CHAPTER 4

Watershed Processes

Watersheds are the geographic areas that channel drainage into a river or stream system. They are defined by topographic boundaries and—depending on where they are located—might encompass complex natural ecosystems, highly urbanized landscapes, or elements of both. The term "watershed processes" refers to the dynamic physical and chemical interactions that form and maintain the landscape on the scale of a watershed. This chapter describes how the health of watersheds in the Bel-Red Corridor—including surface water, water quality, wetlands, and habitat—could be affected by new development or redevelopment that could occur under the alternatives. This chapter also identifies both potential adverse impacts and potential improvements that could result from these changes under each alternative.

Sustainable Urban Watershed Processes

As described in Chapter 2, the City of Bellevue has made a substantial commitment to creating "a sustainable urban habitat with clean air and water, habitat for fish and wildlife, and comfortable and secure places for people to live and work" (City of Bellevue, 2006a). One means by which the City hopes to achieve this goal is to weigh environmental concerns in all decision-making processes, such as selecting a preferred alternative for the Bel-Red Corridor that promotes opportunities and provides incentives to go beyond the mitigation requirements of a standard SEPA EIS. Consequently, this assessment of urban watershed processes in the Bel-Red Corridor includes evaluating opportunities to enhance watershed processes and the associated fish and wildlife habitat as part of the overall redevelopment effort. The following sections define watersheds and describe how they function in urban areas.

Watersheds

A watershed is an area of land defined by a topographic boundary that directs the rain falling onto it to flow towards a common stream, river, or lake. We typically think of watersheds as very large areas, draining thousands of acres of undeveloped forestlands to lakes and major rivers, but this concept is equally applicable to smaller, urban (or built) environments, such as those found within Bellevue's city limits. Both natural and built environment watersheds have three distinct characteristics: (1) upland zones that intercept, infiltrate, and transport rain as groundwater and surface water flow, (2) riparian zones that border surface water bodies, filter surface water runoff, and provide shade that can lower water temperature, and (3) surface water bodies, such as rivers and lakes, that provide habitat, food, and water to aquatic and terrestrial species. Naturally functioning watersheds can also provide migratory corridors and habitat connectivity for birds and mammals.

Watersheds can assimilate some level of land development and air and water contamination while continuing to provide the above-stated benefits. Converting natural watersheds to land uses such as agriculture, housing, and industrial activities can directly interact with natural forces to change the condition of the land and water as well as the species associated with it. An example of this type of change is increasing impervious surfaces (such as covering soil with

concrete or asphalt) in urban areas. This leads to decreased water retention and infiltration, which then leads to increased water runoff. Increased water runoff can in turn lead to increased erosion and can carry contaminants into surface water bodies, where increased stream velocities resulting from increased flows can significantly alter the stream channel and reduce the presence, abundance, and diversity of aquatic species.

Watershed Processes and Riparian Buffer Functions

The types of general watershed processes described in the previous section can be broken down into a number of specific functions and characteristics, displayed in Table 4-1 below. Biologists use these characteristics as indicators of the overall health of a watershed.

TABLE 4-1
Watershed Functions and Characteristics
Bel-Red Corridor Draft Environmental Impact Statement

Watershed Process	Functions and Characteristics
Soils, soil processes, and erosion	Soil structure, soil organics, soil water repellency, soil moisture, infiltration, organic matter mineralization, soil and root interactions, soil formation, topography, soil transport, and soil redistribution following land use changes
Nutrient cycling	Nitrogen dynamics, phosphate fluxes, nitrogen loads through base flow, storm flow and underflow, biogeochemistry, nutrient and metal dynamics
Pollutant transport	Deposition, surface runoff, impacts on water quality, stream temperatures, nutrient concentrations
Riparian habitat and stream buffers	Plant canopy, surface plants and litter, shade loss, riparian vegetation
Stream morphology	Channel characteristics, habitat conditions, stream channel banks, bank stability, sediment transport, in-channel debris torrents
Hydrology	Stream peak flow, rainfall, land cover relationships to stream hydrology, ground water flow, wet and dry seasons, surface and subsurface hydrology, groundwater and surface water interaction
Stream chemistry	Water quality, pH, dissolved oxygen, nitrate, phosphate, turbidity, benthic macroinvertebrates

Source: Hill *et al.*, 2003.

It should be noted that these processes are complex; difficult, expensive, and time-consuming to measure; and not readily amenable to control and improvement through regulations, although regulations and land use controls are an essential component of long-term restoration efforts. It is possible, however, to say that, in properties with impervious surface and little or no forest cover in riparian buffers, these processes are severely limited or cannot take place at all. Without intact riparian buffers, unfiltered surface water runoff from impervious upland areas flows directly into surface water, altering stream chemistry, flow, and channel characteristics. As a result, for this programmatic evaluation, we have chosen to evaluate the alternatives in terms of how they differ in their potential for restoring riparian buffers in the various stream segments within the Bel-Red Corridor. Land use changes that create the potential to increase the width of riparian buffers are considered to establish the potential for improved watershed processes.

Another useful measure for evaluating relative effects on watershed processes is the degree of effective impervious surface that new land uses would create. As noted above, higher levels of impervious surface degrade watershed functions in a variety of ways. To the extent that regulations and incentives can be used to limit or reduce impervious surface in new development, redeveloping the Bel-Red Corridor offers the potential to improve watershed processes. Therefore, land use changes that create opportunities to limit impervious surface—especially those that support the use of low-impact development (LID) techniques—are also considered positive.

Methodology

Assessing the potential for both adverse and beneficial impacts for the No-Action Alternative and the three action alternatives required a variety of methods, including the following:

- Identifying and reviewing the study area's existing water quality and quantity, wetland resources, and habitats for species of local importance
- Describing the regulatory factors (such as critical area ordinances and water quality criteria) affecting the quality of these aquatic and terrestrial resources
- Identifying opportunities for improving watershed processes and the resources that depend on them, such as fish and wildlife

Surface Water Resource Quality

The descriptions of the types and quality of surface water resources in the Bel-Red Corridor study area were taken from previous project studies undertaken by the City. These commissioned studies reviewed the seven basins in the study area and examined the condition of each stream segment, fish use, the proportion of the stream in culverts, and the condition of the shoreline and riparian areas (City of Bellevue, 2003a, 2003b, and 2006b). Rather than basing conclusions on basinwide descriptions, the analysis used work recently performed for the City of Bellevue to evaluate the existing conditions in those segments of the streams within the study area (Herrera Environmental Consultants, 2005 and 2006).

Impervious Surface

One key way of determining the potential impacts of the alternatives on water resources is evaluating the changes they are likely to make in the total impervious area (TIA) within a drainage basin. Clearing forested areas and covering soil with structures, asphalt, and/or concrete prevents rainwater infiltration into the ground and rapidly transfers runoff to local surface waters, transporting with it any chemicals that might have accumulated on these hardened surfaces. Because this is a programmatic analysis of proposed changes in land use classifications in the Bel-Red Corridor, however, there are no specific project-related changes in TIA to analyze. Consequently, potential changes in impervious surface associated with the No-Action Alternative and Alternatives 1, 2, or 3 relative to existing conditions were estimated by the following methods:

- Identifying the various land use classifications included with each alternative, including the No-Action Alternative

- Assigning a percentage of impervious surface to each land use classification
- Comparing the proportional change in TIA based on the introduction of new types of land use into the Bel-Red Corridor

While these data are only approximations, this approach allows the alternatives to be qualitatively compared on an equal basis. Data for TIA associated with different types of land use classifications were reported by Hill *et al.* (2003) from a series of Landsat satellite images taken of northwestern Washington between 1991 and 1998. This effort produced "a single set of impervious area values for five land use categories for use in studies of western Washington watersheds" (Hill *et al.*, 2003). These five categories include the following:

- Low-density residential (one unit per two to five acres)
- Medium-density residential (one unit per acre)
- "Suburban" density (four units per acre)
- High-density (multifamily or eight or more units per acre)
- Commercial and industrial

The TIA values reported for each of these five classes were matched to the 14 land use classifications proposed in the alternatives that they most closely paralleled (Table 4-2). Five of the 14 mixed-uses land classes—mixed-use housing and commercial higher-density, mixed-use housing and retail, office and housing (transition area), office medium-density, and retail (pedestrian-oriented)—were assigned the average TIA of high-density and commercial and industrial categories reported by Hill *et al.* (2003; Table 4-2).

TABLE 4-2
Typical Total Impervious Area Associated with Proposed Land Use Classifications
Bel-Red Corridor Draft Environmental Impact Statement

Land Use Classification	Estimated Total Impervious Surface (percent)
Civic and arts	75
Housing	60
Light industrial	90
Low-density office (transition area)	60
Medical office	90
Mixed-use housing and commercial higher density	85
Mixed-use housing and retail	75
Office campus	90
Office and housing (transition area)	75
Office medium-density	90
Parks and open spaces	10
Retail (pedestrian-oriented)	75
Retail and commercial	90
Services Core	90

Source: Hill *et al.*, 2003.

Information on the number, size, and impervious basin areas spanning the study area; stream distribution; and existing conditions was adapted from reports prepared by the City of Bellevue and its consultants (City of Bellevue 2003a, 2003b, 2005, 2006a, and 2006b; Herrera Environmental Consultants, 2005 and 2006); the Existing Conditions section of this chapter summarizes this information.

While the TIA analysis is useful for evaluating the relative impacts of land use types within a watershed, it has limitations. Most importantly, this approach is based on historical development, which before the 1990s was typically done with little consideration of resource protection. Newer development standards generally limit the amount of site area that can be covered by impervious surface and require setbacks from streams and wetlands; therefore, new developments have less impervious surface (other factors being equal) than older ones. In addition, cities can provide developers with incentives to limit impervious surface by a variety of methods, such as reducing the development footprint (for example, by increasing building heights rather than floor plates); clustering development in one area of the site and leaving other areas vegetated; and/or using LID approaches to infiltrate stormwater naturally into the soil. Such opportunities are discussed in the Impacts section to provide a more complete picture of potential watershed effects than would be possible through TIA analysis alone.

Wildlife Habitats

Potential impacts on habitats for species of local importance, as well as priority habitats and species (PHS) and wetlands within the study area, were assessed qualitatively, with an emphasis on identifying how the action alternatives would compare in their impacts and in the opportunities they might afford for mitigation and enhancement.

Species of Local Importance

Under the current City of Bellevue Critical Areas Ordinance (CAO), habitats associated with species of local importance are designated as critical areas (20.25H.150 BCC). These species include 12 birds, 3 mammals, 4 fish, 2 amphibians, and 1 reptile that are known or suspected to occur in the city (Table 4-3). Data for the occurrence of wildlife species of local importance was obtained from the City of Bellevue Wildlife Inventory (City of Bellevue, 2003a); data for fish species of local importance were obtained from U.S. Fish and Wildlife Service (USFWS, 2005) and the National Ocean and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries, 2006).

Priority Habitats and Species

PHS existing conditions information was obtained from Washington Department of Fish and Wildlife (WDFW)'s PHS database (WDFW, 2005), and the USFWS's (USFWS, 2005) and NOAA Fisheries' (NOAA Fisheries, 2006) lists of species with federal status in King County. Information was also obtained from City of Bellevue reports, including reports prepared specifically for the Bel-Red Corridor Project (City of Bellevue 2003a, 2003b, 2005, and 2006a; Herrera Environmental Consultants, 2005 and 2006). Selected information from these sources is presented in the Existing Conditions section.

TABLE 4-3
Species of Local Importance and Their Preferred Habitat in Bellevue
Bel-Red Corridor Draft Environmental Impact Statement

Species	Federal/ State Status[1]	Preferred Habitat	Occurrence in Bellevue
Common Breeders and Resident Species			
Bald eagle	T/T	Mature trees near water bodies	Documented
Pileated woodpecker	ns/C	Large snags	Common
Vaux's swift	ns/C	Open water, dead snags	Undocumented, though likely present
Purple martin	ns/C	Large snags	Undocumented
Merlin	ns/C	Tree cavities	Undocumented
Great blue heron	ns/ns	Wetlands and shorelines	Documented
Green heron	ns/ns	Shorelines	Documented
Osprey	ns/ns	Large trees or utility poles near open water	Documented
Red-tailed hawk	ns/ns	Mix of forest and open grassland	Documented
Migrants, Rare, or Extirpated Species			
Common loon	ns/S	Large, forest lakes, coastline	Rare
Peregrine falcon	SOC/S	Lake shoreline, cliffs	Rare
Western grebe	ns/C	Riparian, lakes	Migrant
Western big-eared bat	SOC/C	Forests, caves, mines, abandoned buildings, bridges	Rare
Keen's myotis (bat)	ns/C	Forests, tree cavities, cliff crevices	Rare
Long-eared myotis (bat)	SOC/M	Forests, caves, mines, tree bark, rock crevices, abandoned buildings, bridges	Documented
Oregon spotted frog	C/E	Ponds, emergent wetlands	Rare
Western toad	SOC/C	Wetlands, ponds	Extirpated from area
Western pond turtle	SOC/E	Ponds	Extirpated from area
Chinook salmon	T/C	Cool, clean streams, gravel substrate	Documented
Bull trout	T/C	Cool, clean streams, gravel substrate	Undocumented
Coho salmon	SOC/ns	Cool, clean streams, gravel substrate	Documented
River lamprey	SOC/C	Major rivers, silt-sand backwaters	Documented in Lake Washington

Source: City of Bellevue, 2003a; WDFW, 2005.
[1]C = candidate, E = endangered, M = monitored, ns = no status information, S = sensitive, T = threatened, SOC = species of concern

Opportunities for Enhancing Watershed Processes

Each alternative was evaluated for potential opportunities to enhance watershed processes and the resources supported by them. The first step was to describe the existing conditions in the watershed and that part of the basin located within the study area. Based on recent studies sponsored by the City in the Bel-Red Corridor, deficiencies for streams and riparian, wetland, and forest habitats in each segment were then identified. Following this characterization, each alternative was reviewed to determine the proposed land use classifications that will be adjacent to each individual stream segment. Lastly, the land use classifications for each alternative were evaluated for their potential to improve identified deficiencies by stream segment, particularly by protecting riparian buffers and using LID practices such as stormwater infiltration into suitable soils. This analysis was entirely based on available information, which included recently completed studies of the geology and soil types in the northern portion of Bellevue (Booth and Wisher, 2006).

Applicable Regulations

Surface Water Management

All new development and redevelopment within the Bel-Red Corridor must include provisions for surface water management in accordance with the City's Storm and Surface Water Code, part of Chapter 24.06 of the BCC (adopted April 3, 1995, and last amended in January 2006). The code sets forth engineering standards that establish the minimum requirements for planning, designing, and constructing stormwater and surface water systems. The regulations focus primarily on engineered stormwater management systems, which do not mimic natural watershed processes and consequently can have negative effects on watershed functions and habitat. They do serve to reduce peak stormwater flows—hence reducing erosion—and eliminate some pollutants from runoff. However, more naturally based techniques like LID, while not mandated by regulations, are more protective of ecosystem health.

Any development or redevelopment that is expected to occur under any action alternative would be required to comply with applicable provisions of the code and to obtain drainage and construction permits before project construction. Under Section 24.06.130(3) of the City's Storm and Surface Water Utility Code, redeveloping 5,000 square feet or more within a 12-month period is subject to all engineering and design requirements in the code, including requiring the project sponsor to construct, operate, and maintain stormwater BMPs for water quality treatment and flow control.

Section 24.06.130(4) dictates that redevelopment on a site that is larger than one acre and that has 50 percent or more impervious surface must submit a schedule to implement the following stormwater management measures for the entire site (including adjoining parcels if they are part of the project) to the maximum extent practicable:

- Runoff control (provided that the site drains to a stream, either directly or indirectly)
- Runoff treatment BMPs
- Wetland discharge and recharge requirements if the site drains to a wetland
- Off-site analysis and mitigation
- An operation and maintenance plan for the stormwater system

Additionally, Section 24.06.130(6) states that modifications to existing runoff control or treatment systems or the conveyance system shall be subject to engineering and design requirements of the code.

Critical Areas

Part 20.25H of the CAO establishes standards and procedures that apply to development within the Critical Areas Overlay District, which includes any site that is in whole or in part designated as a critical area or critical area buffer. All development within the Critical Areas Overlay District must be reviewed and approved pursuant to Part 20.25H in addition to being subject to all other relevant standards of the BCC.

As stated in the CAO (Part 20.25H.010), the Critical Areas Overlay District is a mechanism by which the City recognizes the existence of natural conditions that impact the use and development of property. Through the CAO, the City designates and classifies ecologically sensitive and hazard areas and imposes regulations on the use and development of affected property in order to protect the functions and values of these areas and the public health, safety, and welfare and to allow the reasonable use of private property.

An important fact to note about the CAO as it applies to the Bel-Red Corridor is that many of its provisions apply primarily to new development. In other words, critical areas on previously developed land proposed for redevelopment are not subject to the same level of protection as critical areas on undeveloped land. For example, stream buffer requirements are substantially less for redevelopment projects than for new projects. Because most of the Bel-Red Corridor is already developed, these lands would be subject to the less stringent standards. Thus, to enhance stream corridors and other critical areas in the corridor, regulatory mechanisms will be needed to enforce higher levels of protection, provide incentives for developers to enhance critical areas, or both. The stream buffer and setback standards established in the CAO for developed and undeveloped properties are shown in Table 4-4.

Wetlands

Wetlands are areas where soils are inundated by water for some portion of the year and that, as a result, support unique vegetation communities that are adapted to saturated conditions. They perform many valuable functions within the overall ecosystem, including flood water attenuation, stream base-flow maintenance and groundwater support, water quality improvement, erosion and shoreline protection, wildlife habitat, and opportunities for passive recreation, education, and open space. Wetlands are defined as critical areas in WAC 365-190-080 as follows: "*…fragile ecosystems which serve a number of functions. Wetlands assist in the reduction of erosion, siltation, flooding, ground and surface water pollution, and provide wildlife, plant, and fisheries habitats. Wetlands destruction or impairment might result in increased public and private costs of property losses.*" Activities that affect wetlands within the city of Bellevue are regulated by the City of Bellevue under its CAO, by the State of Washington, and by the U.S. Army Corps of Engineers (Corps).

TABLE 4-4
Stream Buffer and Setback Standards
Bel-Red Corridor Draft Environmental Impact Statement

Critical Area Category or Type	Critical Area Buffer Width (feet)		Structure Setback (feet)	
	Undeveloped	Developed	Undeveloped	Developed
Type S water	100	50	20	50
Type F water	100	50	20	50
Type N water	50	25	15	25
Type O water	25	25	10	0
West Tributary of Kelsey Creek	50	50	20	20
Closed (piped) segments within Kelsey Creek basin	0	0	50 feet or combined buffer and structure setback required for stream type, whichever is less	50 feet or combined buffer and structure setback required for stream type, whichever is less
Closed segments other than Kelsey Creek basin	0	0	10	10

Source: City of Bellevue, 2003c.

In 2003, the City of Bellevue completed a wetland inventory (City of Bellevue, 2003c) and stream inventory (City of Bellevue, 2003b) as part of a Bellevue critical areas update that described wetlands in the city. In 2005, Herrera Environmental Consultants completed an ecological inventory and characterization within the study area that provided further information on stream and wetlands (Herrera Environmental Consultants, 2005). These reports identify potential wetland areas at a fairly broad scale for purposes of identifying potential constraints on development and identifying specific areas that might require further investigation to establish wetland and buffer boundaries. They do not capture all the small wetlands that might exist in the study area. Specific projects implementing the *Bel-Red/Northup Subarea Plan* (City of Bellevue, 1988) would need to complete detailed fieldwork approved by the City of Bellevue, the State of Washington, and the Corps to identify all potentially affected wetlands and establish their jurisdictional status. This would typically be performed when the project proposal is submitted to the City for SEPA review and permit approvals.

Habitats Associated with Species of Local Importance

As mentioned above, habitats associated with species of local importance are designated critical areas in the city. These habitats are displayed for each species in Table 4-3 and include forests, wetlands, open water, streams, and riparian habitat.

Endangered Species

The Endangered Species Act (ESA) is a United States law that is administered by NOAA Fisheries and the USFWS. The ESA is designed to save species and their habitats when other efforts have failed. NOAA Fisheries is accountable for animals that spend most of their lives in

marine waters, including marine fish, most marine mammals, and anadromous fish, such as the Pacific salmon. The USFWS is responsible for land animals and for fish species that spend their life cycles in fresh water.

Any unauthorized "take" of an ESA-listed species is prohibited. Once a species is listed, Section 7 of the ESA is the regulatory process most commonly used to minimize impacts on these species as a result of development projects. Section 7 applies to actions taken by federal agencies and to activities involving federal permitting or funding (such as actions that require Corps Section 404 permits); this entails consulting with the appropriate federal agency, which begins to prepare a biological assessment (BA) that details how the proposed action might impact listed species. The agency then issues a biological opinion that explains how the proposed action impacts the species and describes which measures should be implemented to protect the species. Most biological opinions allow for the proposed action to be implemented subject to certain conditions; however, in some instances a jeopardy opinion is issued, stating that the proposed action might jeopardize the species' continued existence. After the biological opinion has been issued (assuming it is not a jeopardy opinion), the agency can appropriate funding, issue permits, or take other steps necessary for the project to advance.

The following federally listed, proposed, or candidate species are known or suspected to occur in the Bel-Red Corridor study area and vicinity (USFWS, 2005; NOAA Fisheries, 2006):

- Bald eagle (*Haliaeetus leucocephalus*), which is listed as threatened
- Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound Evolutionary Significant Unit (ESU), which is listed as threatened
- Steelhead (*O. mykiss*) Puget Sound ESU, which is proposed for listing

Note that the bald eagle and Chinook salmon are both considered species of local importance in the city, but that steelhead are not on this list at this time. Steelhead require cool, clean streams with gravel substrate, however, as do the other fish species of local importance, so habitat enhancements that benefit these other species would also benefit steelhead. Bellevue's stream classification system gives streams with fish habitat the highest levels of protection, so the fact that steelhead are not on the City's list of species of local importance does not result in lesser protection for them.

Existing Conditions

Stormwater Drainage and Flood Control System

The City of Bellevue manages the study area stormwater and surface water utilities. City operations include flood control, surface water quality maintenance and enhancement, sensitive areas protection, and public education. To prevent flooding and damage from storms and to protect surface water, the City operates and maintains a storm drainage system, which is a combination of streams, lakes, wetlands, pipes, catch basins, and flood control sites. Two regional stormwater and surface water flood control facilities are located in the western half of the study area along the West Tributary of Kelsey Creek: one west of 120th Avenue NE and one east of 124th Avenue NE. There is also a regional stormwater detention facility on Sears Creek. Study area streams and wetlands are described below in the Surface Water Resources section.

Surface Water Resources

Study area surface water resources include seven basins that encompass six streams, a pond, and two wetlands functioning as regional water treatment facilities (Table 4-5, Figure 4-1). In general, these basins exhibit the typical characteristics of urbanized watersheds, with current levels of impervious surface ranging from 29 percent to 68 percent (Table 4-6) (City of Bellevue, 2006b).

TABLE 4-5
Study Area Basins and Associated Surface Water Features
Bel-Red Corridor Draft Environmental Impact Statement

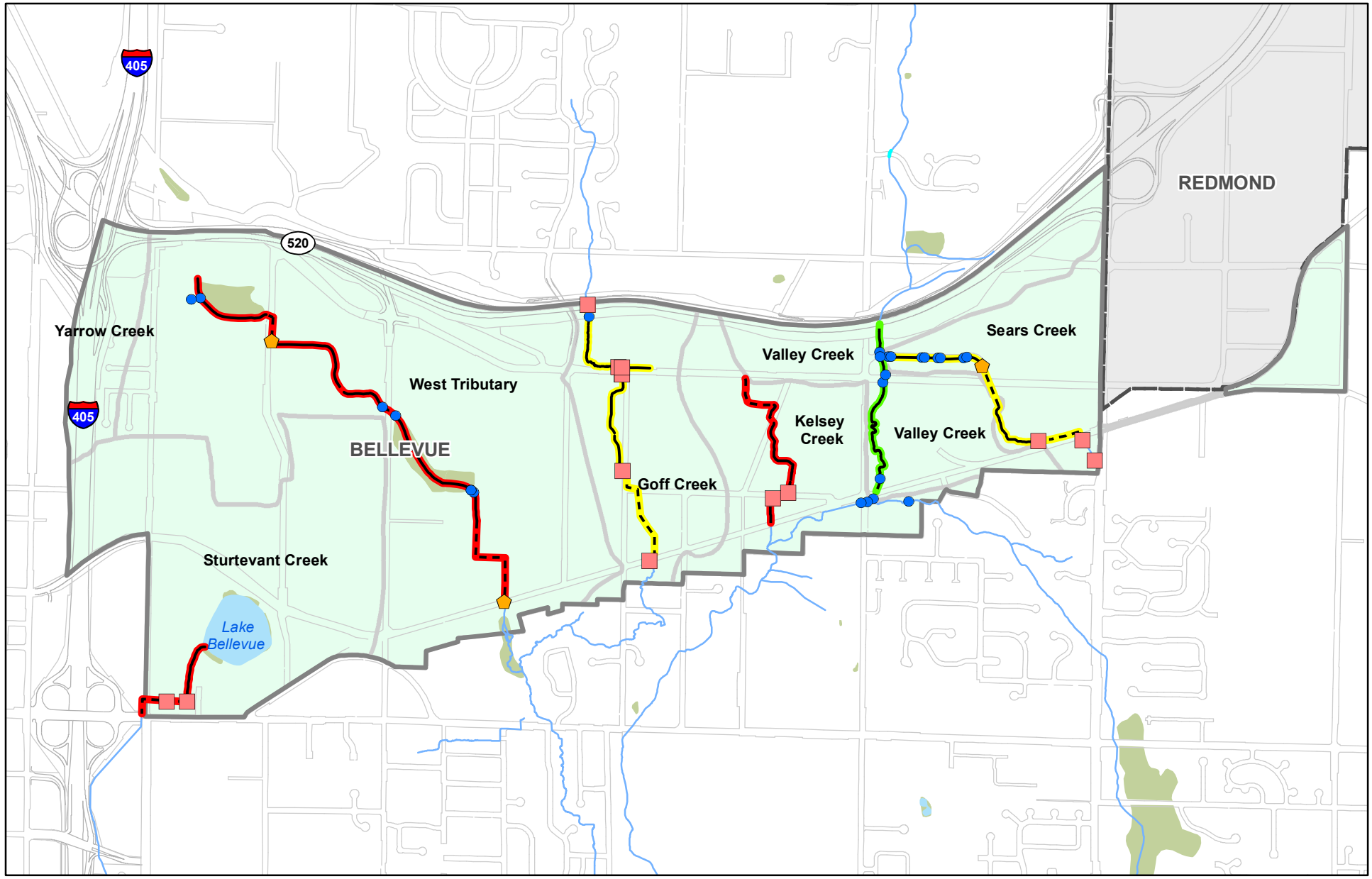
Basin	Surface Water Resource
Yarrow Creek	No surface water features in study area portion of this basin
Sturtevant Creek	Lake Bellevue[1] Sturtevant Creek
West Tributary	West Tributary, Wetland 1, Wetland 2
Goff Creek	Goff Creek
Kelsey Creek	Unnamed tributary to Kelsey Creek
Valley Creek	Valley Creek
Sears Creek	Sears Creek

Source: City of Bellevue, 2006b.
[1]Lake Bellevue is considered a pond by the State of Washington based on the definition in WAC 173-22-030; "Lake" means a body of standing water in a depression of land or expanded part of a river, including reservoirs, of 20 acres or greater in total area.

TABLE 4-6
Total Basin Area and Amount of Each Basin within the Study Area
Bel-Red Corridor Draft Environmental Impact Statement

Study Area Basin	Total Basin Area (acres)	Basin as Impervious Surface (percent)	Study Area in Basin (acres)	Basin Within Study Area (percent)
Yarrow Creek	1,667.20	29	35.14	3.77
Sturtevant Creek	773	68	182.31	19.54
West Tributary	1,005.80	44	338.13	36.24
Goff Creek	674.4	30	90.39	9.69
Kelsey Creek[1]	2,822.40	42	91.85	9.84
Valley Creek	1,390.90	32	100.76	10.8
Sears Creek	577.5	64	94.45	10.12

Source: City of Bellevue, 2006b.
[1]The Unnamed Tributary of Kelsey Creek comprises a very small area of the total Kelsey Creek basin; the portion of the basin associated with the Unnamed Tributary generally has a much higher degree of impervious surface than the basin as a whole (probably comparable to Sears Creek).



Bel-Red Corridor
Wetland
City Boundary
Basin
Open Channel
Piped Stream
Stream segments outside Study Area

Fish passage assessment
No Barrier
Partial Barrier
Definite Barrier

Stream habitat rating
Poor
Fair/Moderate
Good

N

0 0.25 0.5 Miles

Figure 4-1
Bel-Red Corridor Basins, Streams, Wetlands, and Fish Passage Features
Bel-Red Corridor Draft EIS

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Streams in basins with 26 to 100 percent impervious surface are typically considered "nonsupporting" of fish (Schuler, 1994) and are characterized as having highly unstable channels, fair to poor water quality, and poor biodiversity (the types and numbers of species present). However, most of the streams that lie within the Bel-Red Corridor do support fish, including salmonids, at locations within and/or downstream of the study area.

In general, the study area occupies a fairly small portion (4 to 36 percent) of each hydrologic basin, so the percent of impervious surface basinwide does not necessarily represent the overall trends in the study area. For example, the Kelsey Creek Basin as a whole has 42 percent impervious surface, but this includes protected wetland and open space areas downstream of the Bel-Red Corridor (20 percent of the entire basin is in parks and open space use). The Unnamed Tributary to Kelsey Creek, located within the study area, is in a highly developed area and has a higher proportion of impervious surface than the basin as a whole. Similar differences in impervious surface coverage between the study area sections and the basins overall are also likely to exist in the other six basins. Thus, rather than basing conclusions on basinwide descriptions, the City of Bellevue recently evaluated the existing conditions in those segments of the streams within the study area (Herrera Environmental Consultants, 2005 and 2006). The results of this work are summarized later in this chapter in the Basin-Specific Resources section.

Wetlands

There are four general wetland types in the city of Bellevue, all of which occur in the major basins and are dispersed throughout the landscape (City of Bellevue, 2003c): Large Wetland Complexes (Outflow Depression); Small Riparian Wetlands (Riverine); Seep Wetlands (Slope); and Lacustrine, Hydrologically Isolated Wetlands (Closed Depression. Most of these wetlands are associated with riparian corridors or drainages (City of Bellevue, 2003c), and most of the larger wetlands that have been preserved in Bellevue are located within publicly owned park land. Bellevue has also created new wetlands through mitigation required for permitted development activities. These created wetlands, along with wetland and stream buffers that have been designated for protection as part of development projects, are known as Native Growth Protection Areas (NGPAs).

Based on an overlay of the National Wetland Inventory (NWI) map on aerial photographs, three prominent wetlands are located in the study area: two on the West Tributary of Kelsey Creek and one on Sturtevant Creek (Figure 4-1). The West Tributary's two large riparian wetlands within the study area both function as regional stormwater facilities rather than as natural wetland systems. One is located upstream and west of 120th Avenue NE and one east of 124th Avenue NE, upstream of 127th Place NE (Herrera Environmental Consultants, 2005). The 120th Avenue NE wetland is a forested wetland with areas of permanent flooding. The 127th Place NE wetland has open water and emergent, shrub, and forested vegetation communities. Both wetlands provide high-quality fish and wildlife habitat (Herrera Environmental Consultants, 2005).

The other sizable wetland is Lake Bellevue—located in the southwest portion of the study area, south of NE 12th Street and east of 116th Avenue NE. The lake measures approximately nine acres and is considered a pond by the State of Washington based on the definition in WAC 173-22-030; according to the code, a lake is defined as being 20 or more acres in total area. Notably, Lake Bellevue is completely surrounded by development along its shores.

Wildlife

No federally listed wildlife species breed in the Bel-Red Corridor; however, there are two bald eagle nest sites within one mile of the study area on the west side of I-405 (WDFW, 2005). Notably, one peregrine falcon (*Falco peregrinus anatum*) and two osprey (*Pandion haliaetus*) nests also exist within one mile of the study area on the west side of I-405. Neither peregrine falcons nor ospreys are federally listed species, but peregrine falcons are state-listed as sensitive (WDFW, 2005). A Washington State sensitive species is defined by WDFW as "a species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats" (WAC 232- 12-297). Although bald eagles, peregrine falcons, and ospreys are not currently nesting in the study area, they might use sites within the study area for resting or foraging.

Besides the bald eagle, peregrine falcon, and osprey, several other species of local importance have been documented in the study area (Table 4-3). Preferred habitats for these species include large snags, wetlands, shorelines, forest/grassland mix, and forests. No forest habitat or ground cover habitat types exist in the study area; however, riparian habitat is located along two sections of the West Tributary, one central section of Goff Creek, Valley Creek, and Sears Creek, and to a much lesser extent along the unnamed tributary to Kelsey Creek. The City of Bellevue considers shrubs, trees, grass, and crops to be riparian habitat. Wetlands and open water are limited to Lake Bellevue on Sturtevant Creek and the two wetlands along the West Tributary (Figure 4-1). City trees, located primarily along NE 20th Street and Bel-Red Road, might provide resting and foraging opportunities for the bird species of local importance. Based on the land use classifications adjacent to the habitats for species of local importance in the study area, there appear to be no significant existing opportunities for restoring or enhancing these study area critical areas.

Fish

The Bel-Red Corridor includes reaches of six streams, all of which ultimately drain to Kelsey Creek; from west to east, these are Sturtevant Creek, West Tributary to Kelsey Creek, Goff Creek, Unnamed Tributary to Kelsey Creek, Valley Creek, and Sears Creek. Several of these streams support salmonids for some distance along their length, including the West Tributary, Goff Creek, Valley Creek, and Sears Creek (City of Bellevue, 2003b). Within the Bel-Red Corridor study area, however, only Valley, Goff, and Sears creeks are used by salmonids (Herrera Environmental Consultants, 2005). Although NOAA Fisheries does not identify the immediate Bel-Red Corridor study area as being used by federally listed, proposed, or candidate fish species (NOAA Fisheries, 2006), the *Bel-Red Corridor Environmental Opportunities and Constraints Memorandum* (Herrera Environmental Consultants, 2006) identifies Chinook salmon as being present within the study area in Valley and Sears creeks. Chinook also exist in downstream reaches of streams outside the study area but in many cases are blocked from entering the study area by impassable culverts. In addition, the coho salmon (*Oncorhyncus kisutch*) Puget Sound/Strait of Georgia ESU, which is a species of concern, are present near the study area. Other typical urban fish species, such as cutthroat and rainbow trout, stickleback, and lamprey, are also present in study area streams.

The study area basins exhibit the typical characteristics of urbanized watersheds, with high levels of impervious surface (see Table 4-5; City of Bellevue 2006b). As noted above, streams in

basins with 26 to 100 percent impervious surface are typically considered to provide poor support for fish species (Schueler, 1994) and are characterized as having highly unstable channels, fair to poor water quality, and poor biological diversity. Most of the study area streams are piped for significant distances, and most are blocked at multiple locations by obstructions such as damaged or silt-filled culverts. Nevertheless, the presence of salmonids and other fish species in study area streams suggests that habitat enhancements might provide the potential to increase fish use in the Bel-Red Corridor by improving the current unfavorable conditions in much of the area.

In early 2006, the City of Bellevue commissioned a study to identify which study area streams might benefit most from restoration or enhancement as part of the Bel-Red Corridor redevelopment. This study (Herrera Environmental Consultants, 2006)—which is included in Appendix C—concluded that Valley Creek presented the greatest opportunities because it currently supports salmon use, includes good spawning habitat, has no blockages, and is bordered by significant amounts of riparian vegetation. Goff and Sears creeks, although both contain blockages and piped sections, are also considered promising candidates for restoration. The West Tributary and the Unnamed Tributary of Kelsey Creek are less suitable for fish habitat enhancement because they are piped in many areas, have less streamside vegetation, and do not currently support salmon; however, these streams still provide some benefits for downstream reaches that do support salmon use. Sturtevant Creek is in poor condition in the study area, with fish use very limited because of the long culvert under I-405 and, hence, was considered to offer limited potential for enhancement.

Basin-Specific Resources

Yarrow Creek

A small section of the northwestern corner of the study area lies within the Yarrow Creek Basin (Figure 4-1); this study area portion represents less than 4 percent of the total basin. This basin's surface water features are all located north of the study area, but stormwater generated in the study area portion drains to Yarrow Creek and its tributaries. This basin is currently 29 percent impervious, with the two largest land uses being single-family residential and public streets (City of Bellevue, 2006b). No stream or riparian habitat is present in that portion of Yarrow Creek Basin lying within the study area.

Sturtevant Creek

Sturtevant Creek is located in the southwestern portion of the study area (Figure 4-1) and drains to Lake Bellevue. Lake Bellevue is surrounded by multifamily residences, commercial buildings (many of which extend out over the lake on piers), parking lots, and streets, with the Sturtevant Creek Basin currently being 68 percent impervious (Table 4-5). From the lake, the stream flows south and then enters a pipe at NE 8th Street until it leaves the study area. Sturtevant Creek is rated as having the lowest quality of the study area streams, with no documented fish use and poor physical stream corridor conditions (Herrera Environmental Consultants, 2005 and 2006). This stream passes under I-405, which acts as a major barrier to upstream fish movement.

Overall, the stream, wetland, and riparian habitat of Sturtevant Creek in the study area is poor (Herrera Environmental Consultants, 2006), due primarily to the highly built-out condition of the area surrounding Lake Bellevue, the adjacent railway corridor, and I-405. The barrier to fish

passage at I-405 further limits the value of any potential improvements to the stream and riparian habitat of Sturtevant Creek in the study area.

West Tributary of Kelsey Creek

Most of the West Tributary of Kelsey Creek, the longest of the study area's streams, is located within the study area boundaries. This stream flows in a general northwest-to-southeast direction across the western portion of the study area and is associated with two large, forested wetlands (Figure 4-1). Both wetlands currently detain and treat stormwater and are functioning near or at their capacity. While the West Tributary has relatively high levels of stream riparian vegetation (up to 70 percent bank cover) in some areas, at least some of the sections are located in pipes (Herrera Environmental Consultants, 2005). Existing conditions in the West Tributary of Kelsey Creek were rated either moderate (fish use and fish access) or poor (physical street corridor conditions, fish habitat conditions, and riparian conditions).

Goff Creek

Goff Creek is roughly equidistant from the east and west borders of the study area. The basin in which it is located has 30 percent overall impervious surface (Figure 4-1, Table 4-5). The northern segment of Goff Creek within the study area is mostly open channel, "more closely resembling a ditch more than a natural stream" (Herrera Environmental Consultants, 2005). A culvert blocks upstream fish passage at Bel-Red Road, and several more blockages exist farther upstream. The stream's southern segment in the study area is piped downstream of 132nd Avenue NE. Existing conditions in Goff Creek were rated as moderate (fish access and riparian condition) to poor (fish use, physical stream corridor conditions, and fish habitat conditions) (Herrera Environmental Consultants, 2006).

Unnamed Tributary to Kelsey Creek

The Unnamed Tributary to Kelsey Creek lies between Goff and Valley creeks in the upper portion of Kelsey Creek Basin, of which it comprises only a small portion. Two of this tributary's segments are located in pipes, and the stream passes through several culverts associated with driveways (two of these create fish passage blockages near NE 16th Street). The surface segments are generally swale-like in upstream areas and straight ditches with rip-rapped banks in the rest of the study area (Herrera Environmental Consultants, 2005). Existing conditions in this stream were rated either moderate (fish use, fish access, fish habitat conditions, and riparian condition) or poor (physical stream corridor conditions) (Herrera Environmental Consultants, 2006). No mappable riparian or wetland habitat occurs along the portion of this stream in the study area. A review of Ecology's Impaired Waterways List found that, of the study area streams, only Kelsey Creek exceeds the state water quality standards. The categories in which the stream exceeded the standards were dissolved oxygen (DO), fecal coliform, and temperature. These measurements were all recorded at an Ecology monitoring station at river mile (RM) 2.1 of Kelsey Creek, which is south of the study area.

Valley Creek

Valley Creek is located in the eastern portion of the study area (Figure 4-1), entering the study area as it passes under SR 520 and joining Kelsey Creek just south of Bel-Red Road (Herrera Environmental Consultants, 2005). Valley Creek is rated as being in good condition in terms of use by anadromous salmon, including coho, Chinook, and sockeye; in moderate condition in

terms of percent of stream in culverts; and in poor condition based on watershed alteration and riparian breaks (City of Bellevue, 2003a and 2003b; Herrera Environmental Consultants, 2006). There is riparian habitat along the portion of this stream in the study area; it can be seen on the east side of 140th Avenue NE just south of Highland Park. Of the study area streams, Valley Creek is considered to have the highest opportunity for rehabilitation of the study streams because it has the fewest constraints with no fish blockages and good potential spawning habitat in two of its reaches (Herrera Environmental Consultants, 2006).

Sears Creek

Sears Creek is located in the eastern portion of the study area (Figure 4-1) and, in contrast with the other streams in this area, flows primarily east to west (Herrera Environmental Consultants, 2005). With an overall basin impervious surface of 64 percent, Sears Creek is rated as being in moderate condition based on a series of five measurement parameters: fish use, physical stream corridor condition, fish access, fish habitat conditions, and riparian conditions (City of Bellevue, 2003a and 2003b; Herrera Environmental Consultants, 2006). Sears Creek has fish passage barriers at two culverts and flows in two piped segments within the study area. The channel segments between the piped segments are in good condition and comprise a series of pools, riffles, and glides (Herrera Environmental Consultants, 2005). A regional stormwater detention facility, Commissioner's Waterway, is located on Sears Creek.

Impacts

The actions being considered in this programmatic evaluation are three alternatives involving changes in the land use classifications in the Bel-Red Corridor. Changing land use classifications could lead to redeveloping existing land uses that currently generate untreated and undetained stormwater and developing new land use types that might differ in percent impervious surface and in methods to treat stormwater. They could also present opportunities to protect and/or enhance riparian buffers. Also considered is a No-Action Alternative, which assumes no major changes in land use classifications and a slight increase in commercial and industrial uses in the study area beyond what exists today. Opportunities for enhancing each individual basin within the Bel-Red Corridor are discussed in a subsequent section.

Construction Impacts

Construction related to redevelopment and new development could impair adjacent streams, riparian habitats, and wetlands through impacts such as increases in erosion and sedimentation. Sediments, if not properly managed, could adversely affect water quality. The risk of potential impact could increase during construction because construction activities could create exposed soils and introduce erosion into nearby streams and wetlands. Ecosystem impacts of primary concern are erosion and sedimentation into streams and wetlands as a result of soil disturbance during construction. Sediment discharges can smother valuable fish habitat and reduce the wetland's ability to store peak stormwater flows and filter pollutants.

It is assumed that any action alternative would be implemented on an incremental basis over the planning horizon. However, the specific scale of construction in any given year through 2030 cannot be predicted. Because no specific projects are under review in the EIS, specific construction methods and the acreages to be disturbed are not foreseeable at this time. Stormwater discharge during construction on lots from 1 to 5 acres in size would require site

coverage under a National Pollutant Discharge Elimination System (NPDES) permit issued by Ecology under the federal Clean Water Act (CWA) authorization. Temporary erosion and sediment control (TESC) BMPs would be implemented and maintained in accordance with a stormwater pollution prevention plan (SWPPP) that would be prepared, as required by the NPDES permit. The SWPPP would identify BMP plans to control and maintain erosion and soils, as well as spill response to prevent or control construction equipment leakage of fuel, oil, or hydraulic fluid. Possible construction impacts would be further evaluated as part of project-specific SEPA reviews when those projects move forward.

The City of Bellevue's development standards also require developers to prepare plans for erosion and sediment control before construction. The plans must specify BMPs to prevent sediment and other pollutants from entering streams and wetlands. Other federal and state agencies, such as the Corps, NOAA Fisheries, and Ecology, also review erosion and sediment control measures and overall construction practices to ensure that ecosystems and ESA-listed species are protected to the fullest extent practicable. Permits issued by the City of Bellevue and other jurisdictional agencies would contain detailed conditions of development and requirements for protecting critical areas and habitats.

Operational Impacts

Each action alternative would create higher development intensities in many areas of the Bel-Red Corridor than those that exist today. In many cases, this development would take place close to existing habitats for species of local importance, including fish-bearing streams and/or wetlands. However, greater development intensities would not necessarily equate to adverse impacts. Most current land uses in the study area have a high degree of impervious surface and few or no controls on stormwater quantity or quality. Most also were built before the GMA mandated protecting critical areas. Hence, redevelopment could provide an opportunity to develop land uses within the corridor that are lower in impact, create less impervious surface, and incorporate higher levels of environmental protection. All of these changes would benefit aquatic habitat and fish, including ESA-listed Chinook salmon. Within this overall range of possibilities, the alternatives would vary to some degree, depending primarily on the specific types of land uses proposed within each basin.

Although the overall effect of redevelopment is expected to be positive, existing regulations constrain how much benefit is achievable. As discussed earlier in this chapter, the highest levels of protection under Bellevue's CAO do not apply to redevelopment, which would constitute most of the anticipated activity in the Bel-Red Corridor. Also, as noted above, the existing stormwater regulations are focused on "end-of-pipe" solutions rather than more natural approaches, such as LID. Thus, in order to meaningfully protect or enhance corridor watersheds, the City would need to use some combination of new or stronger regulations, incentives for developers, and/or programs to acquire and enhance high-value habitat (perhaps as part of creating park resources in the corridor). Such opportunities are described in the Mitigation section of this chapter.

In addition to land use changes, transportation improvements could potentially affect ecosystems. Although Sound Transit's proposed LRT route is not part of Bellevue's proposal for the Bel-Red Corridor, it is likely to cross all study area streams. This could—in conjunction with station-area development—present opportunities for enhancement. For example, Goff Creek, which otherwise has relatively good salmon habitat, is blocked by an impassable culvert at

approximately NE 16th Street (as well as another culvert downstream at Bel-Red Road). Developing the LRT line along this alignment in conjunction with the proposed new NE 16th Street arterial would allow this barrier to be eliminated. Transportation improvements by the City that are included in the alternatives also present possibilities for eliminating passage barriers. For example, the proposed improvements to 120th Avenue NE could provide an opportunity to remove a partial blockage to fish passage where the street crosses the West Tributary of Kelsey Creek.

Offsetting Factors

While each factor above could improve aquatic habitat quality by reducing peak flows, reducing contaminant loads, and reducing the overall stormwater volume, three factors could offset these benefits: transportation corridor improvements, soil constraints, and the voluntary nature of redevelopment. Accompanying the land use reclassification in the study area are plans to introduce LRT and surface street improvements. These improvements would also add impervious surface to the study area, although they would include appropriate water quality treatment measures per the relevant elements of the BCC.

Converting current impervious surface to bare soil or a landscaped lawn area does not automatically translate into complete infiltration of the rain falling on these surfaces. Puget Sound soils are frequently composed of glacial tills and other materials with low percolation rates that could inhibit infiltration for particular properties. If stormwater could not infiltrate completely into the soil, then some proportion of it would run off into surface waters. This offsetting factor would vary across the study area, depending on the underlying soil of redeveloping properties. The potential of each study area basin for stormwater infiltration is discussed below in the Comparison of Impacts and Opportunities by Basin section.

Last, any benefit derived from redeveloping and reclassifying land uses would require the action of property owners, developers, and contractors. The actual amount of land redeveloped solely in response to the proposed action cannot be predicted at this time. In some places, existing development that does not conform to current surface water regulations would remain in its current state, and the benefits of redevelopment on surface waters would not be realized. In addition, without additional regulatory mechanisms to mandate or incentivize added protection of critical areas in conjunction with redevelopment, denser and more urban development near stream corridors could create adverse impacts.

Comparison of Impacts and Opportunities by Basin

Any of the three action alternatives are likely to result in some level of environmental benefit to the study area over time. This conclusion is based on two factors: (1) introducing water quality and quantity treatment for redeveloped land uses where none currently exists, and (2) introducing land uses that typically contain lower levels of impervious surface than those that currently exist in the study area. In addition, there are significant opportunities to protect and even increase the habitat functions of several study area streams to enhance their ecological value. However, given the limitations of the protective regulations that currently apply to redevelopment in the corridor (primarily the CAO and stormwater regulations), the City would need to take additional actions to create meaningful enhancements that would further the project objectives.

To facilitate these actions and identify where the greatest opportunities exist for protecting and enhancing resources, an evaluation was performed on a basin-by-basin basis. The types of land uses proposed in the basin for each alternative were considered in relation to the degree of impervious surface they are likely to create, their suitability for LID in areas with conducive soils, and whether riparian buffer improvements would be likely to enhance fish habitat.

LID approaches depend on the ability of site soils to infiltrate groundwater rather than discharge it as runoff. Permeable, gravelly soils are the best candidates for LID, while dense, compacted till soils are not generally suited to this type of development. While the actual capability of soil to infiltrate stormwater depends on a number of site-specific conditions (Stolar, 2002), the recently completed characterization of the basic geologic units of the Bel-Red Corridor (Booth and Wisher, 2006; reproduced as Appendix D) does indicate whether infiltration would be possible in a given area. In general, much of the study area is underlain by soils that are conducive to infiltration. This presents some unique opportunities to use sustainable approaches to redevelopment in the Bel-Red Corridor.

Yarrow Creek

The opportunities for LID improvements in this segment of the Yarrow Creek Basin are limited due to the general condition of soils in this area. In the case of this portion of Yarrow Creek Basin, the potential for infiltration appears to be low based on the presence of artificial fill in the I-405 and SR 520 right-of-way corridors, as well as that of Vashon subglacial till in the southern part of this basin segment. Coupled with the lack of any significant change in land use classification for any of the three alternatives in this area, no improvement opportunities are provided for by the action alternatives in this section of the study area.

Sturtevant Creek

The small portion of Sturtevant Creek within the study area (immediately downstream of Lake Bellevue) is underlain by Vashon recessional outwash deposits (Booth and Wisher, 2006; see Appendix D), which might be suitable for LID if other supporting conditions exist. However, the extensive amount of development and impervious surface already present in this stream segment makes it a poor candidate for LID improvements. The proposed land use reclassifications in Alternatives 1, 2, or 3 for this stream segment are either retail/commercial or mixed-used housing/commercial higher-density, which are less suitable for LID improvements than some other land uses. Since Sturtevant Creek is underground through most of the study area, enhancing the riparian buffer would not be possible without daylighting the stream—not a likely scenario given its course under I-405.

West Tributary of Kelsey Creek

This portion of the West Tributary of Kelsey Creek is underlain by Vashon recessional outwash deposits (Booth and Wisher 2006; see Appendix D) and, therefore, has the potential for allowing infiltration if the site-specific project conditions allow for it. The proposed land use reclassifications in Alternatives 1, 2, or 3 for this stream segment are either housing, office campus, office medium-density, light industrial, or mixed-use housing/commercial higher-density. Of these, the reclassification to housing provides the best opportunity to improve riparian buffers and stream habitat. However, some of the other land use types—particularly mixed-use housing/commercial and office campus—could be encouraged through incentives to

preserve riparian areas or set aside open space for stormwater infiltration. Although there are no salmonids in this stream segment, LID could be especially beneficial in this area because of the potential to improve water quality in the downstream reaches of Kelsey Creek that have salmon runs. In addition, infiltration upstream of the regional stormwater facilities would reduce the amount of runoff that reached these facilities, effectively increasing their capacity.

Of the three alternatives, Alternative 1 offers the most LID opportunities and buffer preservation because it includes a station area surrounding a large reach of the West Tributary. Although development could be relatively intense here, the stream could become an amenity in mixed-use residential/commercial areas, and developers would likely make use of increased height incentives in exchange for setting aside space to infiltrate runoff or protect riparian areas. Alternative 2 would focus industrial development around the stream, which is consistent with the existing uses but not conducive to stream protection. Alternative 3 provides an intermediate level of opportunity with retail development (typically less amenable to LID approaches because it is associated with large buildings and surface parking areas) and office.

Goff Creek

This segment of Goff Creek is primarily underlain by Vashon recessional outwash deposits and by a nonglacial fan deposit at the northernmost section in the study area (Booth and Wisher, 2006). Both of these soil types could allow infiltration if the site-specific project conditions allow it. Land use reclassifications alongside Goff Creek would allow for developers to reduce impervious surface (e.g., changing from existing conditions to residential housing). Riparian habitat enhancement and stream habitat improvements could, therefore, be a component of site development and redevelopment if the appropriate incentives and/or legal requirements were incorporated into the City of Bellevue LUC during the reclassification process. Of the three alternatives, Alternative 1 presents the least opportunity for improving riparian habitat (with a mix of low-density office [transition area], office campus, Services Core, and retail/commercial classifications). Both Alternatives 2 and 3 offer opportunities for improvement given the opportunity for housing adjacent to the stream corridor.

Outside of any general considerations for habitat improvements from individual property development or redevelopment, use of Goff Creek by anadromous salmon will depend on removing the fish passage barrier that exists where Goff Creek flows beneath Bel-Red Road (Figure 4-1). While an important consideration for salmon, this barrier will not limit improvements to general stream habitat or riparian conditions for wildlife. Resident salmonids (rainbow and cutthroat trout) use the existing habitat in the study area between the passage barriers and would benefit from any enhancements to the stream.

Unnamed Tributary of Kelsey Creek

The Unnamed Tributary of Kelsey Creek is primarily underlain by Vashon recessional outwash deposits, with the headwaters of this segment underlain by a nonglacial peat deposit (Booth and Wisher 2006; Appendix D). The outwash deposits could allow infiltration if the site-specific project conditions allow for it. Similar to Goff Creek, the proposed land-use reclassifications adjacent to the Unnamed Tributary of Kelsey Creek would allow developers to reduce impervious surface. LID, riparian habitat enhancement, and stream habitat improvements could, therefore, be a component of site development and redevelopment if the appropriate

incentives and/or legal requirements are incorporated into the City of Bellevue LUC during the reclassification process.

Of the three action alternatives, Alternative 1 presents the least opportunity for improving riparian habitat, with a mix of low-density office (transition area), and retail/commercial classifications; both Alternatives 2 and 3 offer greater opportunities for improvement. Alternative 3 presents somewhat better opportunities of the two, with a larger proportion of housing allocated to land adjacent to the stream.

Valley Creek

Overall, Valley Creek overlays outwash deposits (likely candidates for infiltration), peat, and a very small section of fine-grained deposits (a poor infiltration candidate) at the south end of the study area. Proposed land use reclassifications adjacent to Valley Creek would allow developers to reduce impervious surface and take advantage of stormwater infiltration opportunities. Riparian habitat enhancement and stream habitat improvements could, therefore, be a component of site development and redevelopment if the appropriate incentives and/or legal requirements be incorporated into the City of Bellevue LUC during the reclassification process.

All action alternatives would preserve Highland Park, which protects Valley Creek's riparian corridor just east of 140th Avenue NE. However, other proposed uses could limit the potential to provide additional protection. Overall, Alternative 1 presents the least opportunity for further improving riparian habitat because of the large amount of land in retail/commercial classification. These uses are generally associated with large buildings and sizable areas of surface parking. Alternative 3 also contains a large amount of retail use, although slightly less than Alternative 1. Alternatives 3 offers the greatest opportunities for improvement, with a larger proportion of mixed-use housing/retail allocated to land adjacent to Valley Creek in this alternative.

Sears Creek

Approximately 75 percent of Sears Creek in the study area overlays Vashon recessional outwash deposits and Vashon advance outwash, with remainder overlaying Vashon subglacial till (Booth and Wisher, 2006; Appendix D). As such, opportunities for infiltration exist in a large part of the segment. The proposed mixed-use reclassification adjacent to Sears Creek would allow developers to reduce impervious surface in Alternatives 2 and 3, with the potential to incorporate the stream into site development plans as an amenity. Developer incentives could prove highly effective under these alternatives in protecting and enhancing the existing salmonid habitat. The major proposed land use classification in Alternative 1—retail/commercial—would not provide any significant opportunities for riparian enhancement.

Summary of Basin Improvement Opportunities

Table 4-7 summarizes the basin improvement opportunities for the seven study area basins.

TABLE 4-7
Summary of Basin Improvement Opportunities
Bel-Red Corridor Draft Environmental Impact Statement

Stream Segment	Infiltration Possible?	Existing Wetlands	Existing Riparian Habitat	Existing Salmonid Use?	Alternative 1	Alternative 2	Alternative 3	Alternative with Best Opportunities for Improvement
Yarrow Creek	No	None	None	None	No opportunity to reduce impervious surface or create wetland, riparian, or forest through reclassification.	Same as Alternative 1	Same as Alternative 1	None
Sturtevant Creek	Yes	None	None	None	Land use reclassification offers little opportunity to reduce impervious surface or create wetland, riparian, or forest habitat.	Same as Alternative 1	Same as Alternative 1	None
West Tributary	Yes	Present	Present	None	Mixed-use development in station area offers opportunity to reduce impervious surface or create wetland, riparian, or forest habitat.	Substantial amount of industrial use offers little opportunity to reduce impervious surface or create wetland, riparian, or forest habitat.	Proposed uses provide some opportunity to reduce impervious surface or create wetland, riparian, or forest habitat.	Alternative 1 provides opportunities to improve watershed processes.
Goff Creek	Yes	None	Present	Limited (only below Bel-Red Road)	Land use reclassification does not allow an opportunity to significantly reduce impervious surface or create wetland, riparian, or forest habitat.	Mixed-use designation offers opportunity to reduce impervious surface reduction and create riparian and forest habitat.	Similar to Alternative 2	Both Alternatives 2 and 3 offer opportunities to improve watershed processes, with Alternative 2 presenting slightly better opportunities of the two.

TABLE 4-7
Summary of Basin Improvement Opportunities
Bel-Red Corridor Draft Environmental Impact Statement

Stream Segment	Infiltration Possible?	Existing Wetlands	Existing Riparian Habitat	Existing Salmonid Use?	Alternative 1	Alternative 2	Alternative 3	Alternative with Best Opportunities for Improvement
Unnamed Tributary	Yes	None	Present	None	Land use reclassification offers little opportunity to reduce impervious surface or create wetland, riparian, or forest habitat.	There is some opportunity to reduce impervious surface and create riparian and forest habitat because of new office campus uses.	There is a greater opportunity to reduce impervious surface and create riparian and forest habitat with proposed housing and park.	Both Alternatives 2 and 3 offer opportunities to improve watershed processes, with Alternative 3 presenting somewhat better opportunities of the two.
Valley Creek	Yes	None	Present	Yes	Maintaining existing retail uses provide limited opportunity to reduce impervious surface and create riparian and forest habitat.	Reclassifying some areas to mixed-use offers opportunity to reduce impervious surface and create riparian and forest habitat.	Similar to Alternative 1	Alternative 2 presents the best opportunities to improve watershed processes.
Sears Creek	Yes	None	Present	Yes	Maintaining existing retail uses offers little opportunity to reduce impervious surface or create wetland, riparian, or forest habitat.	Proposed mixed-use development offers opportunity to reduce impervious surface and create riparian and forest habitat.	Similar to Alternative 2	Both Alternatives 2 and 3 offer opportunities to improve watershed processes.

Source: CH2M HILL, 2006.

Mitigation Measures

Construction

Constructing new land use developments and transportation improvements would likely result in some impacts on ecosystems, including wetland filling and increased potential for erosion and sedimentation. Site-specific project reviews under the SEPA process and permit approvals under city, state, and federal regulations would address any need for mitigation measures for redevelopment, development, and transportation improvement projects that might occur in the future.

Operation

No mitigation measures are likely to be required for developing new land uses under any action alternative. This is because new land uses would comply with the City's existing CAO and stormwater regulations, likely resulting in some level of aquatic habitat and water quality improvement. However, the resources that exist in the study area stream basins present several opportunities to enhance habitat values more substantially than would be possible simply by following current regulations. These opportunities include the following:

- Increase the required stream buffer width for developed properties (as defined by the CAO) in the Bel-Red Corridor to be the same as the required width for undeveloped properties. The new requirements could be selectively applied to the basins with the highest potential for improvement (i.e., Valley, Goff, and Sears creeks).
- Consider reducing surface parking requirements to minimize impervious surfaces, especially in station areas where LRT reduces the need to use personal vehicles. Requiring underground parking could also be considered in higher-intensity residential and mixed-use development areas.
- Develop a set of uniform performance standards for LID and "green" infrastructure development in the corridor (as has been done in the city of Olympia, South Lake Union, and elsewhere) to ensure that clear and consistent expectations are established for developers using LID and "green" infrastructure approaches.
- In conjunction with proposed transportation improvements, develop "green streets" standards, similar to the City of Seattle's SEAStreets, to decrease impervious surface and runoff from transportation facilities. Such standards could be applied citywide.
- Consider adopting incentives that allow developers to provide an additional level of environmental enhancements in the areas adjacent to Valley, Goff, and Sears creeks. This would allow their habitat potential to be more fully realized, while at the same time allowing developers to use the streams as central features of their development plans. Specific potential incentives include the following:
    - Facilitate transfer of development potential away from streams and clustering development on the least-sensitive portion of a site.

  - Allow increased building height (above the base zoning) in exchange for reducing impervious site coverage, implementing LID, and/or increasing or enhancing riparian buffers.

- Identify potential areas for developing new regional stormwater treatment facilities to address the fact that the existing West Tributary facilities are at or near capacity.
- Provide regulatory mechanisms to facilitate consolidation of parcels to create sites that are more conducive to providing open space and infiltration opportunities.
- Explore opportunities for public acquisition and management of key stream segments (especially in Valley, Goff, and Sears creeks) through such methods as conservation easements.
- In acquiring new park lands, look for opportunities to create multiple benefits by including habitat areas suitable for enhancement.

Unavoidable Adverse Impacts

No unavoidable adverse impacts to watershed processes were identified during this analysis.