Sammamish River

What is a catch basin?

An underground facility fitted with a grilled inlet and a pipe outlet drain to collect roadway runoff water and to retain solids.

North Creek basin

Between NE 195th Street and SR 527, North Creek flows southerly, meandering approximately 800 to 1,000 feet east of the I-405 corridor. North Creek is conveyed beneath I-405 just south of the NE 195th Street/Beardslee Boulevard interchange and is conveyed beneath SR 522 just west of the I-405/SR 522 interchange. North Creek enters the Sammamish River about 1,000 feet downstream of I-405.

How do environmental regulations affect the stormwater system design for this project?

Environmental regulations affect the size, location, and type of the stormwater facilities used to treat the amount of stormwater runoff from highway (stormwater quantity or volume) and reduce the pollutants in the runoff (stormwater water quality). Environmental regulations require that stormwater systems for the project be designed to satisfy specific levels of water quality treatment and runoff control (detention). The level of treatment is specified in the regulations and applicable WSDOT and Ecology stormwater guidance manuals. Typically, the regulations specify a certain amount of water quality treatment based on the project's new and reconstructed impervious surfaces, site-specific characteristics, and the characteristics of the receiving water body. Similarly, the level of water quantity treatment depends on local regulations and the receiving water requirements.

The I-405 Corridor Record of Decision committed to full retrofit of the corridor upon completion of the Master Plan development. The project goes beyond the applicable environmental regulations as WSDOT makes progress toward those corridor goals within the limitations of the project constraints and funding.

What regulated floodplains are associated with the surface water bodies in the study area?

Exhibit 4-11 shows the stream flow gauging station locations, the FEMA defined floodway, the 100-year floodplain boundaries, and the 500-year floodplain boundaries in the study area. A floodway is the channel of a river and the adjacent shore area is reserved to carry floodwaters. Structures or other encroachments are not allowed within the floodway in order to prevent exacerbating flooding. The 100-year floodplain is an area of land that would be inundated by a flood having a one-percent chance of occurring in any given year. Similarly, the 500-year floodplain is an area of land that would be inundated by a flood having a two-tenths of one-percent chance of occurring in any given year.

Exhibit 4-11: Floodplains - sheet 1 of 2

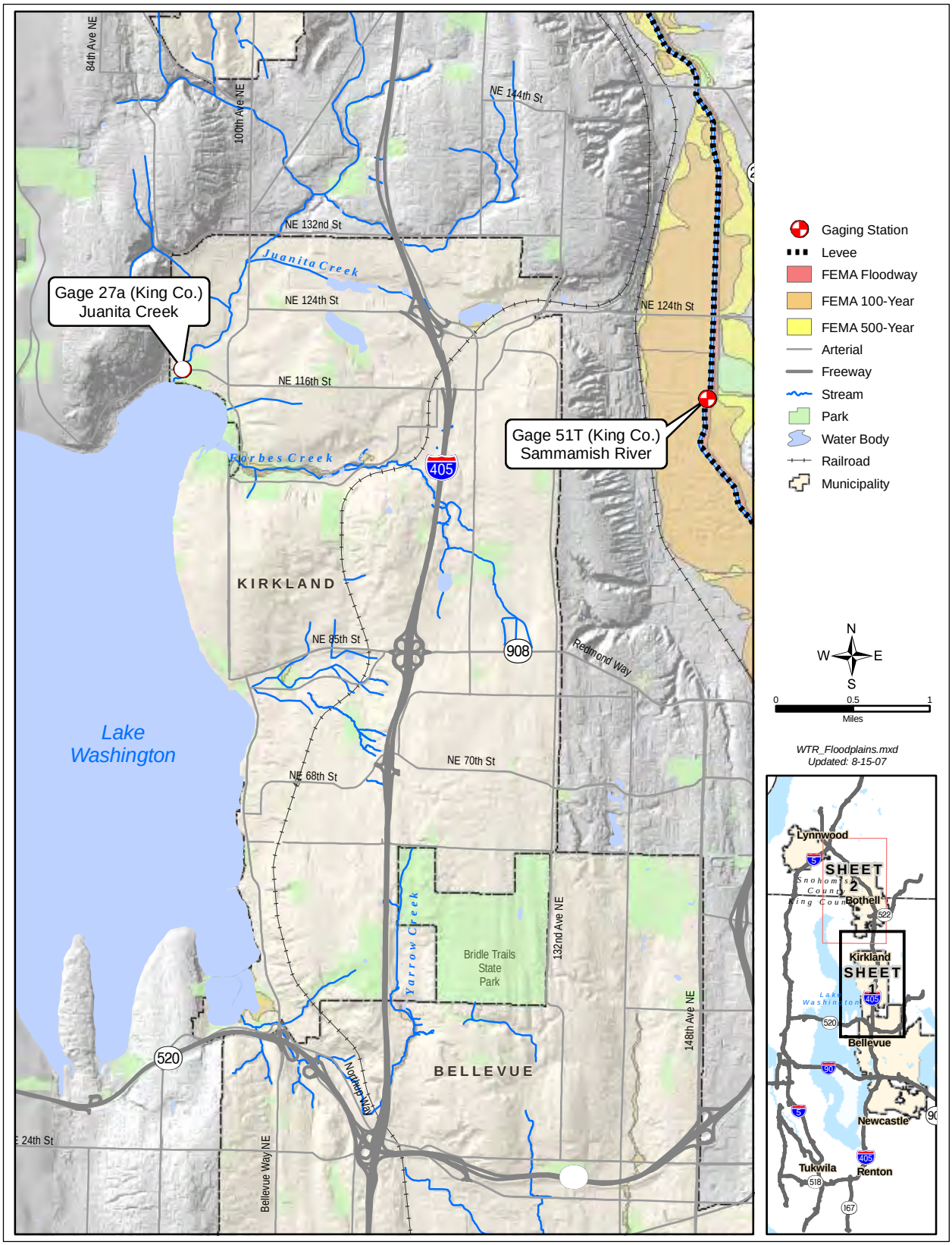
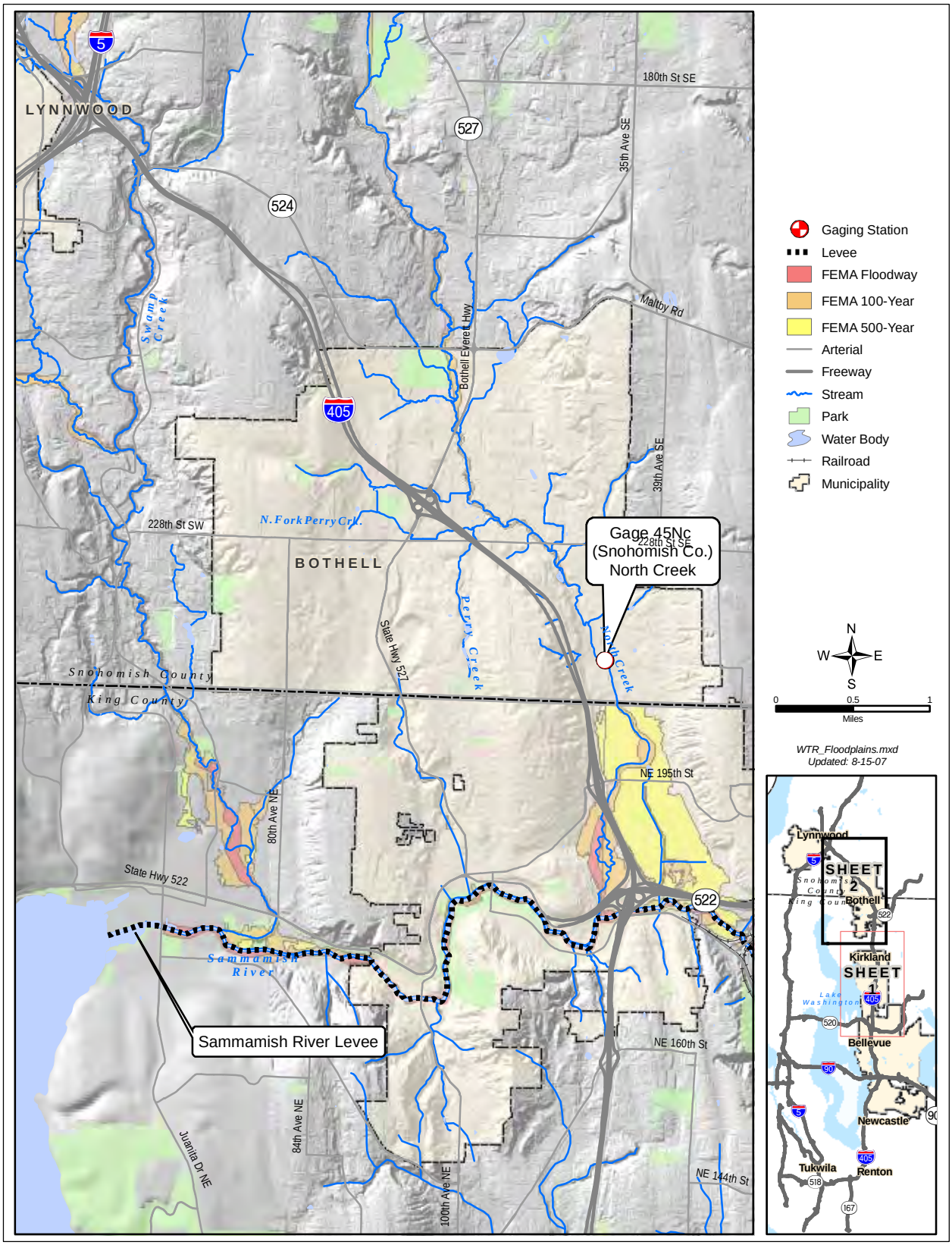


Exhibit 4-11: Floodplains - sheet 2 of 2



The 100-year floodplains are contained within the channels in the project vicinity. Floodplains occur downstream of I-405 near the mouths of Yarrow, Forbes, and Juanita Creeks (refer to Exhibit 4-11). I-405 is elevated above the floodplains on the Sammamish River and North Creeks (Exhibit 4-11).

East Lake Washington[5]

The major flood problems in the East Lake Washington basin are from water accumulation primarily along low-gradient reaches of Yarrow Creek (Federal Emergency Management Agency [FEMA], 2001). A FEMA Flood Insurance Rate Map (FIRM) (FEMA, 1995a) identifies a Special Flood Hazard Area for Yarrow Creek between its crossing of 116th Avenue NE and a point that is 1,900 feet upstream of the crossing. This floodplain area is primarily located in Bellevue south of NE 39th Street, but 100 feet of the upstream end of the floodplain is located within unincorporated King County.

Downstream, there is another FEMA Special Flood Hazard Area (FEMA, 1995b). This floodplain is located in Kirkland downstream of Lake Washington Boulevard and the confluence of Cochran Creek and Yarrow Creek near the Yarrow Bay Park and Wetlands and the mouth of Yarrow Creek (Kirkland, 2003).

Forbes Creek

No written record exists of historical flooding on Forbes Creek. Past flooding appears to have been localized and of short duration, caused by short periods of intense rainfall. Downstream of the study area, FEMA FIRMs, (FEMA 1995a) (FEMA 1995b),(FEMA 1999) identify the floodplain on Forbes Creek as extending from 100th Avenue NE on the east to 108th Avenue NE on the west. This area is also identified on the City of Kirkland Sensitive Areas Map as a Flood Hazard Area (Kirkland, 2003).

Juanita Creek

Totem Lake and adjacent riparian wetlands have been designated by FEMA as Special Flood Hazard Areas (FEMA,

[5] *The Yarrow Creek basin is sometimes treated as a sub-basin of the East Lake Washington basin, such as in the Conceptual Hydraulic Report Summary prepared for this project.*

1999). Totem Lake Boulevard floods during mid-size to large storms (Kirkland, 2005).

Sammamish River

FEMA FIRMs (FEMA, 1999) designate the Sammamish River channel as a Special Flood Hazard Area. The associated floodplain varies from a width of about 1,000 feet to about one mile. Historically, the floodplain was a diversely vegetated wetland containing many channels, sloughs, and oxbows, and the lower half of the corridor flooded to an average depth of two feet (King County, 2003). As a result of channel deepening, the Sammamish River floodplain is diminished in many areas.

The amount of natural storage provided by Lake Sammamish moderates flow in the Sammamish River. Since channels were added to the Sammamish River, flow-related problems have been reduced. The primary areas that are subject to flooding are adjacent to tributary inlets where the channel berm is interrupted. A levee extends along a portion of the Sammamish River and crosses through the study area at the SR 522 interchange with I-405. The Sammamish River flood control project was constructed in the 1970s and is regularly maintained per contract agreement between King County and the Corps. No levee improvements were recommended in the most recent King County Flood Hazard Management Plan (King County, 2006b).

According to the *Highway Runoff Manual* (WSDOT, 2010c), the Sammamish River is exempt from flow control requirements.

North Creek

The historic channel of North Creek lies on the opposite side of the valley from where the stream now flows (FEMA, 2001). The creek was relocated to the high side of the valley to improve its channel capacity. The last reported flooding on North Creek occurred in March 1950, when the flow reached 680 cfs (FEMA, 2001). Localized areas of standing water develop every winter because of the poorly drained soils in the valley (FEMA, 2001). A portion of the North Creek basin within the study area is designated as a Special Flood Hazard Area (see Exhibit 4-11).

Exhibit 4-12: Locations of Group B wells and Sole Source Aquifers

What groundwater resources exist in the study area?

The Bellevue to Lynnwood Improvement project area is characterized by two general groundwater conditions. The lowland areas (Totem Lake area, Sammamish River Valley area, and the four creeks – North, Yarrow, Forbes, and Juanita) are underlain by alluvium, where groundwater is generally shallow, on the order of 10 feet below the ground surface. In these areas, excavations below the groundwater can result in continuous and substantial flows.

The upland areas are underlain by glacial sediments with interbedded sand zones containing perched groundwater. Water levels in the glacial sediments vary seasonally.

Groundwater wells

Many documented water wells were identified within the study area. A search of Ecology's well log database identified 208 wells designated for water supply within one-half mile of the project (Ecology, 2006b).

Group A and Group B water systems are monitored by the Washington State Department of Health (DOH). Group A wells serve 15 or more households; Group B wells serve from two to 14 households. No Group A wells are located within the study area. Exhibit 4-12 shows the location of Group B groundwater supply wells within the study area (DOH, 2006a). The one Group B groundwater well identified in the study area is owned and operated by Wellington Greens Water System in Woodinville, which serves a small homeowners association in the vicinity of the well. The well provides potable water to six households, and is approved to serve an additional three connections.

Sole Source aquifers

The Safe Drinking Water Act provides special protection to aquifers where there is no physically, legally, or economically feasible alternative source, and where the aquifer supplies at least 50 percent of the area's drinking water. The designation is established by the EPA, which has the authority to restrict certain activities in these areas. There are no sole source aquifers within the study area. One sole source aquifer, called

the Cross Valley Aquifer, is located more than one-half mile east of the study area (Exhibit 4-12).

How is groundwater used in the study area?

Groundwater is used to supply drinking water on a very limited basis in the study area. Groundwater also augments flows of the streams in the study area during the low flow summer season

What is the quality of these groundwaters?

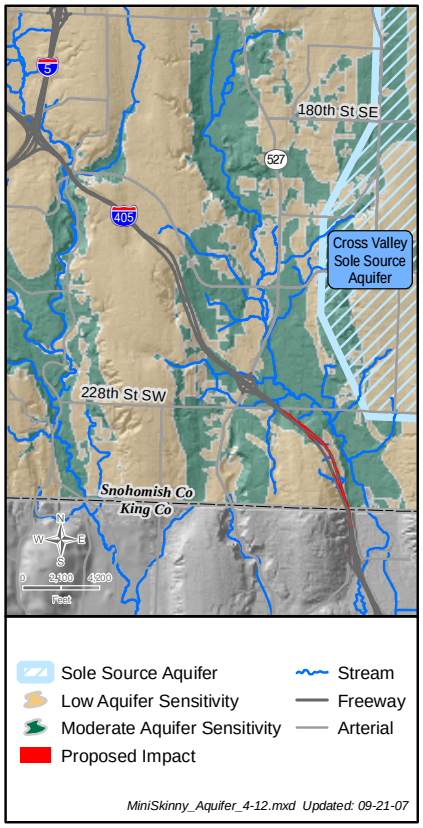
Groundwater quality for Group A and Group B water systems is monitored by DOH. These systems must meet all the DOH water quality criteria (WAC 246-290). The Wellington Greens Water System is required to test its well for coliform every year, and for nitrates every three years. No exceedances of water quality standards have been reported (DOH, 2007).

How is groundwater quality protected?

King and Snohomish counties identify certain areas of aquifers as "critical aquifer recharge areas." These areas are considered highly susceptible to groundwater contamination because the depth to groundwater is shallow; a low-permeability protective layer does not exist; and/or the aquifers are critical for water supply and use. Critical aquifer recharge areas are protected by local Critical Areas Ordinances (King County Code Ch. 21A.24; Snohomish County Code Ch. 30.62C), which regulate development to ensure that effects on these areas are avoided or mitigated. No critical aquifer recharge areas were identified within the portion of the study area located in King County. In Snohomish County, areas of low to moderate aquifer sensitivity, which are classified by Snohomish County as critical aquifer recharge areas, exist within the study area (Exhibit 4-13). Roadway construction and operation is allowed within these critical aquifer areas.

DOH requires public water systems to identify potential effects on groundwater quality and to develop plans that minimize the potential for water quality effects within specified wellhead protection zones. No wellhead protection zones have been identified within the study area.

Exhibit 4-13: Critical recharge areas



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SECTION 5 PROJECT EFFECTS

How will project construction affect surface water?

The Build Alternatives will be constructed in accordance with federal and state technical guidance, permit requirements, and Washington State Department of Transportation (WSDOT) project requirements, which mandate the use of best management practices (BMPs) to control construction runoff. However, the topography and limited space within the I-405 corridor make controlling increased runoff volumes and peak flows difficult for all but the smaller storms. Consequently, there could be increased amounts of runoff entering some local waterways during construction.

Yarrow Creek, Forbes Creek, Juanita Creek, North Creek, the Sammamish River, and other smaller receiving waters and drainage systems that convey water to Lake Washington, will each receive only a small percentage of their total flow from construction areas. Each receiving water is anticipated to have sufficient capacity to convey the flow to Lake Washington without increasing the existing flood risk. Sedimentation ponds and other BMPs provided during construction will help prevent downstream flooding, erosion, and sedimentation.

How will project construction affect water quality?

WSDOT does not anticipate adverse water quality effects during construction because appropriate measures to avoid or minimize effects will be employed.

Measures to avoid effects to the environment consider events that could occur inadvertently as a result of:

- Clearing and grading activities – erosion and spilling of soil into the receiving waters, which temporarily increases suspended sediment and turbidity concentrations in these water bodies;
- Staging and storing equipment – fuel and hydraulic lubricants could be washed from construction equipment and vehicles, or inadvertently spilled with engine coolant and other construction materials; and

- In-water work – materials such as concrete could be spilled during culvert construction or manhole structure adjustment for the new ground elevation. These spills could degrade receiving surface waters and groundwater.

How will project construction affect floodplains?

The receiving waters are anticipated to have sufficient capacity to convey additional flow to Lake Washington without increasing the existing flood risk. Detention provided during construction will help prevent downstream flooding, erosion, and sedimentation.

How will project construction affect groundwater?

WSDOT has well-established design and construction practices for managing the types of soil, geologic, and groundwater conditions anticipated for the project area. WSDOT will implement normal practices and activities to avoid effects on the environment, so there should be no effects on groundwater during construction.

Construction activities associated with this project are allowed in low to moderate Snohomish County aquifer sensitivity areas; however, WSDOT will require an Interim Environmental Compliance Plan that includes a Temporary Erosion and Sediment Control (TESC) Plan and a Spill Prevention, Control, and Countermeasures (SPCC) Plan to be complete and accepted by WSDOT prior to the start of construction activities. These Plans would specify the BMP measures used to prevent groundwater contamination along the entire project including any special measures applicable to the moderate groundwater sensitivity areas.

How will project operation affect surface water?

When pervious surfaces, such as soil and vegetation, are converted to an impervious surface, such as pavement, stormwater cannot infiltrate the ground and stormwater volumes increase. When natural ground cover is changed to a smooth impervious surface, runoff velocity also increases. Increased runoff volume and velocity can cause erosion of stream banks, scouring of streambeds, and increased flooding risks.

Both of the Build Alternatives will each increase impervious area by about 18.2 acres which is about an eight percent increase from the No Build Alternative. The Build Alternatives will include adequate detention (runoff control) facilities to prevent increases in peak flows and velocities or downstream flooding as a result of the greater impervious areas.

The design approach to stormwater quality treatment for the Build Alternatives will be to expand on existing treatment facilities. Opportunities for infiltration will be pursued during the course of the final design.

The Build Alternatives will not substantially change existing on-site runoff patterns with the exception of a new outfall to the Sammamish River. Highway runoff will discharge to receiving waters through existing outfalls or through new outfalls that will be constructed as part of this project. Highway runoff will continue to discharge to existing storm drains or conveyances, and ultimately reach Lake Washington. In the case where the Sammamish River outfalls alter existing flow patterns, a new conveyance system will be constructed to relieve flow to critical drainage and landslide areas. This conveyance system will divert a portion of on-site and off-site runoff to new outfalls for direct discharge into the Sammamish River.

The design criteria for the proposed stormwater facilities are described in detail in the *I-405, Bellevue to Lynnwood Improvement Project Conceptual Hydraulic Summary (WSDOT, 2011)* The primary reference is WSDOT's *Highway Runoff Manual* (HRM) (WSDOT, 2010c).

The project will include the following conceptual design for stormwater facilities:

- Existing stormwater collection and conveyance systems will be modified as required for the new roadway, and as required for effective stormwater management; and
- Three new detention pond flow control facilities will be constructed; three ponds will be modified; and three vaults will be modified.

Exhibit 5-1 describes the existing and proposed stormwater quality treatment facilities in each basin. Approximate locations of proposed stormwater facilities are shown on Exhibit 4-10 (sheets 1 through 6).

Exhibit 5-1: Summary of existing and conceptual stormwater treatment facilities[6]

Basin	No Build Alternative Stormwater Treatment Facilities	Build Alternatives Stormwater Treatment Facilities
Yarrow Creek	Media filter drain treatment facilities that would be able to treat 2.08 acres.	Add stormwater treatment as media filter drain facilities to treat 0.30 acres and modify the detention pond as an infiltration pond that will treat an additional 2.04 acres for a total of 4.43 acres treated.
East Lake Washington	Media filter drain treatment facilities that would be able to treat 1.05 acres.	Add stormwater treatment as media filter drain facilities that will treat 4.70 acres and add a new combined stormwater treatment wetland/detention pond that will treat an additional 1.03 acres for a total of 6.78 acres.
Forbes Creek	Media filter drain treatment facilities that treat 14.01 acres.	Build additional media filter drain treatment facilities that will treat 1.94 acres for a total of 15.95 acres.
Juanita Creek	Media filter drain treatment facilities that treat 13.62 acres and a combined stormwater treatment wetland/detention pond that would be able to treat 1.32 acres.	Add stormwater treatment as media filter drain facilities that will treat 5.69 acres and add two new combined stormwater treatment wetland/detention ponds that will treat 1.30 more acres for a total of 21.93 acres treated.
Sammamish River	Media filter drain treatment facilities that treat 1.48 acres and a combined stormwater treatment wetland/detention pond that would be able to treat 1.05 acres.	Add media filter drain treatment facilities that will treat 8.11 acres and a stormwater treatment wetland pond that will treat an additional 10.73 acres for a total of 21.37 acres.
North Creek	Media filter drain treatment facilities that treat 4.97 acres. 0.19 acres of existing runoff was constructed early as mitigation for this Project.	New media filter drain treatment facilities that will treat and additional 0.13 acres for a total of 5.10 acres.

[6] *Conceptual designs as noted here may change during final design. The intent would be to provide equal or greater levels of treatment or equivalent treatment BMPs or both as the design continues.*

How will project operation affect water quality?

Highway runoff can also have adverse effects on water quality if no measures are taken for the removal of excessive contaminants before the runoff reaches the receiving water. Pollutants in stormwater runoff from highways typically include the following potential contaminants:

- suspended solids (TSS), which are sediments typically consisting of sand, silts, and clays;
- nutrients, which are forms of nitrogen and phosphorus that act as plant growth stimulants;
- toxic metals, including lead, copper, zinc, cadmium, and chromium;
- biochemical oxygen demand, which is a measure of the tendency of polluted water to consume life-supporting oxygen supplies; and
- oil and grease.

These contaminants accumulate on the road surface as a result of regular operation and maintenance activities.

The potential annual pollutant loadings to each of the six project area basins for the Build Alternatives and No Build Alternative are listed in Exhibit 5-2. Although the Build Alternatives will have more impervious area than the No Build Alternative, the Build Alternatives will have lower pollutant loads for the project corridor than the No Build Alternative for TSS, total and dissolved zinc, and total and dissolved copper. This is because the Build Alternatives will treat stormwater from both the new and existing impervious surfaces. Currently, a portion of the existing impervious surfaces discharges without treatment.

Exhibit 5-2: Comparison of annual pollutant loads (pounds per year)

	No Build Alternative					Build Alternatives				
Basin	TSS	Total Zinc	Dissolved Zinc	Total Copper	Dissolved Copper	TSS	Total Zinc	Dissolved Zinc	Total Copper	Dissolved Copper
Yarrow	10,449	20.5	7.5	3.7	1.0	9,685	19.0	7.0	3.5	0.9
East Lake Washington	27,266	53.2	19.4	9.7	2.6	25,056	49.4	18.3	9.0	2.4
Forbes Creek	3,889	8.6	3.6	1.6	0.5	2,911	6.8	3.1	1.3	0.5
Juanita	31,113	61.8	23.1	11.3	3.1	30,263	60.8	23.1	11.2	3.1
Sammamish River	16,700	35.3	14.3	6.6	2.0	16,932	35.9	14.6	6.8	2.1
North Creek	11,385	22.5	8.4	4.1	1.1	11,444	22.7	8.4	4.1	1.1
Total	100,802	202.0	76.4	37.1	10.4	96,291	194.7	74.5	35.9	10.2
Net Change from the No Build Alternative						**-4,511**	**-7.3**	**-1.9**	**-1.2**	**-0.2**
Percent Change from the No Build Alternative						**-5%**	**-4%**	**-3%**	**-3%**	**-2%**

Source: Data based on I-405 Team – December 2010

How will project operation affect floodplains?

Potential flooding effects from project operation can occur from increases in highway stormwater runoff rates and volumes, and from potential decreases in floodplain storage resulting from physical encroachment.

The Build Alternatives will not encroach upon any existing floodplains and will not substantially change downstream floodplains or flooding characteristics. The Build Alternatives will also include the required detention to eliminate peak flow velocities and volume increases.

How will project operation affect groundwater?

Project operation will result in negligible effects on groundwater. Pollutant loads and potential effects from pollutants on groundwater will generally decrease slightly as a result of improved stormwater management. The increase in impervious area as a result of the project, and the resulting loss of infiltration, is very small compared with the size of the basins (refer to Exhibit 4-1). The proposed stormwater facilities (media filter drain treatment facilities and an infiltration facility) will help to mitigate the relatively small loss of groundwater recharge and reduced stream baseflows downstream of the project.

Does the project have other effects on water resources that may be delayed or distant from the project?

The project does not have other effects on water resources that may be delayed or are located away from the project.

Were potential cumulative effects for water resources considered?

Cumulative effects result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative effects are important to consider during project construction and operation. While they may be minor when viewed in the individual context of direct effects, they can add to the effects of other actions and eventually lead to a measurable environmental change. Cumulative effects can be positive or negative, depending on the environmental resource being evaluated.

Additional details about cumulative effects on the project can be found in the *I-405, Bellevue to Lynnwood Cumulative Effects Technical Memorandum*.

What effects would occur under the No Build Alternative?

There would be no construction activities with the No Build Alternative; therefore, no effects on the water resources in the study area would occur.

The stormwater treatment improvements proposed as part of the project would not be implemented and the pollutant loading and critical drainage and landslide areas (Stream KL14 and Riverside Drive) in the Sammamish River basin would remain.

SECTION 6 MEASURES TO AVOID OR MINIMIZE EFFECTS

What measures will be taken to mitigate effects during construction?

Both of the Build Alternatives will be designed and constructed in compliance with Washington State Department of Transportation (WSDOT) and Washington State Department of Ecology (Ecology) technical guidance and federal, state, and local regulations and permits to protect water resources. WSDOT will implement measures to avoid or minimize effects during construction, and will comply with all applicable environmental procedures, rules, and regulations.

The following measures will be followed to minimize or avoid effects to water resources during construction:

- The contractor will mark environmentally sensitive areas, no-fill areas, and mitigation areas with fencing prior to beginning work in an area. The fencing is to remain in place throughout construction in the area. The contractor will also clearly delineate sensitive areas, fencing requirements, and permit conditions on plan sheets.
- The contractor will assign an Environmental Inspector(s) trained in permitting requirements, water quality protection, wetland biology, and agency compliance procedures to project sites to ensure compliance with all permit conditions through construction completion and site stabilization.
- The contractor will be required to prepare and implement a temporary erosion and sedimentation control (TESC) plan.
- Should any BMP or other operation not function as intended, the contractor will take additional action to minimize erosion, maintain water quality, and achieve the intended environmental performance.
- Prior to construction, a NPDES Stormwater Construction Permit covering activity in the highway right-of-way will be obtained from the Washington State Department of Ecology (Ecology). The NPDES permit requires the preparation of a Stormwater Pollution Prevention Plan

(SWPPP). Implementing the SWPPP, following permit guidelines, and applying the measures to minimize or avoid effects on water quality during construction.

- WSDOT will obtain a Hydraulic Project Approval from the Washington Department of Fish and Wildlife prior to construction.
- For work within waters of the United States, WSDOT will obtain a Section 404 permit from the US Army Corps of Engineers for discharging, dredging, or placing fill materials within waters of the US, including wetlands.
- The contractor will identify and develop staging areas for equipment repair and maintenance away from all drainage courses. Washout from concrete trucks will not be dumped into storm drains or onto soil or pavement that carries stormwater runoff. Thinners and solvents will not be used to wash oil, grease, or similar substances from heavy machinery or machine parts. The contractor will be required to designate a washdown area for equipment and concrete trucks.
- The contractor will be required to implement construction BMPs (such as silt fencing or sedimentation ponds) and to avoid disturbing sensitive areas during the development and use of any staging areas, access roads, and turnouts associated with resurfacing activities.
- The contractor will not allow any in-water work to occur except during seasonal work windows established to protect fish.

BMPs will minimize short-term erosion effects associated with clearing and grading activities, such as increased turbidity and sedimentation in receiving waters.

What measures will be taken to mitigate effects during operation?

Both of the Build Alternatives will be designed and operated to meet all current federal, state, and local standards for stormwater management. Design criteria are based on requirements in the *Highway Runoff Manual* (WSDOT, 2010c) and the *Hydraulics Manual* (WSDOT, 2010b). Additional design guidance and project-specific design criteria will be obtained through the permitting process and agency coordination.

The runoff treatment and flow control described in this report are conceptual and will be revisited as the design continues; however, the level of stormwater management will be equal to or better than described in this report. With proper design, implementation, and maintenance of best management practices (BMPs), stream crossings, and highway stormwater management facilities, there will be no need for additional measures to minimize effects.

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SECTION 7 UNAVOIDABLE ADVERSE EFFECTS

Does the project cause any substantial adverse effects that cannot be avoided?

The Build Alternatives include design and implementation of a stormwater management system, including best management practices (BMPs) and other treatment of highway runoff treatment and flow control that meet applicable federal, state, and local standards. These stormwater management features are an integral part of the project. We do not anticipate unavoidable adverse effects to water resources to result from either of the Build Alternatives.

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SECTION 8 REFERENCES

GIS Data Sources

Exhibit 2-1

All data from base data referenced below.

Exhibit 2-2

WSDOT (Washington State Department of Transportation). 2006 – 2007. I-405 Staff; Corridor Mile Post, Lane Striping.

Noise Wall, Retaining Wall, Stormwater Feature, Pavement, Existing Right-of-Way, Proposed Right-of-Way, Culvert.

Exhibit 3-1

HDR. 2007. Study Area Boundary.

Exhibit 4-1, 4-3-4-6

King County, 2006, Topo Drainage for Subbasins, Basins, Watersheds, and WRIAs.

King County Standard GIS Data Disk, extract June 2006: Urban Growth Boundary.

Puget Sound LiDAR Consortium, LiDAR, 2002. http://pugetsoundlidar.ess.washington.edu/About_PSLC.htm

Snohomish County, 2006; Rural-Urban.

Exhibit 4-8

WSDOT (Washington State Department of Transportation). 2006 – 2007. I-405 Staff; Threshold Discharge Area, Wetlands.

Exhibit 4-10

FEMA (Federal Emergency Management Area). 1996. Floodway, 100-year Floodplain and 500-year Floodplain.

King County Standard GIS Data Disk, extract June 2006:

2005. Hydrological Gauges.

WSDOT (Washington State Department of Transportation), Spatial Data Catalog, 2006. Levee.

Exhibit 4-11

EPA (United States Environmental Protection Agency). 1995. Sole Source Aquifer.

WSDOH (Washington State Department of Health). 2004, 2005. Wellhead Protection Areas, Group A and B Wells.

Base Data

All GIS exhibits contain one or more of the following as base layers:

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2005. Trails in King County. Data updated by I-405 staff to match fieldwork, 2002 LiDAR and orthorectified aerial photography.

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APPENDIX A STREAM NAMES CONVERSION TABLE

Exhibit A-1: Bellevue to Lynnwood, Stream Names Conversion Table

Bellevue to Lynnwood Project Working Name	Milepost	Culvert Number	Stream Conveyed	Also Known As	Department of Natural Resources	King County	Snohomish County	Bothell
KL1	15.25	NA	Yarrow Creek	KL1, KL-1	4001405	718		
C5	16.47	C-5	C5	Stream 5				
KL2	17.23	C-10	Lake Washington Tributary	Stream C-10				
KL3	17.4	C-11a	Lake Washington Tributary	Stream C-11	4001206			
KL4	17.55	C-12,13	Lake Washington Tributary	Stream C-12	4001198			
C18	18.96	C-18	Forbes Creek Tributary	Stream C-18				
C19		C-19	Forbes Creek Tributary					
Forbes Creek	19.14	C-20	Forbes Creek	KL5, KL-5 West of I-405, KL-6 East of 405, RF#	4003865	Forbes		
C22	19.59	C-22	Unnamed Stream	Stream 22		X170YZ		
Juanita Creek at NE 124th St	20.46	C-24	Juanita Creek Tributary	KL-5, RJ#		DV39KD		
KL12	20.86	C-25	Juanita Creek Tributary	Juanita Creek, Juanita @ 132nd, RJ#	4001336	WA69TP		
C28	21.27	C-28a, C-28	Juanita Creek Tributary	Stream 28				
C29	21.41	C-29a, C-29	Juanita Creek Tributary	Stream 29				
Juanita Creek Main Stem /KL13	21.92	C-32	Juanita Creek (145th)	KL13, Mainstem of Juanita, Juanita @ 145th, RJ#	4001315	Ry87CI		

Bellevue to Lynnwood Project Working Name	Milepost	Culvert Number	Stream Conveyed	Also Known As	Department of Natural Resources	King County	Snohomish County	Bothell
KL14	22.75	C-36	Sammamish Tributary	Stream 36	400172	YU65FY		
Stream 42	23.2	C-42	Sammamish Tributary	Stream 42	4002525			
Sammamish River	23.6	NA	Sammamish River	KL15, KL-15	4001124	CA16HI		
North Creek	24.3	NA	North Creek		4001116	SM74QQ		
Stream 64	25.26	C-64	Stream 64					
Stream 66	25.34	C-66	Stream 66					
Stream 71-70	25.58	C-70,71	Stream 71-70	Median Stream 70-71				
Stream 76-75	25.75	C-75,76	Stream 76	Median Stream 75-76				
Perry Creek	26.32	C-80	Perry Creek		4001360		513	S.F. Perry Creek
North Fork Perry Creek	26.45	C-81	North Fork Perry Creek		4001352		512	N.F. Perry Creek