King County Initial Infiltration and Inflow Reduction Project Alternatives Analysis Report

APPENDIX A. ENVIRONMENTAL TECHNICAL MEMORANDUM

April 2009

Environmental Technical Memorandum King County Inflow and Infiltration Basin Study King County, Washington

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LIST OF ACRONYMS

ASTM	ASTM International		
BEMP	Bald Eagle Management Plan		
bgs	below ground surface		
BMPs	Best Management Practices		
CERCLIS Comprehensive Environmental Response, Compen			
	and Liability Information System		
CSCSL	Confirmed and Suspected Contaminated Sites List		
DMV	Department of Motor Vehicles		
Dodds	Dodds Geosciences, Inc.		
Ecology	Washington State Department of Ecology		
EDR	Environmental Data Resources, Inc.		
EPA	U.S. Environmental Protection Agency		
ERNS	Emergency Response Notification System		
FINDS	Facility Index System		
GIS	Geographic Information System		
I&I	Inflow and Infiltration		
I-90	Interstate 90		
ICR	Independent Cleanup Reports		
KCC	King County Code		
KCDNR	King County Department of Natural Resources		
LUC	Land Use Code		
LUST	leaking underground storage tank		
NFA	No Further Action		
NFRAP	No Further Remedial Action Planned		
NGPA	Native Growth Protection Area		
NGPE	Native Growth Protection Easement		
NRCS	National Resource Conservation Service		
PCBs	polychlorinated biphenyls		
PHS	Priority Habitats and Species		
RCRA	Resource Conservation and Recovery Act		
RCRA-SQG	Resource Conservation and Recovery Act-Small Quantity		
RCW	Revised Code of Washington		
ROW	right-of-way		
Spills	Spill Prevention, Preparedness and Response		
SPU	Seattle Public Utilities		
SQG	Small Quantity Generator		
UST	underground storage tank		
VCP	Voluntary Cleanup Program		
WDFW	Washington State Department of Fish and Wildlife		
WDNR	Washington State Department of Natural Resources		

KING COUNTY INFLOW AND INFILTRATION PROJECT STUDY ENVIRONMENTAL TECHNICAL MEMORANDUM

This report describes the State Environmental Policy Act environmental concerns that we anticipate for the King County Inflow and Infiltration (I&I) project study in the Issaquah, Bellevue, and Skyway project areas. The Issaquah project area includes two mini-basins identified as ISS003 and ISS004. The Bellevue project area includes four mini-basins (BEL011, BEL012, BEL031, and BEL032). The Skyway project area includes three mini-basins (BLS001, BLS002, and BLS003).

The proposed project includes replacing and/or rehabilitating the sanitary sewer systems in the Issaquah, Bellevue, and Skyway project areas to alleviate infiltration leaks and peak flows in the sewer system. Work on private property would generally consist of rehabilitation and/or replacement of side sewers and installation of cleanouts. Work in the public right-of-way (ROW) would generally include the rehabilitation or replacement of main lines, service connections to the main line, laterals, and manholes. Construction techniques would include pipe bursting, pipe replacement, pipe lining, manhole rehabilitation, manhole replacement, cleanout installations, and disconnection or repair of direct connections (inflow sources) to remove groundwater and stormwater sources from the sewer system.

Each section of this report describes the potential environmental concerns associated with hazardous materials; wetlands, streams, and wildlife issues; landslide and erosion concerns; and groundwater systems for each project area.

1.0 ISSAQUAH PROJECT AREA (MINI-BASINS ISS003 AND ISS004)

1.1 Hazardous Materials Research

1.1.1 Site Description

The Issaquah project area is located southeast of Lake Sammamish and south of Interstate 90 (I-90) in King County. Most of the project area consists of residential properties on the east-facing slope of Squak Mountain. The eastern portion of the project area is relatively flat and dominated by a mixture of commercial and residential properties. The study was conducted to evaluate if hazardous materials may be encountered during the proposed sewer upgrade project. The identified properties were ranked "low," "moderate," or "high" based on the likelihood of contaminants to be present in the soil in the vicinity of the sewer line and manholes where excavation may occur. Properties with known groundwater and/or soil contamination located near or adjacent to the sewer are considered to have a **high** potential for contaminating the soil in the vicinity of the sewer line. Adjacent businesses such as historical gas stations, historical automobile repair shops, dry cleaners, print shops, paint shops and photo shops where there are no known releases are considered to have a **moderate** potential for contaminating the soil. These types of businesses have commonly released contaminants into the soil and/or groundwater; however, where no evidence of a release has been observed or documented, the risk of contamination is evaluated to be **moderate**. Properties adjacent to sewer lines where reported petroleum or chemical spills of significant or unreported size have reached the soil are also considered to have a **moderate** potential to impact the project area.

Businesses, including gas stations and automobile repair shops developed since approximately 1988; construction companies with no known underground storage tanks (USTs); and residences with heating oil tanks are considered to have a **low** potential for contamination. Newer gas stations are considered to have a **low** contamination potential because of stringent regulations for UST construction, system installation, monitoring and testing. Although construction companies frequently have USTs, such companies are considered to pose a **low** potential for contamination where the presence of USTs has not been confirmed. Properties with heating oil tanks are considered to have a **low** potential because heating oil generally does not travel far in soil. The locations of the identified properties having a potential to impact soil in the vicinity of the sewer line are indicated in Figure 1.

1.1.2 Document Review

Local, State, and Federal Environmental Databases. Environmental Data Resources, Inc. (EDR) was subcontracted to conduct a search of available agency databases for sites within distances recommended by ASTM International (ASTM) for Phase 1 Environmental Site Assessments. The search included U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), Tribal, and local databases for known and suspected contaminated sites.

Four properties within the project area were identified as being on one or more of the following databases: spills reported to Spill Prevention, Preparedness and Response (Spills),

leaking underground storage tank (LUST), UST, Independent Cleanup Report (ICR), and Facility Index System (FINDS). These listed sites are shown in Figure 1 and are summarized below:

- King County Fire District 10, 175 Newport Way NW, Issaquah (LUST, UST, ICR, Spills, FINDS). The database information indicates that four USTs were removed from the property. Petroleum contamination in soil was found in November 1992, and cleanup was reportedly completed at that time. In February 1996, a separate spill of an unspecified quantity of diesel fuel to the soil was reported. The site is adjacent to the sewer line. Based on the reported diesel fuel spill to soil and the site's proximity to the sewer, the site is considered to have a moderate potential to impact soil excavation areas.
- ▶ 660 Wildwood, Issaquah (Spills). According to King County Assessor information, apartments are located at this address. The agency database information indicates that spill incidents occurred in September 1995 and September 2003. The earlier spill was of an unspecified material to surface water, and the later one was of a chemical spill to "other" media. Neither spill report indicated quantity. Although the site is located adjacent to a sewer line, it is considered to have a low impact potential, because neither of the spill reports indicate that soil was impacted, and the site is not on other databases, which would have indicated that contamination is present.
- Gilman Meadows Apartments, 360 NW Dogwood Street, Issaquah (Spills). The spill incident report indicates that an unquantified hazardous material was spilled on the soil in January 2007. Because soil was reportedly impacted and there are multiple sewer lines on the property, the site is considered to have a **moderate** potential to impact the project area.
- ► 18 Mt. Pilchuck NW, Issaquah (Spills). According to County Assessor information, this is a single-family residence. The Spills report indicates that sewage or sludge was spilled on the soil in December 2006. Unless sewage or sewage sludge is from an industrial source, it generally does not contain hazardous materials in significant quantities. Therefore, the site is considered to have a **low** potential to impact the project area.

Other sites listed outside of the project area were not considered a potential environmental concern because of the type of database listing and/or relative distance from the project area.

Cole's City Directories. City directories were reviewed at the Seattle Public Library for the years 1971 – 1972, 1977, 1981 – 1982, 1986 – 1987, 1991 – 1992, 1997, 2002, and 2007. The majority of the listings were residential, although some of the residential addresses are currently or were previously listed as home businesses. Home businesses of potential environmental concern include construction/contractor, ironworks, landscaping, carpet

installation, and painting. Based on the limited area of the listed home businesses, a database search for USTs, and visual observations of the properties during our site reconnaissance, it is unlikely that subsurface soils are contaminated above regulatory cleanup levels.

Other non-residential properties included a school, churches, a fish hatchery, and a fire station. The fire station is of **moderate** concern and is discussed in the Local, State, and Federal Environmental Databases section (Section 1.1.2). The fish hatchery is of low concern and is discussed in the King County Assessor records section. The other non-residential properties are not considered environmental concerns.

Sanborn Fire Insurance Maps. Sanborn Fire Insurance Maps were not available for the project area.

King County Assessor Records. Current Tax Assessor records were reviewed online at the King County iMap website. Tax assessor information prior to 1970 for this project was reviewed at the Puget Sound Regional Archives. Most of the parcels in the project area were residential, with 55 currently or historically using heating oil (Figure 1). Heating oil generally has low mobility when it has been released to subsurface soils. As a result, contamination is usually not widespread.

Other properties of concern were identified:

- Puget Sound Energy substation (constructed in 1962). The substation is located northwest of the Newport Way SW/W Sunset Way intersection. Substations may contain polychlorinated biphenyls (PCBs). This property is considered to have a **moderate** potential to impact the project area, because PCBs are relatively toxic and because two local sewer mains are located south and east of the property.
- A former gas station was located south of the Newport Way SW/W Sunset Way intersection. This property is now vacant land, and it is not known whether the gasoline USTs were removed and/or if a leak occurred. This property would typically be identified as a moderate risk, but because a local sewer main goes through the property, it is considered to have a high potential to impact the project area.
- ► A maintenance garage/shop constructed in 1952 is located on the fish hatchery property at 120 Newport Way SW. USTs are commonly located in or adjacent to maintenance garages to store used waste oil. This property is considered to have a **low** potential to impact the project area, because it appears that the maintenance garage is located on the eastern end of the property, more than 250 feet from the nearest sewer line in the project area.

A fire station is located at 175 Newport Way SW. Fire stations commonly have USTs on their properties for vehicle refueling. This property is considered to have a **moderate** potential to impact the project area and is discussed further in the Local, State, and Federal Environmental Databases section (Section 1.1.2).

1.1.3 Site Reconnaissance

A visual reconnaissance of the project area was conducted on March 4, 2008. The project area is predominantly residential, with some commercial properties along W Sunset Way and Newport Way SW.

Properties of concern that were identified in the project area during our site reconnaissance include a substation northwest of the Newport Way SW/W Sunset Way intersection and a fire station at 175 Newport Way SW. Both of these properties are discussed in the King County Assessor's records section (Section 1.1.2).

1.1.4 Conclusions

The potential for impact to the sewer line from contaminated sites was evaluated based on the type of business, the proximity of the parcel to the sewer line, and the known or suspected presence of contaminants. In areas where the water table is at or above the sewer pipe elevation, the potential exists that the sewer trench backfill could be serving as a hydraulic conduit for contaminated groundwater migration. In such cases, it is possible that groundwater could carry contamination downgradient for considerable distances along the sewer line corridor. In addition, excavation and dewatering practices used during sewer line repair activities could create or modify contaminant migration pathways and/or distribution. However, this is unlikely because of the limited excavation and dewatering that is anticipated for this project.

The toxicity and cost of remediating contaminated soil that could be encountered during sewer line improvements varies depending on the type of contaminant. For example, dry cleaning solvents are highly toxic at low concentrations and remediation costs are typically very high. Other solvent contaminants resulting from businesses such as photo processing or printing shops may be less toxic than dry cleaning solvents but they can also result in high remediation costs. Soils contaminated with gasoline-range petroleum hydrocarbons generally have a lower toxicity and a lower disposal cost than soils contaminated with solvents, depending on the age of the gasoline. A more recent gasoline spill has more benzene, its most toxic component. The more benzene present in the soil, the higher the remediation costs. Older gasoline tends to be

less toxic and somewhat less expensive to remediate. Diesel- and oil-range petroleum hydrocarbons are the least toxic and least mobile petroleum contaminants and typically have the lowest cleanup costs. Metal contaminants could result in high remediation costs but, unlike the organic contaminants listed above, they do not easily absorb through the skin and have a relatively low health risk unless they are ingested.

Potential properties of concern are shown in Figure 1. Based on the environmental review, historical review, and site reconnaissance, the potential for impact from contaminants to the improvement of the sewer system appears to be **low to moderate** within the Issaquah project area, as summarized in Table 1.

Property	Location	Contaminant Potential	Contaminant(s) of Concern	
Mini-Basin ISS003				
Residences with heating oil	Various (Figure 1)	Low	Petroleum products	
660 Wildwood Boulevard	660 Wildwood Boulevard SW	Low	Unknown	
Fish Hatchery Maintenance Garage	120 Newport Way SW	Low	Petroleum products	
Former Gasoline Station	South of the Newport Way SW/ W Sunset Way intersection	High	Petroleum products	
Mini-Basin ISS004				
Residences with heating oil	Various (Figure 1)	Low	Petroleum products	
18 Mt. Pilchuck Avenue NW	18 Mount Pilchuck Avenue NW	Low	Sewage sludge	
Gilman Meadows Apartments	360 NW Dogwood Street	Moderate	Unknown spilled material: screen for petroleum products, volatiles, and pesticides	
Puget Sound Energy Substation	NW of the Newport Way SW/ W Sunset Way intersection	Moderate	PCBs	
King County Fire District 10 Fire Station	175 Newport Way NW	Moderate	Petroleum products	

TABLE 1ISSAQUAH PROPERTIES OF CONCERN

PCB = polychlorinated biphenyls

We recommend that construction monitoring be performed where excavation is planned in areas of **low** potential for impact from contaminated sites (such as where spills have occurred and where USTs are suspected to be present). If contamination is identified, it would then be necessary to provide appropriate health and safety measures to protect site workers and to analyze the soil for proper disposal. Hazardous household materials such as cleaners, paints, and solvents are often disposed of in the sanitary sewer system from residences and businesses such as paint shops, printers, and photo developers. These materials can leak into the soil through sewer line joints. Also, sediments should be removed from manholes prior to work within them to reduce the risk of exposure to hazardous materials for site workers.

Based on the potential health risks associated with contaminated soil and groundwater, we recommend that earthwork be avoided in the vicinity of **moderate** and **high** risk sites. If earthwork cannot be avoided, we recommend that a Phase II Environmental Site Assessment be performed to determine whether contamination is present and to analyze the soil and/or groundwater for health and safety measures and proper disposal. Because the sites are not expected to be acquired by King County, the Phase II explorations should be confined to soil and/or groundwater sampling in the sewer line easement adjacent to each site. Sampling could be conducted with a Geoprobe[®] at intervals to the approximate depth of the sewer line. Soil samples should be analyzed for the appropriate contaminants of concern, as identified in Table 1.

1.2 Wetland, Streams, and Wildlife Research

1.2.1 Document Review

Washington State Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) Map. No priority habitats were mapped within the project area. Two areas immediately adjacent to the project area were mapped as priority habitat. Squak Mountain Park, located immediately southwest of mini-basin ISS003, is designated as urban natural open space and reported as containing diversely-vegetated, older- and second-growth, mixed forestland. The second priority habitat, located immediately northeast of mini-basin ISS004, is reported as riparian habitat. The riparian habitat is associated with Issaquah Creek and provides protection for fish habitat, as well as habitats for a large variety of avian and terrestrial species.

The PHS maps show several wetlands in the project area. Wetlands associated with Issaquah Creek were mapped south of Newport Way SW. Three wetlands were mapped in minibasin ISS004, northeast of Newport Way SW and between W Sunset Way and Front Street South. These wetlands correspond with the fish hatchery ponds. Another wetland was mapped in mini-basin ISS004, southwest of Newport Way NW, between NW Dogwood Street and NW Alder Court. Based on aerial photography and site reconnaissance, this wetland is no longer present, as this area is now developed.

Priority anadromous and resident fish presence is mapped in Issaquah Creek (both minibasins) and in an unnamed stream (identified as Stream 11 in Figure 2) in mini-basin ISS003. Priority anadromous and resident fish in Issaquah Creek include Fall Chinook salmon, Coho salmon, Sockeye salmon, Winter Steelhead, Coastal Cutthroat trout, and Kokanee salmon. In addition, Coho salmon and resident Coastal Cutthroat trout are documented in the unnamed stream. These species are considered priority species by the WDFW.

The PHS maps identify tailed frog (*Ascaphus truei*) tadpoles approximately ¹/₄ mile outside of the project area in a tributary to Issaquah Creek. Tailed frogs are listed as a statemonitored species and federal species of concern.

Washington State Department of Natural Resources (DNR) Natural Heritage Information System Database. No records for rare plant or high quality ecosystems were identified in the project area.

DNR Forest Practices Website. Issaquah Creek is mapped as a Type S water (both mini-basins). Eight tributaries to Issaquah Creek, classified as Type F and/or Type N waters, were mapped in ISS003. Three of these streams were not observed during our site reconnaissance and are either located in underground pipes or do not exist.

King County Critical Areas Map. Issaquah Creek is mapped as a Class 2 Salmonid stream (both mini-basins). Four unclassified tributaries to Issaquah Creek are mapped in mini-basin ISS003. No wetlands were mapped in the project area. No portion of the King County Wildlife Network is mapped in the project area.

King County Soil Survey. Soils in the project area were mapped in the King County Soil Survey as Kitsap silt loam, Alderwood gravelly sandy loam, Briscot silt loam, Beausite gravelly sandy loam, and Everett gravelly sandy loam. The Briscot silt loam soil series is considered hydric.

AppendixA_EnvironmentalReport.doc/wp/r

City of Issaquah Stream Inventory and Habitat Evaluation Report. Issaquah Creek is rated as a Class 1 stream (both mini-basins). Seven smaller streams in the project area are mapped as Class 2, Class 2 with salmonids, or Class 3 streams in mini-basin ISS003. Two additional streams are shown in mini-basin ISS003 but are not rated.

Four wetlands associated with Issaquah Creek, designated as IC-10, IC-11, IC-12, and IC-13, are mapped in mini-basin ISS003. IC-10 is shown as comprising two open-water wetlands associated with fish hatchery ponds. IC-11 and IC-12 are shown as small (approximately 0.1 acre), forested wetlands along Issaquah Creek. IC-13 is shown as a 59.8-acre wetland located along Issaquah Creek south of SW Clark Street, containing forested, scrub/shrub, emergent, and open-water elements. A 0.4-acre, forested wetland, identified as IC-9, is shown immediately north of mini-basin ISS004.

Fall Chinook salmon, Coho salmon, Sockeye salmon, winter steelhead, coastal cutthroat trout, and Kokanee salmon are reported in Issaquah Creek (both mini-basins). Cutthroat trout presence is reported in two other streams in mini-basin ISS003.

1.2.2 Site Reconnaissance

A reconnaissance of the project area was conducted on March 4, 2008. The project area is largely comprised of single- and multi-family homes with some commercial properties and community facilities along Newport Way NW and Newport Way SW, and occasional undeveloped lots.

Issaquah Creek was observed running north along the eastern boundary of both minibasins. Twelve tributary streams, identified as Streams 1 through 12, were also observed in mini-basin ISS003 (Figure 2).

Several wetlands were observed in mini-basin ISS003. Forested riparian wetlands associated with Issaquah Creek were present south of Newport Way SW. North of Newport Way SW, the Issaquah Creek channel is incised and constricted by development. Riparian scrub/shrub wetlands were also observed associated with Streams 5, 11, and 12. In mini-basin ISS004, two culverts were observed to drain to a utility easement. Although the entire length of the easement was not walked, drainage patterns and the presence of hydrophytic vegetation indicated that a slope wetland is present along this easement.

Immediately north of mini-basin ISS004, a forested/scrub/shrub wetland was observed near the convergence of the east fork of Issaquah Creek and Issaquah Creek.

Two man-made depressions were observed in mini-basin ISS003, west of Sunrise Place SW and 1st Place SW. These depressions contained hydrophytic vegetation, but they are most likely storm ponds and not regulated as wetlands.

No raptors, raptor nests, or other priority habitats were observed during the site reconnaissance.

1.2.3 Conclusions

Wetlands and Wildlife. Wetlands were observed in mini-basin ISS003 along Issaquah Creek and in association with three other streams. One additional wetland was observed along a sloped utility easement in mini-basin ISS004. Wetlands were not categorized, but general buffer requirements are provided below. Both King County and the City of Issaquah wetland buffer width requirements depend on wetland classification based on the adopted Washington State Wetland Rating System for Western Washington, Ecology Publication Number 04-06-025, published August 2004. Issaquah's municipal code requires that wetland buffer widths range from 40 to 225 feet.

WDFW's PHS map shows priority fish presence in Issaquah Creek (both mini-basins) and Stream 5 (mini-basin ISS003). No other priority species were indicated by our document review or observed during site reconnaissance in the project area. Based on our review of Issaquah's municipal code, Issaquah does not have specific regulations regarding wildlife habitat conservation areas.

Streams. Issaquah Creek is located in both Issaquah mini-basins. Twelve additional streams, all tributaries to Issaquah Creek, were observed in mini-basin ISS003 (Figure 2). The City of Issaquah's stream classification system is primarily based on salmonid presence and seasonal flow. In accordance with Chapter 90.58 Revised Code of Washington (RCW), shorelines of the state are considered Class 1 streams under the City of Issaquah code. Streams used by salmonids are rated as Class 2 with Salmonid (2S) streams. Perennial streams without salmonids are rated as Class 2 streams. Intermittent or ephemeral streams without salmonids are Class 3 streams. Class 4 streams are those constructed or channelized, intermittent, without

salmonids or salmonid habitat, and not directly connected to a higher-class stream through an aboveground channel.

Issaquah Creek is identified as a "shoreline of the state," pursuant to Chapter 90.58 RCW, and is therefore regulated by the City of Issaquah as a Class 1 stream. Streams 1 (below Newport Way SW), 4, 5, 7 (below 1st Place SW), and 8 (below Sunrise Place SW) are likely regulated as Class 2S streams, as they appear to have sufficient flow and channel characteristics for salmonid presence and do not likely contain significant barriers to fish passage. However, identification of fish passage barriers was not part of our scope of work. Streams 1 (above Mountain Park Boulevard SW), 2, 7 (above 1st Place SW), and 8 (above Sunrise Place SW) are likely regulated as Class 2 streams, as they appear to be perennial and likely contain significant fish barriers. Streams 3, 6, 11, and 12 are likely regulated as Class 3 streams, as they are intermittent and likely do not contain salmonids because of insufficient flow, steep slopes, and fish passage barriers (roads). Streams 9 and 10 are likely regulated as Class 4 streams, as they have highly disturbed/created channels and are intermittent, and they appear to discharge to underground pipes below a residential development.

Issaquah's buffer width requirements are 100 feet for Class 1 and Class 2S streams, 75 feet for Class 2 streams, 50 feet for Class 3 streams, and 25 feet for Class 4 streams. Table 2 contains site stream classifications and standard buffer widths.

1.3 Landslide and Erosion Research

1.3.1 Geologic Conditions

Nearly the entire Issaquah study area is situated at the lower portions of the east-facing slope of Squak Mountain west of the Issaquah city center. Relatively flat topography of the Issaquah Creek alluvial plain characterizes the eastern portion of the project area. Several east-oriented tributary drainages to Issaquah Creek, separated by several prominent, steep-sided ridges, characterize the project area topography. In general, slope inclinations on the ridges range from 15 to 60 percent, while the slopes within the ravines range from 65 to steeper than 100 percent.

		City of Issaquah	
Stream	Mini-Basin	Classifications	Buffer Width (feet)
Issaquah Creek	ISS003 and ISS004	1	100
Stream 1 (above Mountain Park Boulevard SW)	ISS003	2	75
Stream 1 (below Newport Way SW)	ISS003	28	100
Stream 2	ISS003	2	75
Stream 3	ISS003	3	50
Stream 4	ISS003	28	100
Stream 5	ISS003	2S	100
Stream 6	ISS003	3	50
Stream 7 (above 1st Place SW)	ISS003	2	75
Stream 7 (below 1st Place SW)	ISS003	2S	100
Stream 8 (above Sunrise Place SW)	ISS003	2	75
Stream 8 (below Sunrise Place SW)	ISS003	28	100
Stream 9	ISS003	4	25
Stream 10	ISS003	4	25
Stream 11	ISS003	3	50
Stream 12	ISS003	3	50

 TABLE 2

 ISSAQUAH STREAM CLASSIFICATIONS AND BUFFER WIDTHS

The Issaquah study area is underlain by Pleistocene glacial soils and Tertiary bedrock, according to published geologic maps (Booth et al., 2006b). The glacial soils in the project area consist of Vashon recessional deposits, till, advance outwash, and older, pre-Vashon, fine-grained clay and silt. Vashon recessional deposits, though deposited by glacial processes during the last (Vashon) glacial episode, were deposited during the wasting of the glacial ice and were not overridden by the Vashon ice sheet. The glacial recessional deposits may contain interbedded glaciofluvial sand and gravel, glaciolacustrine silt and clay, and/or ablation till. Glacially consolidated soils consisting of Vashon till and Vashon advance outwash mantle most of the slope in the northern portion of the project area. Vashon till is a very dense, gray, gravelly, silty sand of glacial origin that is commonly referred to as "hardpan." Older,

pre-Vashon, fine-grained deposits of silt and clay underlie the advance outwash sand and gravel near the toe of the east-facing slope at the northern and southern portions of the project area.

West of the study area, and in the upper elevations to the south, bedrock of the Renton and Tukwila Formations forms the topographically high knobs and steep slopes. The Renton Formation conformably overlies the Tukwila Formation and includes the Renton coal measures, which were extensively mined throughout much of the Newcastle Hills in Renton and Issaquah in the late 19th and early 20th centuries. Most of the Renton Formation consists of fine- to medium-grained arkosic sandstone with siltstone, shale and coal seams. The Tukwila Formation is composed of silty sandstone and sandy siltstone with interbeds of andesitic lava flows (Walsh, 1984). The Renton or Tukwila Formations may also underlie glacial soils at shallow depths where the two units are mapped close to each other.

Soils within the relatively flat floodplain of Issaquah Creek in the eastern portion of minibasin ISS004 include fill soils overlying Holocene alluvium consisting of interbedded silt, fine sand, and gravel. Existing subsurface information reviewed for this study indicates groundwater depths as shallow as 4 feet below ground surface (bgs).

Holocene mass wastage soils (colluvium and/or landslide deposits) are mapped at the southern end of the project area along the toe of the east-facing slope. The mass-wastage deposits are found directly downslope of the contact between the advance outwash sand and gravel and the underlying pre-Vashon silt and clay deposit. Although not mapped in the vicinity of W Sunset Way, mass-wastage deposits are also likely to exist where sand and gravel overlies clay and silt.

Intensive underground coal mining in the late 19th and early 20th centuries occurred in the southern portion of the project area, in the vicinity of Wildwood Boulevard SW. Coal mine-related subsidence features have been documented in several geotechnical engineering reports reviewed for this project, as well as in historical newspaper articles. Historically, many of the collapse features were backfilled with various available materials including old cars, stumps, refuse, tires, mine spoil, and boulders. Additionally, several shafts, portals, and gangways (including drainage tunnels) exist in the Wildwood Boulevard SW vicinity. Elsewhere in the project area, many of the steep slopes have been modified by residential housing construction, street grading, and park development. The following sections describe the observations made during reconnaissance of each of the Issaquah mini-basins.

Mini-basin ISS003. West of SW Mount Baker Drive, 60 to 100 percent slopes bound a bowl area with wet ground, seepage, and evidence of soil creep. The head of the bowl is due west of Mount Defiance Circle SW. Trees within the bowl are mostly deciduous, with scattered cedars. Several leaning/tilting trees and trees with bowed trunks were observed within the bowl area.

South of the bowl area described above, the Mount Defiance Circle SW area is developed with residential housing terraced into the east-facing slope. Fill and cut slopes range in inclinations between 75 and 100 percent. Minor seepage was observed along the shoulder of a newly paved utility easement. No evidence of instability was observed in this area. Bounding the southern side of the Mount Defiance Circle SW area and outside the mini-basin is an east-flowing tributary drainage with 75 to 85 percent slopes exhibiting signs of shallow colluvial sloughing and soil creep.

South of the intersection of Newport Way SW and Wildwood Boulevard SW, the ground surface topography exhibits signs of modification, including fills and excavations related to historical mining activity and relatively recent residential and commercial development. Existing subsurface information reviewed for this project reveals the presence of mine spoils throughout the southern portion of the mini-basin.

In general, the ground surface of the mini-basin area adjacent to Issaquah Creek is inclined to the east at 15 to 30 percent. Steep, 55 to 75 percent fill slopes are present adjacent to relatively recent residential developments located between Sunrise Place West and Issaquah Creek. Instability in the form of soil creep and slumping was observed along the trail within the utility easement adjacent to Issaquah Creek. Based on soils observed within the open ditchline at the toe of the slope and on the slope surface, the instability appears to be mobilizing Wildwood Boulevard SW fill soils, mine spoils, and colluvium. Abundant seepage emerges from the slope toe, and drainage water flows from pipes adjacent to the trail. Some of the drainage water was iron-oxide stained and had a sulfur odor, which could be related to former mining activity. Slope instability related to unmapped, buried drainage tunnels along Wildwood Boulevard SW was noted in the existing geotechnical literature.

The utility easement located south of the Sunrise Place SW cul-de-sac crosses at least two east-flowing tributaries to Issaquah Creek. Culverts associated with the stream crossings appear

to have been improved recently (in 2008), and erosional evidence on and downslope of the trail indicate that the culverts may have been previously overtopped and/or plugged.

Mini-basin ISS004. Abundant seepage and slopes inclined between 50 and 70 percent exist in a bowl-shaped area east of Sunset Court NW. Standing water was observed in the utility easement extending between W Sunset Way and the head of the bowl to the north. Several bowed and/or tilting alder and cedar trees were observed within the axis of the bowl. The 65 to 75 percent, east-facing, undeveloped slope continues north of the bowl area, subparallel to Newport Way NW, and outside of the mini-basin.

Modified ground related to residential development exists along Dorado and Capella Drives NW, and little evidence of slope instability was observed in this area during our visits. However, seepage was noted issuing from the sidewalk areas at the intersection of Dorado and Capella Drives NW. Upslope of the intersection, wet ground and abundant seepage exists within an east-facing bowl off the dead end of Almak Court NW. The surface water from this bowl appears to be contributing to the seepage noted downslope along the sidewalks of Capella and Dorado Drives NW.

A back-tilted 36-inch-diameter fir tree is located within the axis of a subtle, northwestfacing swale between the dead end of Big Bear Court NW and W Sunset Way. Abundant seepage and associated wet ground were observed in this area during our visit. Other than the back-tilted fir tree, no other signs of instability were noted in the field. To the west, existing geotechnical literature notes the presence of potential instability around the existing municipal water tanks where landslide debris was encountered over pervious sand and gravel interbedded with silt and clay.

A minor amount of seepage exists along Big Bear Place NW, specifically at the intersection with W Sunset Way where water was observed seeping from around an existing drain inlet. The ground surface in the vicinity of Big Bear Place NW and areas to the east, including Aires Place NW, Mount Olympus Drive NW, and Mount Pilchuck Avenue SW, is modified with housing developments, and little to no indicators of slope instability were observed in the area.

Documented slope instability related to residential construction along Mount Quay Drive NW, near the western boundary of the mini-basin, was noted in the existing geotechnical literature. Seepage was observed at the dead ends of Mount Rainier and Mount Si Places NW, upslope of the landslide area. Subsurface explorations performed for the mitigation of the instability indicate fill soils over a thin veneer of older landslide debris overlying glacial till.

1.3.2 Presence or Proximity to Mapped Geologic Hazards

The entire Issaquah project area is situated within the Issaquah city limits. The City of Issaquah does not currently have citywide critical areas maps. However, based on the definitions in the City of Issaquah Critical Areas Regulations, landslide hazards exist in most of the project area below elevation 400 feet for one of three main conditions:

- ► Slopes greater than 40 percent.
- Areas with a combination of:
 - Slopes greater than 15 percent
 - Impermeable soils (typically silt and clay) frequently interbedded with granular soils (predominantly sand and gravel)
 - Springs or groundwater seepage
- Areas exhibiting evidence of movement during the Holocene epoch (from 10,000 years ago to present) or underlain by mass-wastage deposits.

Erosion hazard areas regulated by the City of Issaquah consist of those areas mapped by the National Resource Conservation Service (NRCS, formerly the U.S. Department of Agriculture Soil Conservation Service) as having a "severe" or "very severe" erosion hazard. Soils exhibiting a severe or very severe erosion hazard within the project area include:

- ► Alderwood gravelly sandy loam, 15 to 30 percent slopes
- ► Beausite gravelly sandy loam, 15 to 30 percent slopes
- Kitsap silt loam, 15 to 30 percent slopes

Based on the NRCS soils map of the project area, erosion hazards exist along portions of Sunrise Place SE, Mount Quay Drive SW, the steep east-facing slope west of Newport Way NW, and in the vicinity of Mount Defiance Circle SW.

Steep slope hazard areas, as defined by slopes of 40 percent or greater, are also not mapped and are ubiquitous throughout the Issaquah project area.

Based on City of Issaquah Critical Areas definitions, reviewed geotechnical information, and King County Sensitive Areas maps, the entire Issaquah project area south of Mountain Park

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Boulevard SW is classified as a coal mine hazard area. General topographic observations made during our field reconnaissance are consistent with the mapped coal mine hazard.

No seismic hazard areas are indicated on the King County Sensitive Areas maps within the Issaquah project area. However, considering that the City of Issaquah defines seismic hazard areas as those areas underlain by cohesionless soils of low density with a high groundwater table, portions of the project area situated within the Issaquah Creek alluvial plain could be considered seismically hazardous.

1.3.3 Conclusions

The potential for inducing landsliding or erosion in most of the Issaquah project area by reducing I&I is low to negligible. However, in some areas previously and subsequently discussed, and illustrated in Figure 3, the potential is moderate to high, if I&I is currently being directed into sewer lines in these zones:

- The bowl area located north and east of W Sunset Way, in the vicinity of Sunset Court NW (ISS004, Area 1).
- The bowl area between the Almak Court NW and Dorado Drive NW dead ends (ISS004, Area 2).
- ► The Mount Quay Drive NW area of historical instability (ISS004, Area 3).
- The bowl area between Mount Defiance Circle NW and SW Mount Baker Drive (ISS003 and ISS004, Area 4).
- The area east of Wildwood Boulevard SW between SW Clark Street and Sunrise Place SW (ISS003, Area 5).

Improvements to reduce I&I could cause the groundwater levels to rise, thereby increasing the risk of landslides. While we understand that the pipe-bursting method proposed for this project greatly reduces the amount of ground disturbance relative to trenching, the ground surface around maintenance holes located in steep, undeveloped ROW could be disturbed and may engender erosion in the erosion hazard areas, if Best Management Practices (BMPs) are not followed during construction.

Based on our review of the maps, we understand that all of the utility components included in this project area lie within the City of Issaquah; therefore, City of Issaquah development standards apply to the planned improvements.

The City of Issaquah Critical Areas Regulations require a 50-foot setback from steep slopes (greater than 40 percent) or from all edges of identified landslide hazard areas. An additional 15-foot setback from the 50-foot buffer is required for structures. Exemptions from the setback requirement may be granted if studies by a licensed geologist or geotechnical engineer indicate that the landslide hazard could be mitigated or eliminated. On the other hand, the ordinance allows an exemption for normal and routine maintenance or repair of existing utility structures, if performed in compliance with permitting requirements.

1.4 Groundwater Systems Research

1.4.1 Groundwater Setting

Issaquah is located in the Issaquah Creek Valley groundwater management area (KCDNR, 1998). East of Newport Way NW, the Issaquah project area is located in a wellhead protection area (King County, 2007). In mini-basin ISS004, around Big Bear Place NW and Mount Fury Circle SW, the areas are mapped as having a medium susceptibility to groundwater contamination; this is in the general vicinity of the glacial advanced outwash deposits (King County, 2007).

The use and protection of groundwater in the Issaquah project area is governed by several local agencies. Drinking water is managed by the Cascade Water Alliance.

1.4.2 Physiographic Setting

The project area slopes downward, eastward to northeastward from a northwestsoutheast-trending ridge. In the parts of the project area farthest east, the topography is relatively flat. Elevations rise as high as 550 feet in the farthest western area, and drop to elevation 80 feet in the northeastern project area.

Mini-basin ISS004 consists of Fraser Glaciation and Vashon Stade deposits, mainly glacial till, with glacial advanced outwash deposits found in the north-central part of the project area (Booth, et al., 2006b). There is also evidence of ice contact deposits and pre-Vashon fine-grained deposits in the north-central section of the project area. The lowlands to the east, along Newport Way, are alluvium deposits (Booth, et al., 2006b). In mini-basin ISS003, in the vicinity of Mine Hill Road and Wildwood Boulevard SW, the geology consists of modified ground from coal-mining activities (Golder and Associates, Inc., 1989 and 1994). In the southern end of mini-basin ISS004, scattered mass-wasting deposits of colluvium are found along bases of the

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slope in residential, construction-altered terrain. Additional discussion of the geology can be found in the Geologic Conditions section (Section 2.3.1).

1.4.3 Site Reconnaissance

A drive-by reconnaissance of mini-basins ISS003 and ISS004 was conducted on February 29, 2008. In general, the project area is predominately single-family homes with yards. Multiple condominium and apartment developments have been constructed around the intersection of Newport Way NW and W Sunset Way in both mini-basins. Sidewalks border some arterial streets but are absent in cul-du-sacs. Multiple streams appear in the northern, eastern, and southern parts of the project area, some with wetlands scattered near streams. Additional discussion on streams and wetlands can be found in the Wetlands, Streams, and Wildlife Review section (Section 2.2) of the report. Ravines and landslide scarps are noted in the Geologic Conditions section (Section 2.3.1).

Stormwater catch-basin ditches with standing water were found in mini-basin ISS003 on Mt. Defiance Circle SW, SW Mt. Baker Drive, and Hillside Drive SE, indicating a potential impact on shallow groundwater through water infiltration.

Groundwater seeps were found in abundance in the northwestern end of mini-basin ISS004, off of W Sunset Way, Sunset Court NW, Big Bear Place NW, Capella Drive NW, El Dorado Drive NW, Almak Court NW, Mt. Rainer Place NW, and Mt. Si Place NW (Figure 4). Additional seeps were found off of Mount Park Boulevard SW and Mount Defiance Circle SW in mini-basin ISS003. Minor seeps located in the southern end of mini-basin ISS003 were found emerging from the slope along Hillside Drive SE. In our opinion, seeps are an indication of shallow or perched groundwater.

1.4.4 Groundwater Occurrence

Shallow groundwater, as indicated by numerous seeps, is frequent in mini-basin ISS004; these seeps are located in an area of coarse-grained, glacial advanced outwash deposits. Groundwater appears to be collecting in the glacial advanced outwash deposits and perching on underlying, finer-grained, pre-Vashon deposits. Where the fine-grained perching layer intersects the ground surface, seeps could occur. In mini-basin ISS003, groundwater seeps are present in colluvium, again likely perching on a less pervious base layer.

From the NW Geomaps search, we identified geotechnical reports from multiple developments along the lowland eastern area of the mini-basins. From our review of these reports, we understand that test pits at 420 Newport Way NW encountered groundwater seepage between 4 and 10 feet bgs, and are likely a good representation of shallow groundwater conditions in the alluvial valley (AGRA Earth & Environment, Inc., 1996).

Mini-basin ISS003 contains areas of former mining activity. These include Mine Hill Road and east of Wildwood Boulevard SW, where groundwater seepage has been reported emerging from the hillside following a landslide, and groundwater was encountered in borings at 5 to 11.5 feet bgs (Golder Associates, Inc., 1989). Farther south in the former mining area, in the vicinity of Wildwood Boulevard SW and Sunrise Place SW, groundwater was encountered between 22 and 24 feet bgs (Golder Associates, Inc., 1994).

We reviewed our project files for the lower Issaquah Valley and identified a surficial aquifer approximately 10 to 80 feet bgs. The aquifer was also encountered in the City of Issaquah's explorations for a production well just east of Newport Way NW (Golder Associates, Inc., 2000).

1.4.5 Ecology Well Logs

Well records and drilling logs were collected from Ecology for the Issaquah mini-basins and immediate surrounding areas. Specific areas included Township 24 North, Range 6 East, Sections 28, 33 and 34, and Township 23 North, Range 6 East, Section 3. Well logs provide depth-to-water information for Table 3 in the following section.

1.4.6 Depth to Water

The depth to groundwater generally depends on the presence of perching layers in relation to the ground surface in the upland areas, and the presence of surface water bodies in the lowland areas.

Township, Range, Section	Location	Depth to Water	Date
24, 6E, 34 (east)	Front Street and Lewis Street SE	7	March 2005
24, 6E, 34 (east)	515 Front Street	3	November 2007
24, 6E, 28 (east)	30 W Sunset Way	8, 18.5, 24	1989, 1997, 1992
24, 6E, 28 (east)	19 1st Place NW	27	June 1992
24, 6E, 28 (east)	NW Dogwood Street and 1 st Place NW	15	November 1998
24, 6E, 28 (north)	730 NW Gilman Boulevard	5.5, 6, 7.5	February/April 2004
24, 6E, 28	(Not indicated)	125	October 1954

TABLE 3GROUNDWATER DEPTHS – ISSAQUAH PROJECT AREA

Note: The depth to groundwater in the project area was identified from Washington State Department of Ecology Well Records.

1.4.1 Water-level Fluctuations

No specific water-level fluctuation data were identified. However, based on experience in similar locations, groundwater perching on low-permeability soil would likely fluctuate seasonally, with less water present during the summer and fall and more water present during the winter and spring or following prolonged rainfall events.

Groundwater in the alluvium deposits would likely fluctuate seasonally in direct relationship to the elevation of Issaquah Creek.

1.4.2 Groundwater Flow Direction

In general, groundwater flows with topography to the northwest, flowing toward Lake Sammamish (KCDNR, 2005). Locally, the direction of groundwater flow could be influenced by variability in soil conditions, the presence of surface water, and subsurface structures, including utility trenches.

1.4.3 Conclusions

Alluvium deposits in the eastern part of the project area are most likely in hydraulic connection with Issaquah Creek, and significant amounts of groundwater could be encountered near Issaquah Creek. Excavation activities near Issaquah Creek could require construction dewatering to control groundwater inflow in test pit areas associated with pipe-bursting activities. In both mini-basins, pipe-bursting activity could cause groundwater pressures to rise

around the bursting head, making the saturated soils more fluid. In this area, construction methods used in pipe bursting should control soil brought by groundwater inflow between the burst and replacement pipes, to prevent locking of the pipes during installation.

In the northwestern part of mini-basin ISS004, groundwater seeps from the glacial advanced outwash deposits are seen entering storm drains, so a small amount of sewer flow is currently caused by infiltration. Groundwater could be present in significant amounts in these glacial advanced outwash deposits. Groundwater in the deposits might need to be controlled with dewatering activity around test pits associated with pipe-bursting activities. Construction methods should also control soil and groundwater inflow between pipes during construction.

In the mine-altered ground found in mini-basin ISS003, excavation activities could require limited to significant dewatering activities because of the variable nature of the backfill. The mining activity included drainage tunnels, indicating that groundwater is present in the area.

Small accumulations of groundwater could perch atop the glacial till or exist within coarse-grained lenses in till and ice-contact deposits. Groundwater in these areas could contribute seasonally to sewer infiltration but likely would not pose significant problems during excavation activities, and only limited construction dewatering could be necessary in the vicinity of the test pits.

Locally perched groundwater lenses are unlikely to provide a large portion of base flow to local streams.

With the Issaquah project area being located in a groundwater management area for both mini-basins, and with the presence of a wellhead protection area east of Newport Way NW for mini-basin IS004, coordination with local regulatory agencies could be necessary. King County and the City of Issaquah regulate the groundwater management area while the King County Department of Health is responsible for the wetland protection area. In both cases, notification is required for work in both areas and the use of BMPs may be required to protect groundwater resources.

2.0 BELLEVUE PROJECT AREA (MINI-BASINS BEL011, BEL012, BEL031, AND BEL032)

2.1 Hazardous Materials Research

2.1.1 Site Description

The Bellevue project area is located between Lake Washington and Lake Sammamish, and south of the I-90 corridor in King County. The project area consists of residential properties on north-facing hillsides that slope to the commercial area near the I-90 corridor in the northern part of mini-basin BEL012.

This study was conducted to evaluate if hazardous materials could be encountered during the proposed sewer upgrade project. The identified properties were ranked **low**, **moderate**, or **high**, based on the likelihood of contaminants to be present in the soil in the vicinity of the sewer line and manholes where excavation could occur. Properties with known groundwater and/or soil contamination located near or adjacent to the sewer are considered to have a **high** potential to contaminate the soil in the vicinity of the sewer line. Adjacent businesses, such as historical gas stations, historical automobile repair shops, dry cleaners, print shops, paint shops, and photo shops where there are no known releases are considered to have a **moderate** potential to contaminate the soil. These types of businesses have commonly released contaminants into the soil and/or groundwater; however, where no evidence of a release has been observed or documented, the risk of contamination is considered to have a **moderate** potential. Properties adjacent to sewer lines where reported petroleum or chemical spills of significant or unreported size have reached the soil are also considered to have a **moderate** potential to impact the project area.

Businesses, including gas stations and automobile repair shops developed since approximately 1988; construction companies with no known USTs; and residences with heating oil tanks are considered to have a **low** potential to impact the project area. Newer gas stations are considered to have a **low** contamination potential because of the implementation of stringent regulations for UST construction, system installation, monitoring, and testing. Although construction companies frequently have USTs, such companies are considered to pose a **low** potential for contamination where the presence of USTs has not been confirmed. Properties with heating oil tanks are considered to have a **low** potential because heating oil generally does not travel far in soil. The locations of the identified properties that have a potential to impact to soil in the vicinity of the sewer line are indicated in Figure 5.

2.1.2 Document Review

Local, State, and Federal Environmental Databases. EDR was subcontracted to conduct a search of available agency databases for sites within distances recommended by ASTM for Phase 1 Environmental Site Assessments. The search included EPA, Ecology, Tribal, and local databases for known and suspected contaminated sites.

Eleven properties within the project area and one Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) No Further Remedial Action Planned (NFRAP) site within one mile of the project area boundary were identified as being on one or more of the following databases: Spills, LUST, UST, ICR, Resource Conservation and Recovery Act (RCRA) Small Quantity Generator (SQG), Confirmed and Suspected Contaminated Sites List (CSCSL) No Further Action (NFA), Volunteer Cleanup Program (VCP) and FINDS. The CERCLIS-NFRAP site (former Eastgate Landfill) was also on the CSCSL and Institutional Control Site List databases.

These listed sites are shown in Figure 5 and are summarized below:

- Tosco Corporation Site 2564273, 15220 SE 36th Place, Bellevue (CSCSL NFA, VCP, ICR, FINDS, RCRA-SQG). The database information indicates that petroleum-contaminated soil was observed during the removal of three USTs in 1998. Following remediation, Ecology issued a NFA status (5/12/2005). Site soil has been remediated and groundwater was reportedly not affected. Therefore, the site is evaluated to have a low potential to impact the project area.
- Eastgate Plaza 24 Hour Custom Cleaner, 15100 SE 38th Street, Bellevue (FINDS, RCRA, Inactive Drycleaner). The drycleaner in the Eastgate Plaza shopping center is listed on databases that indicate hazardous chemicals are or were stored on site. A gas station is also located on this property but is not considered a risk to the project because it is located 1,000 feet to the east. Although the dry cleaner is not listed on a database that would indicate that a release of hazardous materials has occurred, the property is still considered to have a moderate potential to impact the project area because dry cleaning fluids (solvents) are highly toxic at low concentrations.
- Seattle Public Utilities (SPU) Eastside Reservoir, 4404 146th Avenue SE, Bellevue (FINDS). Ecology's information indicates that the facility stores hazardous chemicals and reports annually for emergency preparedness planning. Inclusion on this database does not indicate that a release of hazardous materials has occurred. Therefore, this site is considered to have a **low** potential to impact soil in the project area.
- South Bellevue Community Center, 14509 SE Newport Way, Bellevue (Spills). The spill incident report indicates that 60 gallons of diesel fuel spilled to soil in March 2005.

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-basin BEL032. It

w potential to impact the project area, because the spill report indicates that soil was impacted.

- Hewlett-Packard Company, 15815 SE 37th Street, Bellevue (UST, RCRA-SQG, CSCSL NFA, VCP, ICR, FINDS). The database information indicates that five USTs were removed from the site. Petroleum products and metals-impacted soil and groundwater were observed during UST removal. Following remediation, Ecology issued a NFA status (4/27/2000). Site soil and groundwater have reportedly been remediated; however, the site is evaluated to have a moderate potential to impact the project area.
- Hotel, 15805 SE 37th Street, Bellevue (Spills). The Spills report indicates that an unspecified quantity of oil spilled on the paved roadway in July 2001. Based on the material spilled and no indication that soil was impacted, the site is evaluated to have a low potential to impact the project area.
- ► Washington Environmental Pro T, 4017 162nd Avenue SE, Bellevue (RCRA-SQG, FINDS). The RCRA database information indicates that no violations were found. Inclusion on the RCRA database does not indicate that a release of hazardous materials has occurred. Therefore, the site is considered to have a low potential to impact the project area.
- Comcast Cable Communications Bellevue, 3622 156th Avenue SE, Bellevue (FINDS). Ecology's information indicates that the facility stores hazardous chemicals and reports annually for emergency preparedness planning. Inclusion on this database does not indicate that a release of hazardous materials has occurred. Therefore, this site is considered to have a low potential to impact the project area.
- ► Arrow Lumber, 16343 SE 40th Street, Bellevue (Spills). The Spills report indicates that two quarts of hydraulic oil spilled on a paved roadway in July 2002. Based on the material spilled and no indication that soil was impacted, the site is evaluated to have a low potential to impact the project area.
- ► **5101 145th Place SE, Bellevue (Spills).** The Spills report indicates that 20 gallons of a petroleum product spilled on a paved roadway in January 2000. Although the site is located adjacent to a sewer line, it is considered to have a **low** potential to impact the project area because the spill report does not indicate that soil was impacted, and the site is not on other databases that would indicate that contamination is present.
- Theil Collins residence, 5215 146th Avenue SE, Bellevue (CSCSL NFA, VCP, FINDS). Ecology's database information indicates that this site was granted NFA status on December 29, 2004, following remediation. The site is located just outside of the project area, and not in proximity to sewer lines scheduled for work. Based on the site's cleaned-up status and its location, it is considered to have a low potential to impact the project area.

The former Eastgate Landfill site (2805 160th Avenue SE) is located approximately onehalf mile north of the closest project boundary. The database information indicates that groundwater is known to have been impacted by non-halogenated solvents, priority pollutant metals/cyanide, and conventional organic and inorganic contaminants. These and other contaminants are suspected in surface water and soil. Remedial action is in progress, and a restrictive covenant has been filed limiting property, soil, and groundwater use. Based on the site's distance and location downgradient relative to the project area, this site is not considered a risk to the project area.

Other sites listed outside of the project area were not considered a potential environmental concern because of the type of database listing and/or relative distance from the project area.

Polk and Cole's City Directories. Polk city directories were reviewed at the Seattle Public Library for the years 1964 – 1965, 1970, 1975, 1980 and 1985. Cole's city directories were reviewed at the Seattle Public Library for the years 1990 – 1991, 1994 – 1995, 2000, and 2005.

The majority of the listings were residential but also included schools, churches, daycares, and a reservoir. These non-residential properties are not considered an environmental concern with the exception of the reservoir, which is of low concern and is discussed in the Local, State, and Federal Environmental Databases section (Section 2.1.2).

Other residential addresses that currently or previously were listed as home businesses include construction/contractors; carpet cleaning, landscaping, painting, and handyman services; roofing; stained glass production; and a photographer. Based on the limited area of the listed home businesses, database searches for USTs, and visual observations of the properties during our site reconnaissance, it is unlikely that subsurface soils are contaminated above regulatory cleanup levels.

At 4642 159th Avenue SE, a property was listed as a business called Brake Stop in the 1994 directory listing; however, the property is not listed in our UST search and is located on a residential parcel. This property is not considered a risk to the project because the brake shop was listed for only one year, and it is unlikely that a brake repair shop was actually located on this residential property.
Commercial properties are present on SE 37th Street, and on 156th Avenue SE. Schuck's Auto Supply (15303 SE 37th Street) and the Department of Motor Vehicles (DMV) Vehicle Emissions Testing facility (15313 SE 37th Street) are the only property uses of concern; however, the Hewlett-Packard Company, Comcast Cable Communications Bellevue, and Bellevue Studio Hotel are properties of concern because of their listings on Local, State, and/or Federal Environmental Databases section (Section 2.1.2).

Sanborn Fire Insurance Maps. Sanborn Fire Insurance Maps were not available for the project area.

King County Assessor Records. Current tax assessor records were reviewed online at the King County iMap website. Tax assessor information prior to 1970 for this project was reviewed at the Puget Sound Regional Archives. The parcels in the project area were generally listed as residences, of which 56 currently or historically used heating oil (Figure 5). Heating oil has generally low mobility when it has been released to subsurface soils. As a result, contamination, if any, is usually not widespread. Other properties of concern include Schuck's Auto Supply (built in 1975); the DMV vehicle emissions testing facility, listed as a service garage and built in 1982; and the drycleaners located at the Eastgate Plaza shopping center, built in 1972.

2.1.3 Site Reconnaissance

A visual reconnaissance of the project area was conducted on March 3, 2008. In general, the project area is predominantly comprised of single-family homes. Commercial properties are located on the northern section of the project area, along SE 37th Street and 156th Avenue SE. Commercial properties of concern that were identified in the project area during our site reconnaissance included:

- Schuck's Auto Supply, located at 15303 SE 37th Street. Auto supply shops typically store used motor oil in drums, which are then picked up by a waste disposal company.
- 76 Gas Station, located at 15220 SE 37th Street (referred to as Tosco Corporation Site 2564273 in Section 2.1.2.

2.1.4 Conclusions

The potential for impact to the sewer line from contaminated sites was evaluated based on the type of business, the proximity of the parcel to the sewer line, and the known or suspected presence of contaminants. In areas where the water table is at or above the sewer pipe elevation, the sewer trench backfill could be serving as a hydraulic conduit for contaminated groundwater migration. In such cases, it is possible that groundwater could carry contamination for considerable distances downgradient along the sewer line corridor. In addition, excavation and dewatering practices used during sewer line repair activities could create or modify contaminant migration pathways and/or distribution. However, this is unlikely because of the limited excavation and dewatering anticipated for this project.

The toxicity and cost of remediating contaminated soil that could be encountered during sewer line improvements varies depending on the type of contaminant. For example, drycleaning solvents are highly toxic at low concentrations, and remediation costs are typically very high. Other solvent contaminants resulting from businesses such as photo processing or printing shops may be less toxic than dry-cleaning solvents but can also result in high remediation costs. Soils contaminated with gasoline-range petroleum hydrocarbons generally have a lower toxicity and a lower disposal cost than soils contaminated with solvents, depending on the age of the gasoline. A more recent gasoline spill has more benzene, its most toxic component. The more benzene present in the soil, the higher the remediation costs. Older gasoline tends to be less toxic and somewhat less expensive to remediate. Diesel- and oil-range petroleum hydrocarbons are the least toxic and least mobile petroleum contaminants and typically have the lowest cleanup costs. Metal contaminants could result in high remediation costs, but unlike the organic contaminants listed above, they do not easily absorb through the skin and have a relatively low health risk unless ingested.

Potential properties of concern are shown in Figure 5. Based on the environmental review, historical review, and the site reconnaissance, the potential for impact from contaminants to the improvement of the sewer system appears to be **low to moderate** within the Bellevue project area, as summarized in Table 4.

We recommend that construction monitoring be performed in areas of low risk, such as where USTs and/or fill material are suspected. If contamination is identified, it would then be necessary to provide appropriate health and safety measures to protect site workers and to analyze the soil for proper disposal. Hazardous household materials such as cleaners, paints, and solvents are often disposed of in the sanitary sewer system from residences and businesses such as paint shops, printers, and photo developers. These materials could leak into the soil through

sewer line joints. Also, sediments should be removed from manholes prior to work within the manhole to reduce the risk of exposure to hazardous materials for site workers.

Property	Location	Contaminant Potential	Contaminant(s) of Concern	
BEL011				
Residence with heating oil	4522 154 th Place SE	Low	Petroleum products	
BEL012				
Residences with heating oil	Various (Figure 5)	Low	Petroleum products	
Hotel	15805 SE 37 th Street	Low	Petroleum products	
Washington Environmental Pro T	4017 162 nd Avenue SE	Low	Unknown	
Comcast Cable Communications Bellevue	3622 156 th Avenue SE	Low	Unknown	
Arrow Lumber	16343 SE 40 th Street	Low	Petroleum products	
76 Gasoline Station/ Tosco Corporation Site 2564273	15220 SE 37 th Street	Low	Petroleum products	
Schuck's Auto Supply	15303 SE 37 th Street	Low	Petroleum products	
Hewlett-Packard Company	15815 SE 37 th Street	Moderate	Petroleum products, metals	
Eastgate Plaza Custom Cleaner	15220 SE 38 th Place	Moderate	Solvents	
BEL031				
Residences with heating oil	Various (Figure 5)	Low	Petroleum products	
5101 145 th Place SE	5101 145 th Place SE	Low	Petroleum products	
Theil Collins Residence	5215 146 th Avenue SE	Low	Petroleum products	
BEL032				
Residences with heating oil	Various (Figure 5)	Low	Petroleum products	
SPU Eastside Reservoir	4404 146 th Avenue SE	Low	Unknown	
South Bellevue Community Center	14509 SE Newport Way	Low	Petroleum products	

TABLE 4BELLEVUE PROPERTIES OF CONCERN

Based on the potential health risks associated with contaminated soil and groundwater, we recommend that earthwork be avoided in the vicinity of the Hewlett-Packard Company site and the Eastgate Plaza Custom Cleaner site. If earthwork cannot be avoided, we recommend that

a Phase II Environmental Site Assessment be performed prior to earthwork activities to determine if contamination is present, and to analyze the soil and/or groundwater for health and safety measures and proper disposal. Because these two listed properties are not expected to be acquired by King County, the Phase II explorations should be confined to soil and/or groundwater sampling in the sewer line easement adjacent to the sites. Sampling could be conducted with a Geoprobe[®] at intervals to the approximate depth of the sewer line. Soil samples should be analyzed for petroleum products and metals in the vicinity of the Hewlett-Packard Company site and solvents in the vicinity of the Eastgate Plaza Custom Cleaner site.

2.2 Wetlands, Streams, and Wildlife Review

2.2.1 Document Review

WDFW Priority Habitats and Species Map. Three priority habitats were mapped in the north portion of mini-basin BEL032. Two of these priority habitats, associated with Eastgate Park, are designated as urban natural open space. The third priority habitat, containing two steep, wooded, riparian ravines that extend south from Eastgate Park, is designated as a riparian zone.

No priority species were mapped in the project area.

DNR Natural Heritage Information System Database. No records for rare plant or high quality ecosystems were identified in the project area.

DNR Forest Practices Application Review System. Four streams are mapped in the project area. Sunset Creek (mini-basin BEL032) and Vasa Creek (in min-basin BEL012, and also known as Squibbs Creek) are mapped as type F (fish-bearing) waters. A tributary to Vasa Creek (mini-basins BEL011 and BEL012) and an unnamed stream (mini-basin BEL012) in the eastern project area are mapped as type N (non-fish-bearing) waters.

King County Critical Areas Map. Four unclassified streams are mapped in the project area: Sunset Creek (mini-basin BEL032), Vasa Creek (mini-basin BEL012), the east tributary to Vasa Creek (mini-basins BEL011 and BEL012), and an unnamed stream (mini-basin BEL012) that crosses SE 43rd Street southeast of 164th Way SE. Vasa Creek and the unnamed stream are tributaries to Lake Sammamish. Sunset Creek flows north to Richards Creek. North of the project area and downstream of I-90, Vasa Creek and Sunset Creek are mapped as Class 2

Salmonid streams. No wetlands are mapped in the project area. No portion of the King County Wildlife Network is mapped in the project area.

King County Soil Survey. Soils in the project area are mapped in the King County Soil Survey as Alderwood gravelly sandy loam, beausite gravelly sandy loam, Everett gravelly sandy loams, "Alderwood and Kitsap soils, very steep," "Arents, Alderwood material," "Arents, Everett material," and "Pits." None of these soil series is considered hydric.

2.2.2 Site Reconnaissance

A visual reconnaissance of the project area was conducted on March 3 and 4, 2008. The site is predominantly comprised of single-family homes, although some commercial properties are located along SE 37th Street.

Four streams were observed in the project area: Vasa Creek (mini-basin BEL012), the east tributary of Vasa Creek (mini-basins BEL011 and BEL012), Sunset Creek (mini-basin BEL032), and an unnamed stream (mini-basin BEL012). The unnamed stream is located in the eastern portion of the project area and crosses SE 43rd Street southeast of 164th Way SE. These streams are identified as Stream 1 (Vasa Creek), Stream 2 (unnamed stream), Stream 3 (eastern tributary of Vasa Creek), and Stream 4 (Sunset Creek) in Figure 6.

Six wetlands, identified as wetlands A, B, C, D, E, and F, were observed in the project area. Wetlands A, B, and D are located in mini-basin BEL012. The remaining wetlands are located in mini-basins BEL011 (Wetland C), BEL031 (Wetlands E and F), and BEL032 (Wetland F). Wetlands A, B, and C are forested/scrub/shrub riparian systems associated with site streams. Wetlands D, E, and F are palustrine forested/scrub/shrub systems. Wetland F is likely a stormwater detention pond and may not be subject to wetland regulations.

The urban, natural, open-space priority habitats mapped by WDFW and associated with Eastgate Park were observed to include steep forested slopes, a public utility facility, and South Bellevue Community Center. The riparian-corridor priority habitat mapped by WDFW was observed to include a steep, riparian ravine conveying Sunset Creek located southeast of Eastgate Park and a steep, forested slope located southwest of Eastgate Park. No raptors, raptor nests, or other priority habitats were observed during the site reconnaissance.

2.2.3 Conclusions

Wetlands and Wildlife. Six wetlands were observed in the project area: Wetlands A, B, and D (mini-basin BEL012), Wetland C (mini-basin BEL011), Wetland E (mini-basin BEL031), and Wetland F (mini-basins BEL031 and BEL032). See Figure 6 for wetland locations. Wetlands were not categorized, but general buffer requirements are discussed below. Both King County and the City of Bellevue wetland buffer width requirements depend on wetland classifications based on the adopted Washington State Wetland Rating System for Western Washington, Ecology Publication Number 04-06-025, published August 2004.

The City of Bellevue has jurisdiction over Wetlands A, B, C, and D. The Bellevue Municipal Code requires wetland buffer widths ranging from 40 to 225 feet, or as established through a previously approved and recorded Native Growth Protection Area (NGPA) or Native Growth Protection Easement (NGPE).

Wetlands E and F are located in unincorporated King County and are subject to King County's buffer requirements. Under King County code, Wetlands E and F would be subject to buffer widths ranging from 50 to 225 feet.

WDFW's PHS maps show three areas of priority habitat, designated as urban, natural, open-space and riparian zones. However, no priority species were indicated by our document review or observed during site reconnaissance in the project area. No areas were observed that would be regulated as habitats associated with species of local importance (under Land Use Code [LUC] 20.25H.150) or as a Wildlife Habitat Conservation area (under King County Code [KCC] 21A.24.382).

Streams. Four streams were observed in the project area: Vasa Creek (mini-basin BEL012), the east tributary to Vasa Creek (mini-basins BEL011 and BEL012), an unnamed stream (mini-basin BEL012), and Sunset Creek (mini-basin BEL032). All four site streams are likely regulated as type N waters by King County (KCC 21A.24.355) and/or the City of Bellevue (Bellevue LUC 20.25H.075). Type N waters are defined as all segments of aquatic areas, "that are not Type S or F waters and that are physically connected to Type S or F waters by an aboveground channel system, stream, or wetland." The site streams contain the following characteristics:

▶ They are not inventoried as "shorelines of the state" under Chapter 90.58 RCW.

- They are located upstream of legally constructed, human-made fish barriers, primarily the I-90 corridor, and therefore do not contain fish or fish habitat.
- They are streams that flow into type S waters (Lake Sammamish) or type F waters (lower Vasa Creek and lower Sunset Creek).

Within the project area, Vasa Creek, the east tributary to Vasa Creek, and Sunset Creek fall under the City of Bellevue's jurisdiction. For Type N waters, the City of Bellevue code requires a 50-foot buffer on undeveloped sites (i.e., sites that do not contain a primary structure). For developed sites (i.e., sites with an existing primary structure), the City of Bellevue code requires a 25-foot buffer or a buffer width as established with the existing NGPA or NGPE, whichever is greater.

The unnamed stream that crosses SE 43rd Street is located in unincorporated King County and is subject to King County's buffer requirements. King County's buffer requirements will need to be met for all site streams within King County. KCC requires a 65-foot buffer for Type N waters. The classifications and buffer widths for the site streams are summarized in Table 5.

		City of Bellevue		King County	
Stream	Mini- Basin	Classification	Buffer Width	Classification	Buffer Width
Vasa Creek	BEL012	N	25-50 feet	n/a	n/a
Vasa Creek – east tributary	BEL011, BEL012	Ν	25-50 feet	n/a	n/a
Sunset Creek	BEL032	Ν	25-50 feet	n/a	n/a
Unnamed stream	BEL012	n/a	n/a	Ν	65 feet

TABLE 5 BELLEVUE AND KING COUNTY STREAM CLASSIFICATIONS AND BUFFER WIDTHS

N = Type N water n/a = not applicable

2.3 Landslide and Erosion Research

2.3.1 Geologic Conditions

Nearly the entire Bellevue project area is situated on the north-facing slope of the Newcastle Hills near the southwestern corner of Lake Sammamish. This north-facing slope consists of several ridges separated by three prominent, steep-sided, north-oriented drainages. In general, slopes on the ridges range from 15 to 50 percent while the slopes within the ravines range from 45 percent to steeper than 110 percent.

The Bellevue project area is underlain by Pleistocene glacial soils and Tertiary bedrock according to published geologic maps (Booth et al., 2006a; and Liesch, 1963). The primary surface deposit in the project area is Vashon Till, a very dense, gray, gravelly silty sand of glacial origin that is commonly referred to as "hardpan." East and west of the study area, and in the upper elevations to the south, bedrock of the Tukwila Formation forms the topographically high knobs and steep slopes. The Tukwila Formation is composed of silty sandstone and sandy siltstone with interbeds of andesitic lava flows (Walsh, 1984). Bedrock of the Tukwila Formation may also underlie Vashon till at shallow depths where the two units are mapped in close proximity to each other. Vashon glacial recessional deposits, consisting of normally consolidated, stratified sand and gravel with variable amounts of interbedded fine-grained silt and clay, exist along the lower portions of the project area. The Vashon recessional deposits range in density from loose to dense and/or very soft to stiff. Many of the steep slopes within the project area have been modified by residential housing construction, street grading, and park development.

The following sections describe the observations made during reconnaissance of each of the Bellevue mini-basins.

Mini-basin BEL012. An area of very steep slopes exist within the Vasa Creek ravine along the northwestern margin of SE Newport Way and extending north to the I-90 ROW. Evidence of soil creep in the form of bowed trees and shallow, colluvial slope instability related to creek erosion exist on the 80 to 100 percent slopes adjacent to the creek.

North of SE 43rd Street and east of 164th Way SE, slopes inclined from 80 to 100 percent and exhibited shallow soil creep and minor shallow colluvial instability adjacent to a northwest-flowing creek. Similar slope conditions exist downstream along the creek toward I-90.

South of SE 43rd Street, seepage, wet ground, and hummocky topography exist along the 70 to 100 percent slope. An older, 30-foot-wide, approximately 10-foot-deep slump and several vegetated gullies (one with silt fencing at the mouth) exist along the slope. Some bowed trees were also observed on this slope.

Slopes inclined 15 to 50 percent with seepage west of 160th Avenue SE; however, because the slope is densely developed, no observed instability was noted in the field.

Mini-basin BEL011. The most significant slope within mini-basin BEL011 is located west of 158th Avenue SE. The east-facing slope is inclined from 35 to 40 percent and exhibits abundant seepage issuing from the lower portions of the slope. Hummocky topography and possible tension cracks were observed midslope, just above the area of abundant seepage and wet ground. Soil erosion in the form of small, 1-foot-deep and 6- to 12-inch-wide, anastomosing gullies exist throughout the upper portions of the slope. Based on the abundant amount of sandstone clasts within the colluvium, the erosion appears to be confined to the colluvial layer formed on top of bedrock. Seepage was also observed issuing along the western curb of 158th Avenue SE.

Similar instability and seepage conditions were observed along the north-facing slope located south of SE 50th Street, particularly toward the eastern boundary of the mini-basin near 159th Place SE where the slope transitions from a convex to concave profile.

Mini-basin BEL031. Slopes inclined from 35 to 50 percent, with bedrock exposures west of Highland Drive near SE 49th Place. Minor seepage was noted based on the presence of wet bedrock outcrops along this slope. No instability was observed.

A relatively short, west trending ravine with 70 percent slopes exists west of 145th Avenue SE. Minor, shallow, colluvial sloughing was observed at the toe of the steep slopes. South of the ravine, toward the 145th Avenue SE dead end, the west-facing slope is generally inclined at 30 percent and exhibits no instability. Sandstone bedrock crops out along the 145th Avenue SE cut slope in this area. Abundant, potentially unstable yard waste has been placed on the roadway fill slope west of the 145th Avenue SE cul-de-sac.

Mini-basin BEL032. Slopes inclined from 55 to 65 percent in the vicinity of Eastgate Park and the adjacent SPU property at the northern end of the mini-basin. Little to no seepage was observed. A steep-sided ravine with slope inclinations in excess of 100 percent extends

along the eastern side of the SPU property. Stream bank erosion and related shallow colluvial instability exist along the steep ravine slopes. Instability in the form of an older, vegetated slump with an over-steepened toe along the creek was observed west of the 148th Avenue SE and SE 45th Place intersection.

The 50 to 60 percent slope located between 145th and 144th Avenues SE exhibited little to no seepage or signs of instability.

2.3.2 Presence or Proximity to Mapped Geologic Hazards

Based on the City of Bellevue and King County Critical Areas Maps, landslide hazard areas are mapped:

- Between SE Newport Way and SE 44th Place (BEL012)
 Between SE 43rd Place and SE 44th Place (BEL012)
- East of 158th Place SE (BEL012)

- West of 158th Avenue SE (BEL012)
 West of 158th Avenue SE (BEL011)
 South of SE 50th Street (BEL011)
 East of the SE 46th Way and 159th Avenue SE intersection (BEL011)

No landslide hazard areas were mapped within mini-basins BEL031 and BEL032.

Erosion hazard areas are regulated by only King County and are generally confined to the Vasa Creek ravine and the northeast-trending ravine to the east in mini-basin BEL012. Additionally, portions of the area underlain by Vashon recessional soils in the Eastgate Park area (mini-basin BEL032) are also classified as an erosion hazard area. No erosion hazard areas are mapped within mini-basins BEL031 and BEL011.

With the exception of the instability observed west of 148th Avenue SE (mini-basin BEL032) and within the short, west-trending ravine west of 145th Avenue SE (mini-BEL031), the mapped erosion and landslide hazard areas are generally consistent with the field observations. However, steep slope hazard areas, consisting of slopes of 40 percent or greater, are not mapped and are ubiquitous throughout the Bellevue project area.

No coal mine or seismic hazard areas are indicated on the King County or City of Bellevue maps within the Bellevue project area.

2.3.3 Conclusions

The potential for inducing landsliding or erosion in most of the Bellevue project area is **low** to negligible; however, in some areas discussed above, listed below, and shown on Figure 7 the potential is moderate to high, if inflow or infiltration is currently being directed into sewer lines in these zones:

- The north-facing slope located south of SE 43rd Street (easternmost portion of mini-basin BEL012, Area 1)
- ► The east-facing slope located west of 158th Avenue SE (mini-basin BEL011, Area 2)
- The north-facing slope located south of SE 50th Street (southern portion of mini-basin BEL011, Area 3)
- The steep (70 percent) fill slope overlain by yard waste at the 145th Avenue SE cul-de-sac (mini-basin BEL031, Area 4)

Improvements to reduce I&I could cause the groundwater levels to rise, thereby increasing the risk of landslides. While we understand that the pipe-bursting method proposed for this project greatly reduces the amount of ground disturbance relative to trenching, the ground surface around maintenance holes located in steep, undeveloped ROW could be disturbed and may engender erosion in the erosion hazard areas, if BMPs are not followed during construction.

Based on our review of the maps, we understand that all of the utility components included in this project area lie within the City of Bellevue or unincorporated King County. Therefore, City of Bellevue and/or King County development standards apply to the planned improvements.

Both the Bellevue and King County Critical Areas Ordinances require a 50-foot setback from steep slopes (greater than 40 percent) or from all edges of identified landslide hazard areas. Exemptions from the setback requirement may be granted if studies by a licensed geologist or geotechnical engineer indicate that the landslide hazard could be mitigated or eliminated. On the other hand, both ordinances allow an exemption for normal and routine maintenance or repair of existing utility structures, if performed in compliance with permitting requirements. King County code allows clearing in erosion hazard areas only from April 1 through October 1, except under special provisions, which could include normal and routine maintenance or repair of existing utility structures.

2.4 Groundwater Systems Research

2.4.1 Groundwater Setting

The use and protection of groundwater in the Bellevue project area is governed by several local agencies. Drinking water is managed by the Cascade Water Alliance. Between minibasins BEL031 and BEL011, an approximately 1,000-foot-diameter circle of the area near the intersection of SE 50th Street and 151st Street SE is located in a wellhead protection area (King County, 2007). The Bellevue project area is not in a critical aquifer recharge area as identified by King County (King County, 2007) and is not located in a King County water management area (DNR, 1998).

2.4.2 Physiographic Setting

The project area consists of two north-south-trending sections. The section to the west is bordered by 143^{rd} Avenue SE to the west, 147^{th} Place SE to the east, and Eastgate Park to the north and is composed of mini-basins BEL032 and BEL031. The eastern section is bordered by SE 37^{th} Street to the north, 168^{th} Avenue SE to the east, and 154^{th} Place SE to the west and is composed of mini-basins BEL012 and BEL011. The southern border for the project area is SE 50^{th} Street. Elevations rise to the south, going from elevation 320 feet in the north up to elevation 1,150 feet in the south. Gullies and ravines are frequent, generally trending northsouth along with the rise in elevation. Ravines are discussed in detail in the Geologic Conditions section (2.3.1) of this report.

The area sits on Vashon recessional outwash deposits at the lower elevations in minibasin BEL012, and all mini-basins sit on Vashon Glacial Till toward the southern higher elevations (Booth et al., 2006a). Outside the project area, to the east, west, and south of the project area, the geology is mapped as areas of Tukwila Formation, silty sandstone to sandy siltstone (Walsh, 1984). Some of the mini-basin slopes are composed of colluvium made up of bedrock materials. The Tukwila Formation bedrock is likely to underlie the Vashon Till deposits; siltstone and sandstone underlying glacial till were found in well logs from the northeastern section of the project area (Liesch, 1955). Additional discussion can be found in the Geologic Conditions section (2.3.1).

Streams and wetlands were found in the project area, flowing downhill, generally to the north. Additional information can be found in the Wetlands, Streams, and Wildlife Review section (Section 2.2).

2.4.3 Site Reconnaissance

A visual drive-by reconnaissance was performed on March 18, 2008. The mini-basins are composed of single-family homes with small to large yards, depending on location. A trail system and small parks run through parts of the neighborhood. In mini-basin BEL012, SE 37th Street is populated with commercial buildings and parking areas.

Many of the residences have drains from their property through the sidewalk that discharge into the street. The drains are most frequent in mini-basins BEL032 and BEL031, but can also be found in all mini-basins. Some of these drains direct up to approximately 1 gallon per minute of groundwater off of the subject properties into storm drains. These drains are an indication of shallow groundwater, as well as groundwater inflow into the sewer system.

Seeps were found frequently throughout the project area, particularly at the bases of slopes in mini-basin BEL011 (Figure 8). Seeps were generally located in mini-basins BEL032 and BEL031 at SE 46th Street, SE 49th Place, 145th Avenue SE, 145th Place SE, 146th Avenue SE, Sommerset Boulevard and Highland Drive. Seeps in mini-basin BEL011 are generally located on SE 43rd Street, SE 49th Street, SE 50th Street, and 158th Avenue SE. Additional small seeps could be found in all four mini-basins in weeping rockeries or as water coming out of landscaping, or cracks in pavement at various residences. The seeps are a likely indication of shallow or perched groundwater in the project area.

Potential stormwater retention or infiltration ponds were visible in both mini-basins BEL032 and BEL031, at the intersections of SE 46th Street and 145th Place SE, Highland Drive and 144th Place SE, SE Somerset Boulevard and 143rd Avenue SE, and the western side of 145th Place SE and SE 51st Street. In mini-basin BEL012, a stormwater retention/infiltration pond is located east of 164th Way SE and SE 43rd Street. These ponds may infiltrate water and impact shallow groundwater.

On SE 50th Street, in mini-basin BEL031, the area has open ditches with standing water. In mini-basin BEL012, open ditches and drainages are frequent north of SE 43rd Street and off of SE 44th Place. These ditches may infiltrate and impact shallow groundwater.

In mini-basin BEL012, a building that looks similar to a well pump house is located at 164th Way SE and SE 43rd Street, and a reservoir is located uphill off of 164th Way SE, just outside of the mini-basin. We did not find information on the pump house or the reservoir.

2.4.4 Groundwater Occurrence

In our opinion, the project area does not have a significant shallow groundwater table within the glacial till areas in the upland sections. Most of the seeps were found coming from areas of colluvium at steep slopes, with the water likely perching on less permeable bedrock or glacial till. Pockets of coarse-grained soils were found in the glacial till and could contribute to small amounts of groundwater. In the recessional outwash deposits in the northern part of mini-basin BEL012, significant shallow groundwater could be encountered.

We reviewed our project files for the Bellevue project area and found that to the north of the selected site, groundwater was found in borings ranging from 14 to 30 feet bgs during explorations for the Eastgate Park & Ride project (Shannon & Wilson, Inc., 2001).

From the GeoMaps NW search, we identified a report addressing 15642 SE Newport Way, in mini-basin BEL012, which encountered perched water at 4 feet bgs in one test pit, and noted groundwater seepage near Vasa Creek (Associated Earth Sciences, 1992).

2.4.5 Ecology Well Logs

Well records and drilling logs were collected from Ecology for the Bellevue project area and immediate surrounding areas. Specific areas included township 24 North, Range 4 East, Section 11 and township 24 North, Range 5 East, Sections 13, 14, 15, 22 and 23. Well logs provide depth-to-water information for Table 6 in the following section.

2.4.6 Depth to Water

The depth to groundwater generally depends on the presence of perching layers in relation to the ground surface in the upland areas, and the presence of surface water bodies in the lowland areas.

2.4.7 Water-level Fluctuations

No specific water-level fluctuation data were identified. Based on experience in similar locations, we assume that groundwater in recessional outwash could fluctuate seasonally in relation to surface water features and rainfall. Also, groundwater may perch on top of the glacial till. In our opinion, the amount of perched water likely would fluctuate seasonally, with less water present during the summer and fall and more water present during the winter and spring or following prolonged rainfall events.

Township, Range, Section	Address	Depth to Water	Date
24, 5E, 23 (between mini- basins BEL031 and BEL011)	15109 SE 53 rd Place	125	July 1960
24, 5E, 14	4538 160 th Place SE	8, 9	February 2004
24, 5E, 14 (east)	16300 SE 45 th Street	2	August 1999
24, 5E, 11	(Not indicated)	142	January 1964
24, 5E, 11	(Not indicated)	6	March 1945
24, 4E, 11	15815 SE 37th Street	15, 24	February 2000
24, 5E, 14 (east)	4603 164 th Avenue SE	2	July 2002
24, 5E, 14 (east)	16316 SE 45th Street	173	July 2000
24, 5E, 11 (north)	15220 SE 36 th Place	30, 31, 32	November 2004
24, 5E, 11 (north)	3670 150 th Avenue SE	36, 38, 39	November 2004
24, 5E, 11 (north)	150 th Avenue SE HOV Access to I-90	10, 11, 12, 14	2004
(west)	4450 142 nd Avenue SE	18	July 1982

 TABLE 6

 GROUNDWATER DEPTHS – BELLEVUE PROJECT AREA

Notes: The depth to groundwater in the project area was identified from Washington State Department of Ecology Well Records.

HOV = high-occupancy vehicle I-90 = Interstate 90

2.4.8 Groundwater Flow Direction

In general, shallow groundwater follows the surface topography, flowing to the north, following the downslope, toward Lake Sammamish and Lake Washington. Locally, the direction of groundwater flow may be influenced by variability in soil conditions, the presence of surface water, and subsurface structures, including utility trenches.

2.4.9 Conclusions

With respect to sewer infiltration, significant volumes of groundwater may be found in mini-basin BEL012 in the vicinity of sewer lines and manholes along the northern part of the project area in the recessional outwash deposits. Excavation activities in these sand and gravel areas may require construction dewatering to control groundwater inflow that could affect test pits associated with pipe-bursting activities. Pipe-bursting activity could cause groundwater pressures to rise around the bursting head, making the saturated soils more fluid. In this area,

construction methods used in pipe bursting should control soil brought by groundwater inflow between the burst and replacement pipes, to prevent locking of the pipes during installation.

In our opinion, seeps generally demonstrate shallow groundwater accumulating in colluvial deposits, likely contributing to sewer infiltration, and may pose problems during excavation activities. Construction dewatering activity could be necessary in the vicinity of test pits, and construction methods should also control soil and groundwater inflow between pipes during construction.

Lesser accumulations of groundwater could perch atop glacial till or exist within coarsegrained lenses in the till. Groundwater in glacial till areas could contribute to sewer infiltration but likely does not pose significant problems during excavation activities, and only limited construction dewatering could be necessary.

Mini-basins BEL031, BEL032, and BEL012 have potential stormwater infiltration or retention areas. Through infiltration, there is a potential for increased groundwater in these areas, which could result in a need for limited construction dewatering. In mini-basins BEL031 and BEL012, the area has open ditches with standing water. This standing water indicates that the area has a high groundwater table, which could result in a need for limited construction dewatering.

The presence of a wellhead protection area between mini-basins BEL031 and BEL011 may require coordination with regulatory agencies for the proposed project. The King County Department of Health is responsible for the wellhead protection area. Notification prior to work in the area is recommended and the use of BMPs may be required to protect groundwater resources.

3.0 SKYWAY PROJECT AREA (MINI-BASINS BLS001, BLS002, AND BLS003)

3.1 Hazardous Materials Research

3.1.1 Site Description

The Skyway project area is located on an upland plateau located west of Lake Washington. Land use within the project area is predominantly residential.

The study was conducted to evaluate if hazardous materials could be encountered during the proposed sewer upgrade project. The identified properties were ranked **low, moderate**, or **high** based on the likelihood of contaminants to be present in the soil in the vicinity of the sewer line and manholes where excavation could occur. Properties with known groundwater and/or soil contamination located near or adjacent to the sewer are considered to have a **high** potential to contaminate the soil in the vicinity of the sewer line. Adjacent businesses such as historical gas stations, historical automobile repair shops, dry cleaners, print shops, paint shops and photo shops, where there are no known releases, are considered to have a **moderate** potential to contaminate the soil. These types of businesses have commonly released contaminants into the soil and/or groundwater; however, where no evidence of a release has been observed or documented, the risk of contamination is considered to have a **moderate** potential to impact the project area. Properties adjacent to sewer lines where reported petroleum or chemical spills of significant or unreported size have reached the soil are also considered to have a **moderate** potential to impact the project area.

Businesses, including gas stations and automobile repair shops developed since approximately 1988, construction companies with no known USTs, and residences with heating oil tanks are considered to have a **low** potential to impact the project area. Newer gas stations are considered to have a **low** contamination potential because of the implementation of stringent regulations for UST construction, system installation, monitoring and testing. Although construction companies frequently have USTs, such companies are considered to pose a **low** potential for contamination where the presence of USTs has not been confirmed. Properties with heating oil tanks are considered to have a **low** potential because heating oil generally does not travel far in soil. The locations of the identified properties having a potential to impact soil in the vicinity of the sewer line are indicated in Figure 7.

3.1.2 Document Review

Local, State, and Federal Environmental Databases. EDR was subcontracted to conduct a search of available agency databases for sites within distances recommended by ASTM for Phase 1 Environmental Site Assessments. The search included EPA, Ecology, Tribal, and local databases for known and suspected contaminated sites.

Seven properties within the project area and one CERCLIS-NFRAP site within one mile of the project area boundary were identified. The seven identified properties were on one or more of the following databases: Spills, LUST, UST, ICR, FINDS, and Emergency Response Notification System (ERNS). The CERCLIS-NFRAP site (Boeing Renton) was also on the CSCSL, RCRA-Large Quantity Generator, Toxic Chemical Release Inventory System, RCRA-Treatment, Storage, and Disposal Facility, RCRA Administrative Action Tracking System, RCRA Corrective Action, Hazardous waste manifest data, ICR, Engineering Controls Sites, and Sites with Institutional Controls lists.

These listed sites are shown in Figure 9 and are summarized below.

- ► 10814-10822 Rainier Avenue South, Seattle (Spills, ERNS) Diesel fuel was reportedly spilled into surface water (Lake Washington) in March 2002. The quantity is identified as a 5 x 200-foot sheen. Because the site is listed as a one-time spill into the lake, and the site is not on other databases that would indicate that contamination is present, this property is not considered a risk to impact the project area.
- ► 10920 Rainier Avenue South, Renton (Spills) An unknown chemical was reportedly spilled into surface water in April 2003. Based on the location of the property, the surface water was likely Lake Washington. Because the site is listed as a one-time spill into the lake, and the site is not on other databases that would indicate that contamination is present, this property is not considered a risk to impact the project area.
- ► 8528 South 121st, Renton (Spills) An unknown chemical was reportedly spilled inside a building in April 2001. Because the site is listed as a one-time spill, there is no indication that the spilled material reached soil, and the site is not on other databases that would indicate that contamination is present, this property is considered to have a low potential to impact the soil in the vicinity of the manholes.
- Former Lake Washington Greenhouses, Inc., 12167 87th Avenue South, Seattle (LUST, UST, ICR, FINDS) Two USTs were removed from the site and three additional USTs have unknown status (two leaded gasoline USTs; and one unleaded gasoline UST). The LUST and ICR databases indicate that petroleum-impacted soil was cleaned up in 1998. This site is considered to have low risk to impact the project area because remediation activities have occurred on the site, and because it is located at least 500 feet from the nearest BLS003 mini-basin sewer line.
- Renton Facilities and Operation Center/Site SE 11 Renton, 12607 82nd Avenue South, Renton (UST, FINDS) – One small UST (between 111 and 1,100 gallons) was removed from the property (stored substance not indicated). The database indicates that the UST was installed in 1985. No known contamination was identified. Because no contamination was identified, the site is considered to have a low potential to impact the soil excavation areas.
- ► King County Fire District 20, 11619 84th Avenue South, Seattle (UST, FINDS) A waste oil UST was closed in place (capacity between 111 and 1,100 gallons). The site is within the project area, but not adjacent to the sewer line. Based on the site's no known

contamination status and its location relative to the project, the site is considered to have **low** potential for impacting soil excavation areas.

- South 120th Street and 79th Avenue South, Skyway (ERNS) A pole-mounted transformer fell and approximately 20 gallons of oil spilled in October 1997. Cleanup response included sweeping oil off of the street and out of a catch basin. Because the site is listed as a one-time spill, there is no indication that spilled oil reached soil, and the site is not on other databases that would indicate that contamination is present, this site is considered to have a low potential to impact soil in the vicinity of manholes.
- 11440 82nd Place South, Seattle (ERNS) Reportedly, product from a 200-gallon UST spilled in the yard in December 1995, and soil smelled of petroleum. The issue was referred to Ecology. The site is located adjacent to a sewer line, and because soil was reportedly impacted, it is considered to have a moderate potential to impact the project area.
- Bryn Mawr Lakeridge Water & Sewer District, 7843 South 116th Street, Seattle (FINDS) Ecology's database indicates that the site has an active listing in the Hazwaste program. Facilities that store hazardous chemicals report annually for emergency preparedness planning. Inclusion on this database does not indicate that a release of hazardous materials has occurred. Therefore, this site is considered to have a low potential to impact soil in planned excavation areas.

The Boeing Renton aircraft manufacturing site (800 North 6th Street) is located approximately 0.8 mile east of the closest project boundary. The database information indicates that groundwater is known to have been impacted by petroleum products, phenolic compounds, non-halogenated solvents, priority pollutant metals/cyanide, other metals, PCBs, and conventional inorganic contaminants. Other contaminants are suspected. Remedial action is in progress. Based on the site's distance and the fact that the Cedar River is between the Boeing site and the project area, this property is not considered a risk to the project.

All other sites listed outside of the project area were not considered a potential environmental concern because of the type of database listing and/or relative distance from the project area.

Cole's and Polk City Directories. City directories were reviewed at the Seattle Public Library for the years 1971-1972, 1977, 1981-1982, 1986-1987, 1991-1992, 1997, 2002 and 2007. A Polk City Directory was reviewed for 1967.

The listings were predominantly residential, although some of the residential addresses were listed as home businesses. Home businesses of potential environmental concern include construction/contractor, landscaping, roofing, taxidermy, handyman and painting. In 1997,

10820 Lake Ridge Drive South was listed as Standard Natural Gas. Between 1991 and 2002, 10441 Dixon Drive South was listed as Accident Reconstruction, which could have potentially been an auto body shop associated with the home address. Perovich & Son fuel was listed at 12433 84th Avenue South in 1981/82 and 1977, and potentially could have been a small gas station or a fuel distributor. Based on the limited time duration of the listed businesses, database search for USTs, and visual observations of the properties during our site reconnaissance, it is unlikely that subsurface soils are contaminated above regulatory cleanup levels associated with these properties. However, the Perovich & Son property is still considered to have a **low** potential to impact soil in the vicinity of manholes because of the potential for a former fueling station.

Sanborn Fire Insurance Maps. Sanborn Fire Insurance Maps were not available for the project area.

King County Assessor Records. Current tax assessor records were reviewed online at the King County iMap website. Tax assessor information prior to 1970 for this project was reviewed at the Puget Sound Regional Archives. Most of the parcels in the project area were residential, with 55 currently or historically using heating oil (Figure 9). Heating oil generally has low mobility when it has been released to subsurface soils. As a result, contamination is usually not widespread.

One property of concern, the Former Lake Washington Greenhouses, Inc., was identified during our assessor record research. The assessor records indicate that the former Lake Washington Greenhouses referenced in the previous section included multiple parcels covering most of the property between South 121st Street and South 123rd Place, and between 85th and 87th Avenues South. Based on the windshield survey, most of the land has been redeveloped as residential properties. The historical greenhouse operations, in addition to the use of petroleum products, may have involved the use of pesticides and herbicides. However, this site is considered to have **low** risk to the project because it is located at least 500 feet from the nearest sewer line.

3.1.3 Site Reconnaissance

A visual reconnaissance of the project area was conducted on March 3 and June 30, 2008. In general, the project area is predominantly comprised of single-family homes. No properties of concern were identified during our site visit.

3.1.4 Conclusions

The potential for impact to the sewer line from contaminated sites was evaluated based on the type of business, the proximity of the parcel to the sewer line, and the known or suspected presence of contaminants. In areas where the water table is at or above the sewer pipe elevation, the sewer trench backfill could be serving as a hydraulic conduit for contaminated groundwater migration. In such cases, it is possible that groundwater could carry contamination for considerable distances downgradient along the sewer line corridor. In addition, excavation and dewatering practices used during sewer line repair activities could create or modify contaminant migration pathways and/or distribution. However, this is unlikely because of the limited excavation and dewatering that is anticipated for this project.

The toxicity and cost of remediating contaminated soil that could be encountered during sewer line improvements vary depending on the type of contaminant. For example, dry cleaning solvents are highly toxic at low concentrations, and remediation costs are typically very high. Other solvent contaminants resulting from businesses such as photo processing or printing shops may be less toxic than dry cleaning solvents, but they can also result in high remediation costs. Soils contaminated with gasoline-range petroleum hydrocarbons generally have a lower toxicity and a lower disposal cost than soils contaminated with solvents, depending on the age of the gasoline. A more recent gasoline spill has more benzene, its most toxic component. The more benzene present in the soil, the higher the remediation costs. Older gasoline tends to be less toxic and somewhat less expensive to remediate. Diesel- and oil-range petroleum hydrocarbons are the least toxic and least mobile petroleum contaminants and typically have the lowest cleanup costs. Metal contaminants could result in high remediation costs, but unlike the organic contaminants listed above, they do not easily absorb through the skin and have a relatively low health risk unless they are ingested.

Potential properties of concern are shown in Figure 9. Based on the environmental review, historical review, and the site reconnaissance, the potential for impact from contaminants to the improvement of the sewer system appears to be **low to moderate** within the Skyway project area, as summarized in Table 7.

TABLE 7SKYWAY PROPERTIES OF CONCERN

Property	Location	Contaminant Potential	Contaminant(s) of Concern
BLS001			
Residences with heating oil	Various (Figure 9)	Low	Petroleum products
8528 South 121 st Street	8528 South 121 st Street	Low	Unknown
Renton Facilities and Operation Center/Site SE 11 Renton	12607 82 nd Avenue South	Low	Unknown
Perovich & Son	12433 84 th Avenue South	Low	Petroleum products
BLS002			
Residences with heating oil	Various (Figure 9)	Low	Petroleum products
BLS003			
Residences with heating oil	Various (Figure 9)	Low	Petroleum products
Former Lake Washington Greenhouses, Inc.	12167 87 th Avenue South	Moderate	Petroleum products, lead, pesticides, herbicides
King County Fire District 20	11619 84 th Avenue South	Low	Petroleum products
South 120 th Street and 79 th Avenue South	South 120 th Street and 79 th Avenue South	Low	PCBs
11440 82 nd Place South	11440 82 nd Place South	Moderate	Petroleum products
Bryn Mawr Lakeridge Water & Sewer District	7843 South 116 th Street	Low	Unknown

PCB = polychlorinated biphenyls

We recommend that construction monitoring be performed in areas of **low** risk, such as where USTs and/or fill material are suspected to be present. If contamination is identified, it would then be necessary to provide appropriate health and safety measures to protect site workers and to analyze the soil for proper disposal. Hazardous household materials such as cleaners, paints, and solvents are often disposed of in the sanitary sewer system from residences and businesses such as paint shops, printers, and photo developers. These materials could leak into the soil through sewer line joints. Also, sediments should be removed from manholes prior to work within the manhole to reduce the risk of exposure to hazardous materials for site workers.

Based on the potential health risks associated with contaminated soil and groundwater, we recommend that earthwork be avoided in the vicinity of the residence located at 11440 82nd Place South. If earthwork cannot be avoided, we recommend that a Phase II Environmental Site Assessment be performed prior to earthwork activities to determine if contamination is present, and to analyze the soil and/or groundwater for health and safety measures and proper disposal. Because the 11440 82nd Place South residence is not expected to be acquired by King County, the Phase II exploration should be confined to soil and/or groundwater sampling in the sewer line easement adjacent to the site. Sampling could be conducted with a Geoprobe[®] at intervals to the approximate depth of the sewer line. Soil samples should be analyzed for petroleum products.

3.2 Wetlands, Streams, and Wildlife Review

3.2.1 Document Review

Washington State Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) Map. Two priority habitats, designated as "Urban Natural Open Space," are mapped in the project area. These habitats are shown within mini-basin BLS002 and described as forested ravines with intermittent streams. Two bald eagle nest sites, identified in 2006, are mapped in or near the project area. Northern portions of the project area fall within the mapped bald eagle 800-foot and shoreline nest buffer. Lake Washington, adjacent to the project area, is reported to contain fall Chinook salmon, Coho salmon, bull trout/Dolly Varden, sockeye salmon, winter steelhead, and coastal cutthroat trout. These species are considered priority species by WDFW.

Washington State Department of Natural Resources Natural Heritage Information System Database. No records for rare plants or high quality ecosystems were identified in the project area.

Washington Department of Natural Resources Forest Practices Application Review System. Taylor Creek and an unnamed stream, identified as Stream 1, are mapped in or adjacent to the project area. Stream 1 crosses into mini-basin BLS002 near its southwestern boundary. Stream 1 is mapped as a Type N stream (for the upper 400 feet) and as a Type F stream. Taylor

Creek, located to the west of the project area, is mapped as a Type F stream. No wetlands were mapped in the project area.

King County Sensitive Areas Map. Three unclassified streams (Taylor Creek, Stream 1, and a tributary to Stream 1) are mapped in or adjacent to the project area. No wetlands were mapped in the project area. No portion of the King County Wildlife Network is mapped in the project area.

King County Shoreline Management Program Map. A narrow portion of the project area along Rainier Avenue South is mapped as shoreline jurisdiction and designated as urban shoreline environment.

King County Soil Survey. Current and historical soil survey data were reviewed for the project area. Soil survey data (published in 1952) maps Alderwood gravelly loam and Alderwood gravelly sandy loam over most of the project area with Cathcart loam in the southern portion of mini-basin BLS001 and "Rough broken and stony land" along the western portion of mini-basin BLS002. Current soil survey data is not available for areas west of 84th Avenue South. Current soil survey data maps areas east of 84th Avenue South as Alderwood gravelly sandy loam and Norma sandy loam. Norma sandy loam is considered to be hydric.

City of Seattle Department of Planning and Development Geographic Information System (GIS). While the majority of the project area is located in unincorporated King County, the western portion of mini-basin BLS002 is located within Seattle city limits. Several "environmentally critical areas" are mapped along the Seattle city boundary. A riparian corridor and wetland along a stream are shown along Taylor Creek at the western boundary of mini-basin BLS002. Wildlife areas are mapped along western and southwestern boundaries of mini-basin BLS002.

Seattle Public Utilities (SPU). Christopher May, stormwater and urban stream habitat lead, provided information on Taylor Creek through a telephone conversation on July 7, 2008. According to Mr. May, the culvert under Rainier Avenue South, located 100 to 200 feet from the creek's mouth, is a barrier to fish passage. Resident cutthroat trout are present in the stream above this culvert. Coho, sockeye, and cutthroat are present in the stream below this culvert. SPU plans to remove this fish barrier within the next couple of years.

Washington State Department of Fish and Wildlife (WDFW). Larry Fisher, area habitat biologist for the project area, provided information on Stream 1 through a telephone conversation on July 7, 2008. According to Mr. Fisher, Stream 1 does not contain fish or fish habitat.

3.2.2 Site Reconnaissance

A visual reconnaissance of the project area was conducted on March 3 and June 30, 2008. The project area included mini-basins BLS001, BLS002, and BLS003. The project area is comprised of single-family homes and a few undeveloped lots. Bryn Mawr Park runs along the boundary between mini-basins BLS001 and BLS003. Lakeridge Park is located along the western boundary of mini-basin BLS002.

Taylor Creek and two unnamed streams, identified as Stream 1 and Stream 2, were observed in or near the project area (Figure 10). Taylor Creek and Stream 1 drain to Lake Washington. Taylor Creek was observed west of the project area in a forested ravine within Lakeridge Park. Stream 1 was observed north of South 114th Street and crosses into the project area at the southeastern boundary of mini-basin BLS002. South of South 114th Street, land has been recently graded and no stream was observed. The tributary to Stream 1, as mapped by the King County Sensitive Areas Map, corresponds to a ravine at the western boundary of BLS003 east of 76th Avenue South. No signs of flowing water or stream channel were observed in this ravine. Stream 2 is located in mini-basin BLS001 and flows northeast from 81st Place South to South 123rd Street where it enters a catch basin.

Three wetlands were observed in the project area. The first wetland was a scrub/shrub system observed within the ravine east of 76th Avenue South and south of South 116th Street. The second wetland was a small scrub/shrub system associated with Stream 2. The third wetland was a small forested/scrub/shrub system on a vacated segment of the South 123rd Street ROW and located immediately west of 85th Avenue South. A potential emergent wetland was observed approximately 250 feet from the project area near the Lake Washington greenhouses.

The urban natural open-space priority habitats mapped by WDFW were observed to include steep, forested ravines conveying Taylor Creek and Stream 1. A bald eagle nest was observed near the southeastern portion of mini-basin BLS002 at approximately South 112th Street and 84th Avenue South. No raptors were observed during reconnaissance. The WDFW

PHS map identified another bald eagle nest west of the project area. No nest was observed at this location.

3.2.3 Conclusions

Shoreline. A narrow portion of the project area along Rainier Avenue South is in King County's shoreline jurisdiction and designated as urban shoreline environment. The proposed activities appear to qualify as exempt from shoreline substantial development permit requirements under Washington Administrative Code (WAC) 173-27-040(2)(b), as they are "normal maintenance or repair of existing structures or developments." Shoreline exemptions can be approved by King County.

Wetlands. Three wetlands were observed in the project area. King County code requires wetland buffer widths ranging from 50 to 225 feet. Wetland buffer widths depend on a wetland classification based on the adopted Washington State Wetland Rating System for Western Washington.

Streams. Three streams were observed in or near the project area. King County's water typing system (KCC 21A.24.355) designates four water types: Type S, F, N, and O. Type S waters are defined as shoreline of the state. Type F waters includes streams that are not Type S waters and contain fish or fish habitat. Type N waters include streams that are not Type S or F waters and connect to Type S or F waters by an aboveground channel system. Type O waters include streams that are not Type S, F, or N waters and do not connect to these waters by an aboveground channel system.

Taylor Creek would likely be considered a Type F water, as it is known to contain cutthroat trout and is not a shoreline of the state. Stream 1 would likely be considered a Type N water, as it is reported to contain no fish or fish habitat and it connects to Lake Washington (a Type S water) by an aboveground channel system. Stream 2 would likely be considered a Type O water, as it does not contain fish or fish habitat and drains to a stormwater catch basin.

King County requires 25-foot buffers for type O streams, 65-foot buffers for Type N streams that are within the urban growth area, and 115-foot buffers for Type F streams that are within the urban growth area and not with a basin or shoreline designated as **high**, as is the case for the project area. According to King County's GIS stream data, Taylor Creek is located

approximately 60 feet west of the project area boundary. Although Taylor Creek is located outside of the project area, its associated buffer would likely overlap the project area.

Bald Eagle. A bald eagle nest was observed in or near the project area. Bald eagles are protected by the following county, state, and federal laws:

- King County King County defines areas within 400 feet from an active bald eagle nest as wildlife habitat conservation areas (KCC 21A.24.382). Activities within 800 feet of the nest must comply with King County's Critical Areas regulations. If the nest is active (being used), construction activities would likely be restricted during parts of the year. Within 800 feet of an active nest, alterations are not allowed between March 15 and April 30, and land-clearing machinery such as bulldozers, graders or other heavy equipment, may not be operated between January 1 and August 31.
- State For activities within ½ mile of a bald eagle nest, where WDFW determines that the proposed activity would adversely impact eagle habitat, a bald eagle management plan (BEMP) would be required. A BEMP is a habitat protection agreement that focuses on maintaining nest trees, perch trees, and associated screening trees.
- Federal In July 2007, the bald eagle was removed from protection under the federal Endangered Species Act. However, two other federal laws still provide protection for the bald eagle, the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. These laws primarily address nest tree protection and protection from harassment.
 Federal laws and regulations come into play when a federal permit is required (such as a permit from the U.S. Army Corps of Engineers). If no federal permits are required for this project and no harm to eagles or their nests is anticipated, federal laws and regulations on protecting bald eagles may not apply to the proposed activities.

3.3 Landslide and Erosion Research

3.3.1 Geologic Conditions

The Skyway study area is located on an upland plateau that overlooks Lake Washington. The ground surface is gently sloping, from 0 to 20 percent. Steep slopes (greater than 40 percent) exist in and adjacent to the western and eastern portions of mini-basin BLS001, within the creek ravines at the north and south margins of BLS002, and within the Bryn Mawr Park area of mini-basin BLS003.

Published geologic maps for this area (Waldron et al., 1962; Mullineaux, 1965; and Booth et al., 2006a) indicate that Vashon Till, a very dense, gray, gravelly, silty sand of glacial origin, underlies most of the Skyway project area. Glacial recessional, normally consolidated soils are mapped on top of the till in several locations:

- Along the east-facing slopes above Rainier Avenue South, east of 85th Avenue South, between South 121st Street and NW 7th Street (BLS001) and at the mouth of Taylor Creek (BLS002).
- On the steep slopes along the western margin of BLS001 and in the vicinity of Bryn Mawr Park in (BLS003).

These normally consolidated, glacial, recessional deposits are generally composed of interbedded sand, gravel, silt and clay and commonly show signs of seepage and Holocene slope instability. These deposits have not been glacially overridden and are therefore less dense than the underlying till.

Older, pre-Vashon glacial and interglacial deposits underlying the Vashon Till are exposed along the steep valley walls of Taylor Creek.

Bedrock of the Tukwila Formation underlies the glacial soils in the project area. While previous mapping by Waldron (1962), Mullineaux (1965) and Booth (2006a) do not show bedrock at the ground surface, bedrock exposures were observed on the steep, east-facing slopes of the Bryn Mawr Park area in BLS003 and along the western margin of BLS001 during field reconnaissance.

Mini-basin BLS001. The dominant feature of mini-basin BLS001 is a large area of steep slopes (greater than 40 percent) in and adjacent to the western portion of the project area. Steep slopes also exist adjacent to the extreme eastern end of the project area immediately above Rainier Avenue South. The southwestern, central, and northeastern portions of the project area are relatively flat lying (slopes of 0 to 15 percent).

Dodds Geosciences, Inc. excavated three test pits at a site on South 123rd Place just east of 84th Avenue South in 1994. They encountered as much as 10.5 feet of fill material on top of glacial till, which is consistent with the mapped geology. During field reconnaissance, our geologists also observed exposures of till at several locations in the western portion of the project area.

While recently developed streets within the project area were built with curbs and storm drainage systems, most streets in the project area lack curbs, and stormwater runoff is directed into ditch inlets in the unpaved parking strips.

Groundwater seeps were observed at two locations: 8115 South 120th Street and 8201 South 121st Street. Standing water was observed in a gravel alley between South 120th and South 121st Streets at 82nd Avenue South. The seepage water is heavily iron-oxide stained and assumed to be issuing from bedrock fractures that daylight on the steep slopes along the western boundary of the project area. Surface water runoff from the Dimmitt Middle School parking lot appears to drain eastward down the school driveway and across 81st Place South. A ravine has been scoured into the steep slope between 81st Place South and 82nd Avenue South, presumably by water from the school and/or 81st Place South.

Throughout much of the project area, newer developments include retaining wall systems and rockeries with no observed signs of instability. However, slight soil creep and bent trees were noted at the head of a ravine on the eastern side of Lind Avenue NW just outside the eastern boundary of the project area. Pavement cracking in the driveway at 8217 South 123rd Place may indicate slope movement and/or fill settlement. An ecology-block wall failure was observed at 12117 82nd Avenue South, and slight cracking of an older concrete retaining wall was seen at 12323 85th Avenue South.

Mini-basin BLS002. Mini-basin BLS002 is located on an upland plateau that overlooks Lake Washington. Nearly the entire mini-basin is underlain by Vashon Till. The ground surface is gently sloping to the north and northwest, from 0 to 20 percent. Very steep (steeper than 70 percent) slope gradients exist within the Taylor Creek and Stream 1 drainages, at the western and eastern margins of the mini-basin, respectively. Other isolated areas of steep slopes exist along Rainier Avenue South and Dixon Drive South.

Observations made in the vicinity of Rustic Road South, north of South 108th Street, indicate possible surface water runoff and infiltration into properties adjacent to very steep slopes of the Taylor Creek ravine. Roadway cracking, wet ground, and seepage were also observed at the toe of the slope northeast of the Cornell Avenue South and Rustic Road South intersection.

Along Dixon Drive South, between South 106th Street and 76th Avenue South, 3- to 20-foot-high steep slopes exist (some are road cuts), but no signs of seepage or instability were observed. A depression with steep side slopes (60 to 80 percent) located at the "T" intersection of South 106th Street and Laurel Lane South appears to be the head of a former channel. The depression is covered in briers, and no instability was observed.

Observations along Rainier Avenue South (10800 block), downslope of Garden Place South, indicate moderately steep cut slopes approximately 3 to 12 feet high, with various types of retaining structures, including rockeries, concrete and wood walls, and earth buttresses. Abundant seepage and standing water exists along the slope toe adjacent to Rainier Avenue South, north of South Lakeridge Drive. Wet ditches were also observed along the Garden Place South cul de sac, upslope of the seepage observed along Rainier Avenue South.

Observations along the Stream 1 ravine at the southeastern corner of the mini-basin revealed 50 to 70 percent slopes with backtilted trees and hummocky topography, which are indicative of colluvial soil creep. Landslide debris associated with older slumps has deflected the creek channel in some reaches of this ravine.

Mini-basin BLS003. Approximately one-half of mini-basin BLS003 is relatively flat lying, ranging from about 0 to 15 percent. Bryn Mawr Park and an undeveloped lot between South 116th and South 118th Streets from 78th Avenue South to 80th Avenue South separate the eastern portion of the mini-basin from the topographically higher western portion, and a series of northeast-southwest-trending ravines cut through the park and wooded lot. The ravine slopes located east of 80th Avenue South, between South 123rd Street and South 122nd Street exhibit slope inclinations between 40 and 90 percent. The head of the Stream 1 ravine is located at about the intersection of South 114th Street and 80th Avenue South and flows northeast to Lake Washington, out of the mini-basin.

In general, reconnaissance of the mini-basin revealed little evidence of slope instability. However, bent trees and hummocky terrain were observed in the ravine east of 80th Avenue South at South 122nd Street where slopes range up to 90 percent.

3.3.2 Presence or Proximity to Geologic Hazards

Based on the City of Renton and King County Critical Areas Maps, landslide hazard areas are mapped as follows:

- ► Adjacent to Taylor Creek, west of Rustic Road South (BLS002)
- ► Upslope and downslope of Raymond Place NW (BLS001)
- ► East of 87th Avenue South along the slope adjacent to Rainier Avenue South (BLS001)

No landslide hazard areas are mapped within mini-basin BLS003.

Mapped erosion hazard areas are generally adjacent to and/or coincident with the landslide hazard areas in mini-basin BLS001. The erosion hazard areas correlate with mapped recessional glacial soils, and exist upslope of Raymond Place NW (BLS001) and east of 87th Avenue South along the slope adjacent to Rainier Avenue South (BLS001). No erosion hazard areas are mapped within mini-basins BLS002 or BLS003.

Areas of observed instability that are not currently mapped by local jurisdictions within geologically hazardous areas follow:

- The steep slope between South 123rd and South 124th Streets east of 81st Place South (BLS001)
- The steep slope between South 120th and South 122nd Streets west of 82nd Avenue South (BLS001)
- ► The ravine slopes along Stream 1 (BLS002)
- ► The east-facing slope below Garden Place South along Rainier Avenue South (BLS)
- ► The east-facing slopes located east of 80th Avenue South, between South 120th and South 123rd Streets (BLS003)

No coal mines or seismic hazard areas are indicated on the King County or City of Renton maps within the Skyway project area.

3.3.3 Conclusions

The potential for inducing landsliding or erosion in most of the Skyway project area is **low** to negligible; however, in some areas discussed previously and subsequently, and shown in Figure 11, the potential is **moderate to high**, if inflow or infiltration is currently being directed into sewer lines in these zones. These areas include:

- ► The slope above Rainier Avenue South east of South 121st and NW 7th Streets (easternmost portion of BLS001, Area 1)
- The slope east of 84th Avenue South in the vicinity of Raymond Place NW (BLS001, Area 2)
- ► The slope between South 123rd and South 124th Streets east of 81st Place South (eastern portion of BLS001, Area 3)
- The slopes located between South 120th and South 122nd Streets west of 82nd Avenue South (eastern portion of BLS001, Area 4)

- The east-facing slopes located east of 80th Avenue South, between South 120th and South 123rd Streets (BLS003, Area 5)
- The slopes north of South Sunnycrest Road, between Cornell Avenue South and Crestwood Drive South (BLS002, Area 6)
- The west-facing slope adjacent to the houses along Rustic Road South and Crestwood Drive South, between house nos. 10619 Rustic Road South and 11033 Crestwood Drive South (BLS002, Area 7)
- ► In the vicinity of the steep-sided depression, approximately 200 feet south and 200 feet north of house no. 10800 Forest Avenue South (BLS002, Area 8)
- ► The slope between Garden Place South and Rainier Avenue South, from South Lakeridge Drive, north to the Garden Place South cul-de-sac (BLS002, Area 9)
- The Stream 1 ravine slopes between 81st and 82nd Avenues South, and between Lotus Place South and 84th Avenue South (BLS002, Area 10)

Improvements to reduce I&I could cause the groundwater levels to rise, thereby increasing the risk of landslides. While we understand that the pipe-bursting method proposed for this project greatly reduces the amount of ground disturbance relative to trenching, the ground surface around maintenance holes located in steep, undeveloped ROW could be disturbed and may engender erosion in the erosion hazard areas, if BMPs are not followed during construction.

Based on our review of the maps, we understand that all of the utility components included in this project area lie within the City of Renton or unincorporated King County. Therefore, City of Renton and/or King County development standards apply to the planned improvements.

Both the Renton and King County Critical Areas Ordinances require a 50-foot setback from steep slopes (greater than 40 percent) or from all edges of identified landslide hazard areas. Exemptions from the setback requirement may be granted if studies by a licensed geologist or geotechnical engineer indicate that the landslide hazard could be mitigated or eliminated. On the other hand, both ordinances allow an exemption for normal and routine maintenance or repair of existing utility structures, if performed in compliance with permitting requirements. King County code allows clearing in erosion hazard areas from only April 1 through October 1, except under special provisions, which may include normal and routine maintenance or repair of existing utility structures.

3.4 Groundwater

3.4.1 Groundwater Setting

The Skyway project area is located north of the South King County groundwater management area (King County GPP, 2008). The southeastern end of mini-basin BLS002 is in a wellhead protection area, near the Oakwood Ave South and South Lakeridge Drive intersection. (King County GPP, 2008). Mini-basins BLS001 and BLS003 are in a wellhead protection area, centered around the community water source wells at 78th Ave South and South 116th Street (King County GPP, 2008). The Skyway project area is not in a critical aquifer recharge area as identified by King County (King County, 2004). The project area is not mapped as being susceptible to groundwater contamination (King County, 2008).

Drinking water is managed by the Cascade Water Alliance.

3.4.2 Physiographic Setting

Mini-basin BLS002 slopes northeastward, downward from a northwest-southeasttrending ridge. Ravines containing streams flowing northward into Lake Washington are found at the eastern and western borders of mini-basin BLS002. Mini-basins BLS001 and BLS003 slope east-northeast.

Published geologic maps for this area (Booth et al., 2006a) indicate that Vashon Till, a very dense, gray, gravelly, silty sand of glacial origin, underlies most of the project area. Glacial recessional deposits, normally consolidated soils but less dense than glacial till, are mapped on top of the till in scattered locations, and are discussed in depth in the Landslide and Erosion Research section (Section 3.3). Mini-basin BLS002 sits on glacial till. However, in the far west of the project area, bordering Lakeridge Park, is a small string of Vashon Recessional Outwash Deposits (Booth et al., 2006a).

3.4.3 Site Reconnaissance

Mini-basins BLS001 and BLS003. A drive-by reconnaissance of mini-basins BLS001 and BLS003 was conducted on January 16, 2008. In general, the project area is predominantly single-family homes with yards, as well as schools and Bryn Mawr Park. Some of the homes are on steep slopes, many with rock retaining walls. There are stormwater ditches on the edges of many streets, and there are no sidewalks. These stormwater ditches may infiltrate and impact

shallow groundwater. Ravines are noted in the Landslide and Erosion Research section (Section 3.3).

In mini-basin BLS001, we found active groundwater seeps along the rockery walls upslope (to the west) of 82nd Avenue South, between the streets of South 120th Street to South 122nd Street (Figure 12). Groundwater seeps were present along slopes in the southern part of mini-basin BLS001, along 84th Avenue South and the upslope west of 84th Avenue South. Groundwater seeps were also found above Rainer Avenue North at the eastern limits of mini-basin BLS001. The seeps are likely an indication of shallow or perched groundwater in the project area.

We observed iron-oxide staining associated with some of the groundwater seeps encountered in mini-basin BLS001 during the site reconnaissance. We do not know the cause of the staining, but it has been known to occur from groundwater seeping out of fractures in bedrock, which may underlie the till.

Mini-basin BLS002. A drive-by reconnaissance of the mini-basin was conducted on May 1, 2008. In general, the mini-basin is predominantly single-family homes with yards, and no sidewalks. Some of the homes are on steep slopes, and the roads are terraced upward toward the south. Along the western boundary of mini-basin BLS002 is a ravine containing Taylor Creek, which is situated in Lakeridge Park, and a smaller creek and ravine are in the eastern end of the site. Ravines are discussed further in Landslide and Erosion Research (Section 3.3), and creeks are discussed in Wetlands, Streams, and Wildlife Review (Section 3.2).

In mini-basin BLS002, there are scattered stormwater ditches on the edges of several streets. Some of the stormwater ditches had standing or flowing water. In certain areas, water entering the storm basins came from drains from the neighboring properties, likely indicating the presence of shallow groundwater. These ditches may infiltrate and impact shallow groundwater.

Minor groundwater seeps were found on South Sunnycrest Road and South Laurel Street. Slightly north of the project area are seeps on South Ryan Street, and on Rainier Avenue South, north of South Lakeridge Drive. Surface sloughing at 10670 Forest Avenue South appears to be partially due to groundwater. The seeps and surface sloughing are likely an indication of shallow or perched groundwater in the project area.

3.4.4 Groundwater Occurrence

Shallow groundwater occurs in the project area, as noted in our observation of seeps during the reconnaissance. In general, where glacial till is encountered in the project area, relatively low volumes of groundwater would likely occur because of the low permeability of the till. At the western edge of mini-basin BLS002, more groundwater might be encountered, depending on the extent of the recessional outwash sand deposits into the project area.

Mini-basin BLS002. During our job file review, we found records scattered throughout mini-basin BLS002. From 11221 Crestwood Drive South, ½ block to the south of the mini-basin, a report indicated groundwater at a depth of 35 feet bgs. On the northeastern edge of the project site at 10880 Rainer Avenue South, groundwater was not encountered in a boring to the depth of 12.5 feet bgs. A block to the northwest of the project area, by the intersection of South Ryan Street and Forest Avenue South, groundwater was at 25 feet bgs, and the report noted that sandy, advanced outwash soils were found, though they have not been mapped in the area.

Our Northwest Geomaps database search found projects in areas adjoining mini-basin BLS002. North of the site, at 10228 Rainer Avenue South, groundwater was encountered in some test pits 3 to 5 feet bgs, and soils were described as mottled to indicate the presence of seasonal perched groundwater in the area (Associated Earth Sciences, Inc., 2001). Also to the north, at 7109 South Taft Street, explorations encountered heaving sands, and groundwater was encountered at 8 to 12 feet bgs (Geotech Consultants, Inc., 2002).

Mini-basins BLS001 and BLS003. We found no pertinent records from our job file review. Our Northwest Geomaps search found a geotechnical report from mini-basin BLS003 located at 116th Street South and 80th Avenue South experienced groundwater seepage at 2 and 10 feet bgs in test pits (Earth Consultants, Inc., 1996). In mini-basin BLS001, at 8236 South 123rd Place, groundwater was encountered at 5.5 and 9.0 feet bgs in test pits (Dodds Geosciences, 1994).

3.4.5 Ecology Well Logs

Well records and drilling logs were collected from Ecology for the Skyway project area and immediate surrounding areas. Specific areas included Township 24 North, Range 4 East, Sections 1 and 2; Township 23 North, Range 4 East, Section 12; and Township 23 North, Range 5 East Sections 6 and 7. Well logs provide depth-to-water information for Table 8 in the following section.

3.4.6 Depth To Water

Depth to groundwater generally depends on the presence of perching layers in relation to the ground surface in the upland areas, as well as the presence of surface water bodies in the lowland areas such as Taylor Creek in mini-basin BLS002 and Lake Washington.

Township, Range, Section	Location	Depth to Water	Date
23N,4E,1E	Rainier Avenue South and	4	June 2004
	68 th Avenue South (west)		
23N, 4E, 12G	78 th Avenue South and South	100, 180, 222, 231,	1929-1985
	116 th Street	235	
23N, 4E, 12R	8214 South 128 th Street	9	June 1991
	(south)		

TABLE 8GROUNDWATER DEPTHS – SKYWAY PROJECT AREA

The depth to groundwater in the project area was identified from Washington State Department of Ecology Well Records.

3.4.7 Water-level Fluctuations

No specific water-level fluctuation data were identified. However, based on experience in similar locations, groundwater could perch on top of the glacial till. The amount of water would likely fluctuate seasonally with less water present during the summer and fall, and more water present during the winter and spring or following prolonged rainfall events.

3.4.8 Groundwater Flow Direction

In general, shallow groundwater that perches on top of the glacial till likely follows the surface topography, flowing downhill to the north, toward Lake Washington. In mini-basin BLS001, water may flow eastward as well, toward the Cedar River. Locally, the direction of groundwater flow could be influenced by variability in soil conditions, the presence of surface water, and subsurface structures, including utility trenches.
3.4.9 Conclusions

With respect to the sewer infiltration and construction dewatering activities, small accumulations of groundwater could perch atop the glacial till or exist within coarse-grained lenses in till, such as seen in the groundwater seeps encountered during site reconnaissance. Groundwater in these areas may seasonally contribute to sewer infiltration, but likely do not pose significant problems during excavation activities. Only limited construction dewatering may be necessary in the vicinity of test pits for pipe-bursting activity. Groundwater seeps could be captured or diverted to reduce construction impacts.

All three mini-basins (BLS001, BLS002, and BLS003) have scattered, open stormwater ditches with standing water. The standing water indicates that the area has a high groundwater table which may result in a need for limited construction dewatering.

Greater amounts of groundwater may be encountered in the western border of mini-basin BLS002, based on our in-house records, Northwest Geomaps record review, and geologic map. The western edge of mini-basin BLS002 is near the occurrence of sandy, advanced outwash soils in borings, and strings of outwash deposits are mapped in the adjacent soils. Also, heaving sands were encountered in explorations to the north of the mini-basin BLS002 area, indicating the potential for greater amounts of groundwater.

Excavation activities for pipe-bursting test pits in these sand areas may require construction dewatering to control groundwater inflow into pipe-bursting test pits. Pipe-bursting activity could cause groundwater pressures to rise around the bursting head, making the saturated soils more fluid. In this area, construction methods used in pipe bursting should control soil brought by groundwater inflow between the burst and replacement pipes, to prevent locking of the pipes during installation.

The presence of a wellhead protection area in the project area may require coordination with regulatory agencies. The King County Department of Health is responsible for the wetland protection area. Notification prior to work in the area is recommended and the use of BMPs may be required to protect groundwater resources.

4.0 CLOSURE

The findings and conclusions documented in this report have been prepared for specific application to this project, and have been developed in a manner consistent with that level of care

and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in the area, and in accordance with the terms and conditions set forth in our agreement. The conclusions and recommendations presented in this report are professional opinions based on interpretation of information currently available to us, and are made within the operational scope, budget, and schedule constraints of this project. No warranty, express or implied, is made.

This report was prepared for the exclusive use of King County, Tetra Tech, and their representatives. We have prepared the documents, "Important Information About Your Environmental Site Assessment/Evaluation Report" (Appendix A), "Important Information About Your Wetland Delineation/Mitigation and/or Stream Classification Report" (Appendix B), and "Important Information About Your Geological/Environmental Report" (Appendix C) to assist you and others in understanding the use and limitations of our reports.

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5.0 REFERENCES

- AGRA Earth & Environment, Inc, 1996, Subsurface exploration and geotechnical engineering report, proposed Village Green residential development, Issaquah, Washington: Report prepared by AGRA Earth & Environment, Inc., Kirkland, Wash., 6-91M-11000, for Urban Design, Inc., Kirkland, WA.
- Associated Earth Sciences, Inc., 1992, Top of slope setback recommendations, proposed Farrar subdivision, King County, Washington: Report prepared by Associated Earth Sciences, Inc., Kirkland, Wash., 9201-24H for Walter Farrar, Bellevue, WA.
- Associated Earth Sciences, Inc. 2001, Addendum geotechnical report, 10228 Rainer Avenue South, Seattle, Washington: Report prepared by Associated Earth Sciences Inc., Kirkland, Wash., KE97256A for Mortgage Solutions, Bellevue, WA.
- Booth, D.B., Troost, K.A., and Wisher, A.P., 2006a, Geologic map of King County, Washington: Seattle, Wash., GeoMapNW, The Pacific Northwest Center for Geologic Mapping Studies, scale 1:100,000.
- Booth, D.B., Walsh, T.J., Troost, K.A., and Shimel, S.A., 2006b, Geologic map of the Issaquah 7.5 minute quadrangle, King County, Washington: Seattle, Wash., GeoMapNW, The Pacific Northwest Center for Geologic Mapping Studies, scale 1:24,000.
- Dodds Geosciences, 1994, Geotechnical engineering report, the Granger Lots, 82XX to 83XX South 123rd Place, King County, Washington: Report prepared by Dodds Geosciences, Bellevue, Wash., 4131, for Nathan Construction Company, Seattle, Wash.
- Earth Consultants, Inc, 1996, Lakeridge Heights, 116th Street South and 80th Avenue, King County Washington: Report prepared by Earth Consultants, Inc., Bellevue, Wash., E-7114, for Bianchi and Berzins, Seattle, WA.
- Geotech Consultants, Inc., 2002, Geotechnical engineering study, proposed new residence, south of 7109 South Taft Street, Seattle, Washington: Report prepared by Geotech Consultants, Inc., Bellevue, Wash., JN 02108, for View Property Associates, LLC, Kent, WA.
- Golder and Associates, 1989, Site investigation and remedial recommendations, Wildwood slope failure, Issaquah, Washington: Report prepared by Golder and Associates, Redmond, Wash., 893-1066, for City of Issaquah, Issaquah, WA.
- Golder and Associates, 1994, Results of confirmatory drilling and remediation concepts, mine subsidence investigation, Wildwood Boulevard and Sunrise Place. S.W., Issaquah, Washington: Report prepared by Golder and Associates, Redmond, Wash., 943-1548.600 for City of Issaquah, Issaquah, WA.

AppendixA_EnvironmentalReport.doc/wp/r

- Golder and Associates, 2000, Report to City of Issaquah on groundwater exploration and pumping tests, Lower Issaquah Valley: Report prepared by Golder and Associates, Redmond, Wash., for City of Issaquah, Issaquah, Wash.
- King County, 2004, King County critical aquifer recharge areas attachment B: Seattle, Wash., September 17, available: http://dnr.metrokc.gov/wlr/wq/groundwater-maps.htm.
- King County, 2007, Groundwater data, King County, Washington: Seattle, Wash., available: http://dnr.metrokc.gov/wlr/wq/groundwater-data.htm#.
- King County, 2008, Groundwater data, King County, Washington: Seattle, Wash., available: <u>http://dnr.metrokc.gov/wlr/wq/groundwater-data.htm#</u>.
- King County Department of Natural Resources (DNR), 1998, King County groundwater management areas: Seattle, Wash., available: http://dnr.metrokc.gov/wlr/wq/pdf/ 9808groundwatermgtareas.pdf.
- King County Department of Natural Resources (DNR), 2005, Issaquah Creek Valley groundwater management area, mapped water table: Seattle, Wash., available: http://www.kingcounty.gov/environment/waterandland/groundwater/management-areas/issaquah-creek-valley-gwma.aspx
- Liesch, B.A., 1955, Records of wells, water levels, and quality of ground water in the Sammamish Lake area, King County, Washington: U.S. Geological Survey, Open File Report 55-96, 193 p.
- Liesch, B. A., 1963, Geology and ground-water resources of northwestern King County, Washington: Olympia, Wash., Division of Water Resources, Water supply bulletin 20, 241 p., 3 plates.
- Mullineaux, D.R., 1965, Geologic map of the Renton quadrangle, King County, Washington: U.S. Geological Survey.
- Shannon & Wilson, Inc., 2001, Geotechnical report, Eastgate park and ride project, interim parking lot: Report prepared by Shannon & Wilson, Inc., Seattle, Wash., 21-1-09453-001, for KPFF Consulting Engineers, Seattle, Wash., September.
- Waldron, H.H.; Liesch, B.A.; Mullineaux, D.R.; and Crandell, D.R., 1962, Preliminary geologic map of Seattle and vicinity, Washington: U.S. Geological Survey miscellaneous geologic investigations Map I-354, scale 1:31,680.
- Walsh, T. J., 1984, Geology and coal resources of central King County, Washington: Olympia, Wash., Washington State Division of Geology and Earth Resources Open-File Report 84-3, scale 1:24,000.

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