FISHERIES TECHNICAL REPORT

THE VILLAGES
MASTER PLANNED DEVELOPMENT

Black Diamond, Washington

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1.0 INTRODUCTION

1.1 Report Scope

A proposed action that would result in development of a mixed-use Master Planned Community on an approximately 1,190-acre site is evaluated for potential impacts to fisheries resources. The Black Diamond Villages (Villages) Project site consists of the approximately 1,108-acre Main Property generally located south and west of the City of Black Diamond, and the approximately 82-acre North Property located on the northern edge of the City. This report analyzes the Proposed Master Planned Development (MPD) and a No Action Alternative.

Existing fisheries conditions on the site and in the vicinity are described based on site-specific field reconnaissance, a review of existing documents, and interviews with regional experts. The data are used to describe existing conditions, to assess potential impacts of proposed development activities to fisheries resources and aquatic habitat, and to evaluate and discuss mitigation measures proposed to avoid and/or minimize impacts. Where appropriate, additional conservation and mitigation measures are recommended.

1.2 Proposed Action

Development of the Villages MPD is expected to commence in 2009. Full buildout is anticipated to occur by 2025. Under the Proposed MPD, the Villages site (including both the Main Property and the North Property) would be developed with a mix of uses, including residential, retail/commercial, office, educational and recreational uses, and open space. Development would be clustered to avoid environmentally sensitive areas (i.e., wetlands, streams and steep slope areas and their buffers).

1.3 No Action Alternative

The No Action Alternative is defined by what would be most likely to happen if the Villages MPD did not occur. Logging activities could continue to take place onsite in the future. The individual tax parcels that comprise the Main Property and North Property could be sold to individuals or small developers and developed in the future in accordance with the City's zoning and other applicable regulations. Sensitive areas' buffers would be protected as required under the code, but there would be no coordinated opportunities to protect larger parcels as public open space.

2.0 AFFECTED ENVIRONMENT

2.1 Site Description

The project site consists of approximately 1,190 acres located on multiple parcels (known as B, C, D, E, BDA and F) within portions of Sections 11, 15, 22, 23 and 27, Township 21 North, Range 6 East in the City of Black Diamond, King County, Washington. Parcels C, D, E, BDA and F are contiguous and located along the south boundary of the City of Black Diamond. Parcel B is located west of SR 169 near the City's north boundary. Existing development on the site consists primarily of native surface logging roads and a small gravel pit on Parcel D.

The main portion of the project site (Parcels C, D, E, BDA and F) consists of approximately 1,110 acres of flat to moderately sloped forestland and scrub-shrub habitat. Site elevations range from approximately 510 feet to around 710 feet. The site straddles a north-south divide with about half of the site draining north to Rock Creek and Lake Sawyer. The rest of the site drains southwest to the Green River. Most of the land consists of managed young coniferous forest. Some of the site was historically mined for gravel and virtually all was commercially logged at one time or another. There is no existing residential development on the site.

Several natural watercourses are found on the site ranging from salmon-bearing Rock Creek to a number of intermittent non-fish-bearing streams (Figure 1). Manmade ditches dug during logging operations and to drain roads are also present but do not meet the definition of watercourses under the City of Black Diamond Code. The entire site was walked by fisheries, wetland, and geologic scientists to identify sensitive areas.

Parcel B (approximately 80-acres) is located near the northern tip of Black Diamond adjacent to the west side of SR 169. The Parcel B Property consists of two relatively flat terraces separated by an average 45-foot high slope. The land is primarily forested with young mixed coniferous-deciduous trees, and has no structures. One short, isolated watercourse (S2) connects two wetlands on the upper and lower terrace within the site. A number of long linear watercourses were examined and found to most closely fit the City's CAO wetland definition rather than the stream definition and are further described by Wetland Resources (2008).

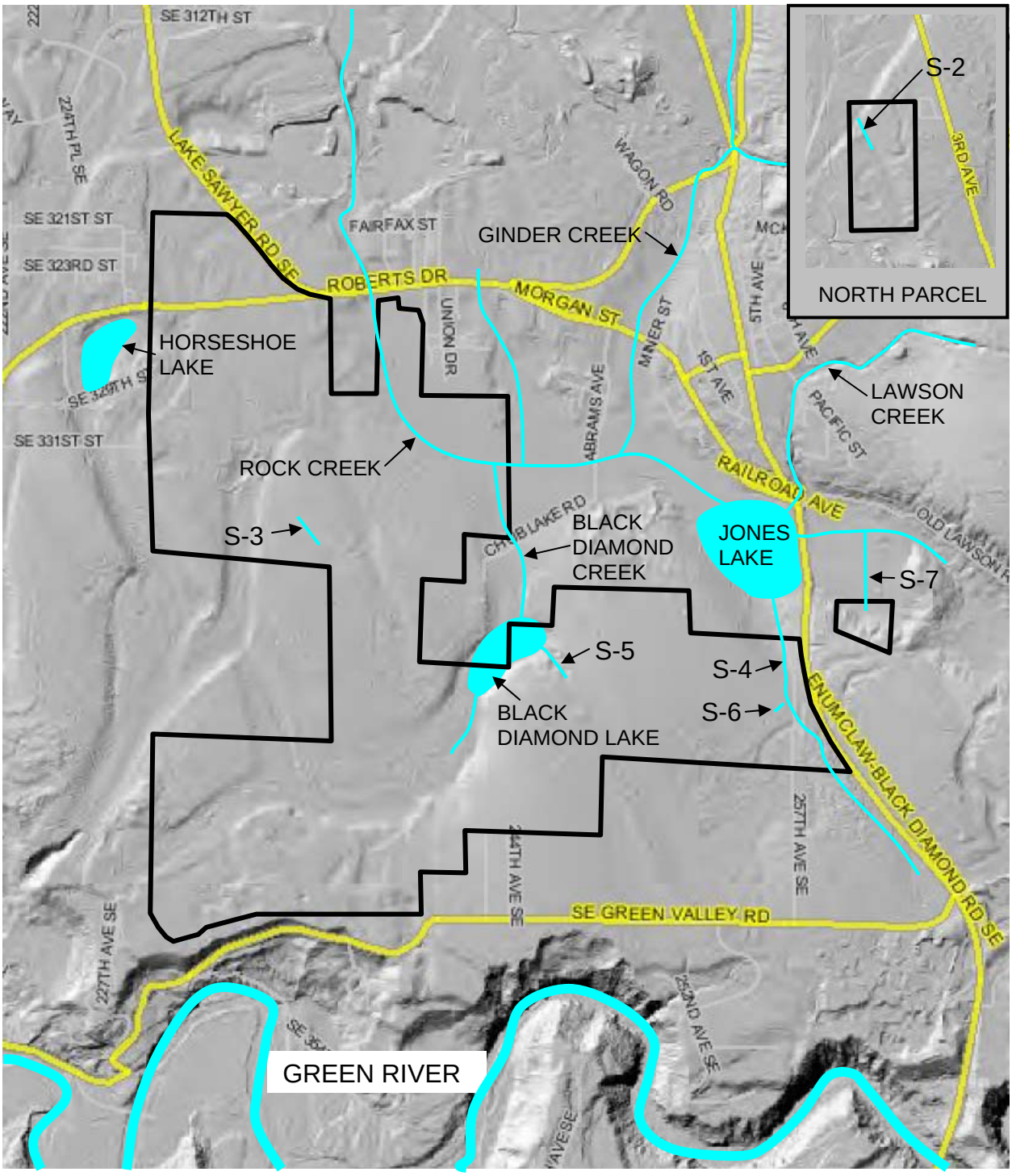

Figure 1. Watercourses on and in the vicinity of the Villages MPD site.

2.2 Surface Water Drainage Setting

The site is entirely within the Green River drainage basin (WRIA 9). All surface water drainage eventually ends up in the Green River (WRIA 09-0001). The majority of the main site (52%) drains in a northwesterly direction via various watercourses that eventually collect in Rock Creek (09-0085). Rock Creek drains via Lake Sawyer, Covington Creek (09-0083), and Big Soos Creek (09-0072) to the Green River near river mile (RM) 33.6. All drainage on Parcel B infiltrates to groundwater which eventually reaches Ravensdale Creek (Associated Earth Sciences, Inc [AESI] 2008). Ravensdale Creek drains directly to Lake Sawyer. A minority of the site (48%) slopes towards the Green River. Rainfall in this part of the site infiltrates or is collected in wetlands that extend off-site to the south. There are no watercourses on the site that drain directly to the Green River.

2.3 City of Black Diamond Watercourse Definitions

The draft City of Black Diamond Zoning Code (January 22, 2008 draft) defines streams according to WAC 222-16-030. Streams are classified based on fish use, size, and flow characteristics as summarized below:

Type S Water means all waters, within their bankfull width, as inventoried as shorelines of the state.

Type F Water means segments of natural waters other than Type S Waters, which are within the bankfull widths of defined channels and periodically inundated areas of their associated wetlands, or within lakes, ponds, or impoundments having a surface area of 0.5 acre or greater at seasonal low water and which in any case contain fish habitat.

Type Np Water means all segments of natural waters within the bankfull width of defined channels that are perennial nonfish habitat streams. Perennial streams are waters that do not go dry any time of a year of normal rainfall.

Type Ns Water means all segments of natural waters within the bankfull width of the defined channels that are not Type S, F, or Np Waters. These are seasonal, nonfish habitat streams in which surface flow is not present for at least some portion of a year of normal rainfall.

2.4 Aquatic Habitat Quality: Onsite Waterbodies

Physical habitat attributes of onsite waterbodies are described in this section. Results are summarized in Table 1. Information about existing conditions was gathered from survey work completed by the applicant for this project and in existing documents (City of Black Diamond 1996, Kerwin and Nelson 2000, WDFW 2008a, 2008b).

Habitat surveys to evaluate existing conditions were completed during the summer of 2007, winter of 2007/2008, and spring of 2008. Onsite channels were walked in their entirety. Affected off-site channels were spot checked.

Only five natural watercourses (Rock Creek and streams S2, S4, S5, and S7) and Black Diamond Lake were identified on the project site. Two other watercourses, (S3 and S6) were dug or created during past road building activities but contain flow from natural sources and therefore are described in this report. A number of roadside ditches and natural wetlands are also present. Neither S3, S6, or any of the roadside ditches show any evidence (based on topography and soil types) of having replaced previously existing natural watercourses. They all appear to have been constructed solely for draining road surface runoff or diverting seepage back to a topographic low point. Evidence of the passage of water was observed in some of the wetlands but the physical features more closely resembled wetlands (aquatic plants, vegetated substrates, hydric soils, etc.) than streams so were classified as such. Wetlands are described in detail by Wetland Resources Inc. (2008).

Table 1
Watercourses and Lakes, Habitat Attributes, and Fish Use on the Villages Site

Watercourse Name	Type of Water	Black Diamond Type	Fish Use	Avg. Slope	Dominant Substrate	Flow
S2	Stream	Ns	None; onsite channel goes dry and is isolated	15%	Silt	Seasonal
S3 (manmade)	Ditch	None	None; onsite channel goes dry and is isolated	7%	Sand	Seasonal
S4	Stream	F	Presumed resident trout; possible coho juvenile	3%	Gravel	Perennial
S5	Stream	F	Presumed resident trout; possible coho juvenile	10%	Gravel	Perennial
S6 (culvert discharge)	Stream	Ns	None, poor access and no habitat	7%	Silt	Seasonal
S7	Stream	F	Presumed resident trout; possible coho juvenile	10%	Silt	Seasonal
Black Diamond Lake	Lake	F	Resident trout; coho juvenile	—	—	Perennial
Rock Creek	Stream	F	Resident trout and coho spawning and rearing	1%	Silt	Perennial

Several unclassified stream channels are identified on maps prepared by the Department of Natural Resources (DNR). Field review found that mapped channels shown throughout Section

15 and in the NW ¼ of Section 22 do not actually exist on the site. It is likely the channels were plotted based on interpretation of topographic data and extrapolation from known watercourses.

2.4.1 Watercourse S2

A single isolated stream (S2) is located on Parcel B. The entire watercourse is approximately 800 feet long and only exists on the steep slope between the upper and lower terraces. Headwaters are located in onsite wetlands on the upper terrace to the east. As Stream S2 reaches the lower terrace, all flow quickly infiltrates into recessional outwash (Qvr, AESI 2008). This effect was observed even during a very wet period in January 2007. The water from Stream S2 ultimately provides baseflow to Ravensdale Creek.

The S2 stream channel is isolated and does not connect with any other surface waterbody. The channel is intermittent, non-fish-bearing, and does not significantly influence water quality downstream with the possible exception of water temperature. The channel would be classified as a Type Ns water.

Wetland 6B is a linear wetland located just south of Stream S2 that has some stream-like characteristics but is dominated by emergent vegetation and organic soils. Because the wetland contains open water during the winter it was walked downstream to identify any possible connection with fish-bearing waters. Much like other watercourses in this area, all flow was found to rapidly infiltrate into the recessional outwash soils once it reached the lower plateau. No surface connection to offsite fish-bearing waterbodies was found for any of the water features in Parcel B.

2.4.2 Ditch S3

Ditch S3 is located on the south half of Parcel D. This is a manmade ditch that was likely dug to during past logging operations. Flow from a wetland through which an old logging road passes currently runs north and west down the road bed before infiltrating when the road reaches the recessional outwash soils near the toe of the slope. There is no evidence of a natural channel nor does the local topography give any indication a natural channel may have existed at this location prior to the road being constructed. The ditch contains a natural source of water but is isolated, seasonal, and non-fish-bearing. This artificial conveyance would not be defined as a watercourse under the proposed Black Diamond CAO (BDMC 19.10.090). About half of the channel has been identified as wetland and will be preserved as such.

2.4.3 Watercourse S4

This watercourse is located on the extreme eastern edge of Parcel F and parallels 257th Avenue SE before discharging to Jones Lake off-site. The stream is headwatered off-site to the south in a large wetland complex in the area bounded by 257th Avenue SE to the west, SE Green Valley Road to the south, and SR 169 to the east. Flow travels north through a broad wetland near the toe of the SR 169 fill slope and enters the site. Flow then crosses under 257th Avenue SE in a small (approximately 8-inch) culvert and continues northwest through the site in a well-defined channel through densely vegetated young forest. The well defined channel in this area is small (2 to 5 feet wide), shallow (approximately 3 to 12 inches at Ordinary High Water), and of

moderate gradient 3 to 5 percent. Substrate is dominated by gravel and small cobble with sand sub-dominant. Cobbles larger than about 2-inches are generally moss covered indicating a lack of frequent high flows. Instream habitat consists primarily of riffle with a few small pools. Large woody debris (LWD) frequency is low.

No natural barriers to fish migration were noted between Jones Lake and the southern property boundary. Given the presence of suitable fish habitat, the entire watercourse through the site is presumed to be fish-bearing (Type F).

2.4.4 Watercourse S5

Watercourse S5 is located near the northwest corner of Parcel F. It is a natural 800-foot long creek draining onsite wetlands directly to Black Diamond Lake. Much of the middle and lower portion of the channel is deeply embedded in Himalayan blackberry making a detailed survey of the channel difficult. However, the channel averages more than 2-feet wide with a gradient of about 10 percent and is presumed fish-bearing throughout its length (Type F). No natural fish barriers were observed in the portion of channel that was observed and topographic conditions appear to preclude the presence of a natural barrier.

2.4.5 Watercourse S6

S6 is a manmade watercourse located near the east boundary of Parcel F that begins as drainage from a 15-inch culvert under an old logging road. The road crosses the eastern tip of Wetland Q. Discharge from the wetland at this location is seasonal and Watercourse S6 is relatively poorly defined, so it is not clear if the watercourse was present at this location before the road was installed or replaced a previously existing watercourse at this or some other location. Flow has created a small poorly defined channel that persists part of the way down the slope towards Watercourse S4. However, there is no evidence flow ever reaches Watercourse S4 on the surface. While it is possible there is a surface connection between Wetland Q and Watercourse S4 under some conditions, there is no evidence of the passage of surface water between the two, so fish use of S6 is not believed possible. The intermittent, non-fish-bearing channel would be classified as a Type Ns watercourse under the draft BDMC.

2.4.6 Watercourse S7

Watercourse S7 is located east of SR 169 on the isolated parcel of land east of Jones Lake. It begins as groundwater seepage on a steep hillside before coalescing into a defined channel and discharging to a ditched watercourse on the Jones Lake floodplain off site. The ditch heads due north and connects to Unnamed Creek a short distance upstream of Jones Lake. The Unnamed Creek system in this area is fish-bearing and no natural barriers are known to exist downstream of the site. It is unknown whether the channel contains perennial flows. The watercourse upstream on to the site would be classified as a Type F stream until the point at which the channel is no longer defined. This point was not flagged in the field as no development was proposed in this area.

2.4.7 Black Diamond Lake

Black Diamond Lake and associated wetlands cover an area of approximately 40 acres in a watershed of approximately 700 acres (City of Black Diamond 1996). The open water portion of the lake is about 10 acres. The mean depth is 6 feet and the maximum depth is 8 feet. A large wetland system extending to the southwest includes some open water during parts of the year. A survey in June 2000 found a channel approximately 5 feet wide at the OHWM with an average water depth of approximately 0.2 feet. Channel gradient was less than 1 percent and water was slow moving. Substrate was organic muck and silt.

The lake is unique in that it contains a bog component. Bogs require special water quality conditions such as a low pH and low flows that are not always conducive to fish use. However, Black Diamond Lake has been stocked with native and non-native fish species on a number of occasions and upstream access from Rock Creek was improved when the intervening channel was cleared and cleaned a number of years ago (see Section 2.6.2). Fishing for both warmwater species and salmonids still occurs at the lake. The lake would be classified as a Type F waterbody, but is also classified as a Category 1 wetland (Wetland Resources, Inc. 2008).

2.4.8 Rock Creek

Rock Creek (WRIA 09-0085) is part of an extensive wetland system that extends from Jones Lake downstream to Lake Sawyer. The active channel averages 10 feet wide at the OHWM. Average water depth ranges from about 0.5 feet to over a foot in places. Channel gradient is approximately 1 percent. Substrate is dominated by silts and organics with some graveled and cobbled reaches present. Channel type is primarily glide or riffle. Very little large woody debris is present. Riparian vegetation is comprised of red alder, bigleaf maple, salmonberry, Indian plum, red elderberry, and skunk cabbage.

Fish rearing habitat in Rock Creek is good. There are abundant on- and off-channel refuge locations, deep pools, and overhanging vegetation. With a few exceptions, riparian buffers are generally large and well vegetated. Water quality issues in Rock Creek in the past include low dissolved oxygen (DO), high temperatures, and other issues (A.C. Kindig & Co. 2008). Rock Creek is known to be used by coho salmon and resident cutthroat trout (Williams et al. 1975, City of Black Diamond 1996, Kerwin and Nelson 2000, WDFW 2008a, 2008b).

2.5 Aquatic Habitat Quality: Off-site Waterbodies

This section provides a description of the physical habitat attributes of off-site waterbodies receiving flow from the project site.

2.5.1 Jones Lake

Jones Lake is located in the southern part of Black Diamond just west of SR169 and is generally considered the headwater of Rock Creek. The lake is approximately 23 acres in size and has a total watershed area of 742 acres (Williams et al. 1975). The mean depth is approximately 4 feet, and the maximum depth is 7 feet (City of Black Diamond 1996). Jones Lake has been characterized as exhibiting high concentrations of acidic organic materials, as well as having

bottom deposits consisting of unrated organic material that accumulates as peat. Jones Lake provides good overwintering habitat potential for salmonids utilizing the Rock Creek drainage, including coho and cutthroat trout. Anecdotal evidence suggests rainbow trout historically stocked in Jones Lake persist in the drainage and some continued use by trout is expected. Warmwater fishes also utilize the lake and may prey on juvenile salmonids.

2.5.2 Black Diamond Lake Creek

This tributary to Rock Creek (09-0085A) exits Black Diamond Lake at the northern end, flows through a wetland with beaver dams, under Abrams Avenue, and then through part of a wetland complex previously utilized by the Black Diamond Wastewater Treatment Plant known as the "Black Diamond Lagoon" (Ecology 1987). Black Diamond Lake Creek combines with Rock Creek downstream of the wetland.

The channel downstream of Black Diamond Lake ranges from about 5 to 6 feet wide at the OHWM. Average water depth is approximately 0.5 feet. Substrate is comprised of silt and organic material. The riparian vegetation is dominated by Douglas' spirea, willow, rushes, sedges, and reed canarygrass. Channel type consists primarily of a glide or run. Downstream of the culvert crossing at Abrams Avenue the channel splits and diffuses into an extensive wetland complex before emptying to Rock Creek.

Salmonid habitat suitability of the creek is generally poor. No gravels suitable for spawning by resident trout or anadromous salmonids were observed. No LWD, pools, or other habitat features of value to salmonid habitat were noted. However, some salmonid use is possible and this system is utilized as rearing habitat for coho and by resident salmonids, especially during the winter when flows are higher (Kerwin and Nelson 2000). The cool summer water temperatures may also provide a summer refuge for fish.

2.5.3 Horseshoe Lake

Horseshoe Lake is located west of the project site off Black Diamond Road. Horseshoe Lake is located in a topographic depression and has no outlet. Water levels in the lake are sensitive to the effects of both overland runoff and ground water inflows (Tetra Tech/KCM, Inc. et al. 1999, AESI 2008).

Horseshoe Lake is generally unsuitable for salmonids. Historical stocking records indicate rainbow trout were stocked in the past for recreational angling. However, the isolated lake is not believed to contain habitat suitable for spawning. No reproductive population of salmonids is expected. In addition, water temperatures are not conducive to salmonid use and a one-time water quality sampling found low oxygen (AESI 2000). Habitat is suitable for warm-water fish species and there are reports of bass, sunfish, and catfish being caught in the lake (AESI 2000).

2.5.4 Ravensdale Creek

Ravensdale Creek has its headwaters in Ravensdale Lake approximately 1.4 miles east of the site. The channel flows through commercial forestland approximately 3 river miles to Lake Sawyer. Ravensdale Creek passes within a few hundred feet of Parcel B at its closest location

but is not within the project boundaries. No surface water drains from the site to Ravensdale Creek, but water infiltrating into the recessional outwash on the lower portion of the site (including flow from Stream S2) ultimately provides baseflow to Ravensdale Creek.

Ravensdale Creek is a major salmon-bearing stream recognized for very high fish use (Williams et al. 1975, City of Black Diamond 1996, Kerwin and Nelson 2000, WDFW 2008).

2.5.5 Lake Sawyer

Lake Sawyer is the forth largest lake in King County with a surface area of approximately 280 acres (Tetra Tech/KCM 1999). Rock Creek and Ravensdale Creek both discharge to Lake Sawyer near the south end. Lake Sawyer drains via Covington Creek (09-0083) eventually reaching the Green River (09-0001) approximately 11 miles downstream of the project site. Lake Sawyer is utilized as a migration corridor and for rearing by coho salmon. The lake also contains native cutthroat trout, stocked rainbow trout, and a warmwater fishery.

2.5.6 Crisp Creek

Crisp Creek (WRIA 09-0113), also known as Keta Creek or Keta Springs, is generally regarded as one of the most important small streams draining into the Green River within this area of the Green River Watershed (Williams et al. 1975). Crisp Creek is 3.5 miles long and enters the Green River at approximately RM 40.1. The Crisp Creek Basin drains an area of approximately 5.0 square miles both within and outside of the Project Area.

Crisp Creek is located approximately three-quarters of a mile west of the project site at its closest point and does not receive any surface water runoff from the site. However, groundwater that infiltrates on portions of the site travels south and west to feed springs that discharge to Crisp Creek (AESI 2008). The Keta Creek Hatchery operated by the Muckleshoot Indian Tribe is located near RM 1.1. Crisp Creek is the primary water supply for the hatchery and the former WDFW rearing ponds located nearby (Carlson 1994). Crisp Creek is dominated by ground water recharge which enters the creek as springs approximately one-half mile upstream of the hatchery and state rearing ponds (Carlson 1994).

Crisp Creek supports runs of coho, Chinook, and chum salmon and winter steelhead (Kerwin and Nelson 2000). Resident and anadromous cutthroats have also been observed.

2.5.7 Green River Spring

The Green River Spring is located near the extreme southwest corner of the Project site (Parcel BDA, northwest corner of Section 27). Source flow for the spring is described by AESI (2008). Flow from the spring enters into the Green River at approximately RM 40. Little is known about salmonid use of the stream emanating from the spring. A very steep chute runs downhill from near the spring to the Green River floodplain. It is likely that fish make use of the stream on the floodplain and the spring influences water quality in the Green River itself.

2.5.8 Green River

The Green River begins in the Cascade Mountains approximately 30 miles northeast of Mount Rainier and flows west and northwest over 93 miles to Puget Sound where it enters at Elliot Bay near Seattle. Instream flows and sediment transport characteristics of the lower Green/Duwamish River system are influenced by Howard Hanson Dam operations and water withdrawal at the Tacoma Headworks. The dam is operated to control flooding downstream and, since its construction in 1961, has eliminated most high flows above the 2-year event. The 2002/2004 Water Quality 303(d) List cites the Green River between RM 11 and RM 42.3 as limited for DO, fecal coliform bacteria, mercury, and temperature (Ecology 2005).

2.6 Fish Use: Onsite

Local, county, state, and federal reports and databases were reviewed to identify any known or presumed fish use of onsite stream channels. These references included Williams et al. 1975, King County 1990, WDFW and WWTIT 1994, City of Black Diamond 1996, WDFW 1998, Kerwin and Nelson 2000, King County 2000, NMFS 2005, USFWS 2005, King County 2007, WDFW 2008a, WDFW 2008b.

Resident cutthroat trout and coho salmon are the dominant native species found in on-site fish-bearing waters discussed above in Section 2.5. These waters are Streams S4, S5, S7, Rock Creek and Black Diamond Lake. Numerous non-naturally occurring fish species in this area have been stocked by WDFW and others. Stocked species include rainbow trout, largemouth and smallmouth bass, yellow perch, eastern brook trout, kokanee, crappie, and bullhead.

The only federally listed fish species known to occur within the project site is a winter run of steelhead salmon (WDFW 2008). Steelhead have been reported in Rock Creek and could be present in the other fish-bearing streams.

Only coho salmon, steelhead, and cutthroat trout are known to occur above the outlet of Lake Sawyer (Covington Creek). Coho salmon and cutthroat trout have been reported upstream as far as Jones Lake in Rock Creek (Kerwin and Nelson 2000). Steelhead move up a mile or two past Lake Sawyer into Rock Creek but have not been reported as far upstream as coho or cutthroat. Coho and cutthroat trout have been reported in Ravensdale Creek (WDFW 2008). Life histories of these three native species are described in more detail below.

Coho Salmon

Coho salmon adults within the Green/Duwamish River system are generally 3-year-olds, having spent approximately 18 months in fresh water and 18 months in salt water. In the Green River, coho salmon begin entering the system in August and spawn from late September to mid-January. The Lake Sawyer run is a late run which moves into the lake in late December with most fish spawning in Ravensdale Creek (City of Black Diamond 1996). In general, earlier migrating fish spawn farther upstream within a basin than later migrating fish, which enter rivers in a more advanced state of sexual maturity (Sandercock 1991). Coho often move upstream into the smaller streams and tributaries to spawn. Coho spawn in all available tributaries and in the mainstem Green River. Mainstem spawning is heaviest in areas between Burns Creek (RM 38.0)

and the Tacoma Headworks dam (RM 61.0) (USFWS and NMFS 2000). Coho fry begin hatching in late winter and typically rear 1 year in freshwater prior to migrating to Puget Sound the following spring. Juvenile coho salmon are found rearing in mainstem sections of the Green River below Howard Hanson Dam and in all tributaries that are accessible to adult spawners. Peak outmigration of juvenile coho generally occurs in May. These fish migrate relatively quickly out to the open ocean, where they overwinter before returning the following summer.

Green River coho salmon are part of the greater Puget Sound/Strait of Georgia ESU considered by NMFS to be a candidate for listing under the ESA. Coho salmon of the Green River system are divided into the Soos and Newaukum Creek stocks. Both stocks are of mixed origin and contain both native and non-native coho. The Newaukum Creek stock is considered depressed, and the Soos Creek stock is currently considered healthy (WDFW and WWTIT 1994).

Steelhead

Steelhead and rainbow trout represent different life histories of the same species of salmonid. Steelhead migrate to salt water after spawning in fresh water (anadromous), but rainbow trout spend their entire lives in fresh water. Two major run types, winter and summer steelhead, are found in the Green/Duwamish river basin. Winter steelhead adults begin river entry in December and generally spawn from February through May. The winter steelhead run is native to the Green River (WDFW and WWTIT 1994). The Green/Duwamish river basin also supports a non-native origin summer steelhead run. Summer-run steelhead generally enter the river from May through October and spawn from February through April. Winter steelhead spawn in the Green River from approximately RM 26.0 to RM 61.0 (USFWS and NMFS 2000). Summer steelhead principally spawn in the mainstream and lower tributary areas from the Tacoma Headworks (RM 61.0) downstream to the upper Green River Gorge (RM 58.0). The resultant fry typically outmigrate between April and June after spending at least one complete year and up to three years in fresh water.

Resident rainbow trout spend their entire lives in freshwater wherever deep, cool water with high oxygen content can be found. Rainbow trout spawning also occurs during the spring, with the juveniles occupying available habitat within the natal stream.

Green/Duwamish River steelhead are part of the Puget Sound ESU. The Puget Sound steelhead stock is considered by NMFS to be at risk of becoming endangered and was therefore listed as threatened under the federal Endangered Species Act (72 FR 26722). Both the summer and winter Green/Duwamish River steelhead stocks were listed as healthy by the WDFW based on meeting escapement goals in the early 1990s (WDFW and WWTIT 1994).

Cutthroat Trout

Resident cutthroat trout are present throughout all perennial reaches of the Green River drainage (WDFW 2000). Anadromous fish are believed present through all accessible reaches of the system (USFWS and NMFS 2000). Anadromous cutthroat enter the river from July through February and spawn from March into early May. Resident trout spawn into June. Spawning occurs throughout the system where medium to coarse gravel is found. The fry emerge from late March to mid-July depending on spawning location and timing. Anadromous cutthroat trout fry

may rear in fresh water for up to several years before migrating to the sea which usually occurs in the spring, peaking during May. They typically spend less than a year in the ocean before returning to spawn. Cutthroat may spawn several times during their lifespan.

The population of coastal cutthroat trout in the Green/Duwamish River system is small and not well studied (USFWS and NMFS 2000). Less than 50 are caught by anglers each year (WDFW 2000). It is considered to be native and the population is maintained through wild production (WDFW 2000). The stock status is labeled unknown by WDFW due to insufficient data. The Green/Duwamish River coastal cutthroat trout population is part of the Puget Sound ESU. The Puget Sound ESU does not warrant listing under the federal ESA, as populations have been fairly stable over the past 10 to 15 years (64 FR 16397).

2.7 Fish Use: Off-site

This section describes fish use in off-site watercourses potentially affected by project actions.

Chinook, coho, chum, pink, and sockeye salmon; steelhead; and coastal cutthroat trout are currently found at various times of the year in the Green/Duwamish River System downstream of the project site (Table 2). Native char (bull trout and Dolly Varden) may be present though this is not considered likely (WDFW 1998, Kerwin and Nelson 2000, USFWS 2005). Native resident salmonids in the WRIA include rainbow and cutthroat trout and mountain whitefish. Other native resident fish species are also present, including lamprey and various minnow, sculpin, and sucker species.

Other listed species found downstream of Lake Sawyer and elsewhere in the Green River watershed include Chinook salmon and bull trout.

Chinook Salmon

Chinook salmon within the Green/Duwamish River basin originate from both native and hatchery fish. The stock is of mixed origin, as natural production is currently supplemented by hatchery releases from the Green River Hatchery located on Soos Creek. Most Chinook salmon in the Green River system are summer/fall run fish (WDFW and WWTIT 1994, Ruggerone and Weitkamp 2004). Adult summer/fall Chinook return to the Green River from late June through September and spawn from early September into mid-November (USFWS and NMFS 2000). The Duwamish/Green stock spawns primarily in the main river channel from Kent (RM 24.0) to the Tacoma Headworks diversion (RM 61.0). The Newaukum Chinook stock spawn in Newaukum Creek (RM 40.7). Fry emergence is usually complete by February with most summer/fall run fish outmigrating within 2 to 3 months of emergence.

Chinook in the Green River are part of the Puget Sound Evolutionarily Significant Unit (ESU) currently listed by the National Marine Fisheries Service (NMFS) as threatened under the Endangered Species Act (ESA). Both Green River Chinook stocks are listed as healthy by the Washington Department of Fish and Wildlife (WDFW) based on stable escapement levels.

Table 2
Green/Duwamish River Salmonid Temporal Distribution

Stock	Lifestage	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Chinook [a]	Adult Migration	■	■	■	■	■							■
	Spawning			■	■	■							
	Incubation/Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Outmigration								■	■	■	■	■
Coho [b]	Adult Migration		■	■	■	■	■	■					
	Spawning			■	■	■	■	■					
	Incubation/Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Outmigration									■	■	■	■
Chum [c]	Adult Migration			■	■	■	■						
	Spawning					■	■	■					
	Incubation/Rearing					■	■	■	■	■	■	■	
	Outmigration								■	■	■	■	
Pink [d]	Adult Migration	■	■	■									
	Spawning		■	■	■								
	Incubation/Rearing		■	■	■	■	■	■	■	■	■	■	
	Outmigration										■	■	
Steelhead	Adult Migration	■	■	■	■	■	■	■	■	■	■	■	■
	Spawning								■	■	■	■	■
	Incubation/Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Outmigration										■	■	■
Cutthroat	Adult Migration	■	■	■	■	■	■	■	■				
	Spawning									■	■	■	
	Incubation/Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Outmigration										■	■	■
Char [e]	Adult Migration	■	■	■	■	■	■					■	■
	Spawning			■	■	■	■						
	Incubation/Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Outmigration										■	■	■

(Adapted from: Williams et al. 1975, WDFW and WWTIT 1994, USFWS and NMFS 2000, WDFW 2007)
[a] Includes both Green/Duwamish and Newaukum Creek summer/fall Chinook stocks.
[b] Includes both Green/Soos (healthy) and Newaukum Creek (depressed) coho stocks.
[c] Includes both Green/Duwamish (unknown) and Crisp Creek (healthy) chum stocks.
[d] Pink salmon spawn only in odd years. Periodicity is based on regional averages. Status not listed by WDFW.
[e] Native char include both bull trout and Dolly Varden. Periodicity based on general/regional information.

Chum Salmon

Chum salmon adults return to the Green River from early September through December. Spawning takes place from early November through mid-January and is concentrated in and downstream of Burns Creek (RM 38.0). Incubation takes between 90 and 150 days depending on water temperature, with fry emergence occurring from February through July. Chum fry usually remain in fresh water for only a few days before beginning their downstream migration to estuarine habitat in the lower Duwamish River and Elliot Bay. Migration takes place at night.

Two chum salmon stocks are recognized in the Green River system (WDFW and WWTIT 1994). The Green/Duwamish stock may be a remnant native stock, but its status is considered unknown by WDFW due to insufficient data. The Crisp Creek fall chum stock originated from releases of Quilcene and Hood Canal stocks in the early 1980s and is considered healthy by WDFW.

Pink Salmon

Not much is known about the distribution of pink salmon in the Green River (USFWS and NMFS 2000). Pink salmon return to the Duwamish and lower Green River every other year (odd years) in the fall and probably spawn between August and October. Pink salmon typically experience a 2-year life span. Females dig redds in riffles or runs with small- to medium-sized gravels. Pink fry begin hatching between February and May and almost immediately begin their migration to Puget Sound. Juveniles form large schools in estuarine areas during the summer where they feed mostly on various species of zooplankton. After several months, the fish move out to the ocean, typically running in the shallower areas nearshore.

The Puget Sound pink salmon stock is considered by NMFS to be healthy and not at risk of extinction based on escapement near historic levels (60 FR 51928). No Duwamish/Green River pink salmon stock is recognized by WDFW (WDFW and WWTIT 1994).

Sockeye Salmon

Sockeye salmon exhibit a variety of life-history types including freshwater (kokanee), lacustrine sockeye, and river-type sockeye. Lake-rearing stocks represent the most common and typical life history. Sockeye that rear in rivers for 1 to 2 years (river-type sockeye) are less common and little is known about them. The Green River possesses river-type sockeye in very low numbers (USFWS and NMFS 2000). Only between 100 and 400 are reported annually near the Headworks Dam (Kerwin and Nelson 2000). Sockeye salmon enter most Puget Sound rivers from mid-June through August. Spawning takes place from late September to late December and occasionally into January. Peak emergence for similar river systems occurs from early March to mid-May.

The origin of adult sockeye observed spawning in the Green/Duwamish river basin is not known. It is hypothesized that the fish may either be strays from other populations, a riverine form of sockeye, or some combination of both (Kerwin and Nelson 2000).

Native Char

Bull trout and Dolly Varden are native char, typically found in high mountain streams or near cold perennial springs, although individual fish can occur downstream throughout larger river systems (Rieman and McIntyre 1993, Buchanan and Gregory 1997). Water temperature above 15°C is believed to limit bull trout distribution, which partially explains the generally patchy distribution within a watershed (Fraley and Shepard 1989; Rieman and McIntyre 1995). Preferred spawning habitat consists of low-gradient streams with loose, clean gravel (Fraley and Shepard 1989) and water temperatures of 5°C to 9°C in late summer to early fall (Goetz 1989). Bull trout generally live in fresh water their entire lives, although a small component of the Puget Sound run is anadromous. Dolly Varden are generally anadromous. Self-sustaining bull trout populations in the Green/Duwamish River Basin have not been documented, although individual fish have been observed (WDFW 1998, Kerwin and Nelson 2000).

Bull trout were historically found in the lower Green River but have not been recently documented. Their presence is considered “possible but not likely” (Kerwin and Nelson 2000). Any bull trout found in the Green/Duwamish River are part of the Puget Sound bull trout

Distinct Population Segment (DPS) identified by the United States Fish and Wildlife Service (USFWS). All bull trout in the coterminous United States were listed by the USFWS as threatened under the ESA (64 FR 58910). Dolly Varden are proposed for listing as threatened due to their similarity of appearance to bull trout (66 FR 1628). The stock status is labeled unknown according to WDFW (1998) due to insufficient data. The mainstem of the Green River, but not any of the tributaries, has been listed as Critical Habitat for bull trout (USFWS 2005).

2.8 Barriers to Fish Migration

The water surface level of Lake Sawyer is controlled by a concrete weir which was constructed at the head of Covington Creek in 1952. A fish ladder at this location allows upstream fish passage when sufficient flow is present. According to Patrick Trotter, a consulting fisheries biologist, the lake level naturally draws down during the summer which exposes the fish ladder built at the weir (AESI 2000). Mr. Trotter believes a beaver dam was originally at the outlet of Lake Sawyer to Covington Creek and the late winter run of coho unique life history timing is a product of the natural drawdown of Lake Sawyer and a long history of a natural barrier at the outlet. Because flows leaving the lake are low in the summer when adult Chinook would normally return, no Chinook have been reported upstream of the head of Covington Creek.

Beaver dams and other partial natural barriers may prevent fish from moving upstream into Black Diamond Lake at certain flow levels. A culvert off-site near the north property boundary may prevent upstream fish passage in Stream S4. An on-site culvert under a logging road near the headwaters of Stream S5 may prevent upstream fish migration at this point. However, the culvert is in a steep section of stream and it is not known if any fish are present at this location. Fish habitat upstream of this point is minimal.

2.9 Federally Protected Fish Species

Three fish species listed as threatened under the federal ESA and one fish species proposed for listing could potentially be directly or indirectly affected by the Proposed Action and Alternatives. The listed species are Chinook salmon, steelhead, and bull trout. The Dolly Varden is proposed for listing because of its similarity of appearance to bull trout. In addition, Chinook, coho, and pink salmon habitat has been designated Essential Fish Habitat (EFH) by the Pacific Fisheries Management Council. Descriptions of the life history and occurrence of these fish species in the project area are provided in Section 2.8.

3.0 IMPACTS ANALYSIS

Impacts and mitigation measures for the Proposed Action and the No Action Alternative are presented in this section. Evaluation of impacts was based on the level of quantification provided in supporting documents prepared by other EIS consultants, in particular the water quality analysis prepared by A.C. Kindig & Co. (2008), surface hydrologic analysis prepared by Triad (2008), and geology, soils, and ground water analysis prepared by AESI (2008).

The capacity of fresh water streams to support a population of salmonid fishes is a function of the quality and quantity of habitat conditions for various life history stages of existing or potentially existing species. Factors related to land development that influence habitat conditions are generally associated with:

- Physical loss or degradation of habitat features resulting from structures being built within or over the active channel, adjacent riparian area, or potential channel migration zone;
- The change in delivery of fine and coarse sediments to the stream channel;
- Impacts to the functions and values provided by riparian zones;
- Effects on water quality; and
- Changes in surface and ground water quantity.

The influence of each of these factors on fish habitat and existing site conditions is discussed below for the construction and post-construction (developed) phases of the project.

3.1 Construction Impacts Analysis

3.1.1 Proposed Action

Construction activity under the Proposed Action would include new road and utility stream crossings of Streams S-2, S-4 and S-5, installation of one new stormwater outfall to Stream S-4, clearing and grading of several hundred acres of the site, and filling of approximately 0.6 acres of wetland associated with streams.

Direct Impacts

Direct impacts to fish habitat are most likely to occur when construction activities take place at or below the ordinary high water mark (OHWM) of a fish-bearing stream, side-channel, or associated open water wetland. Construction within flowing wetlands or streams greatly increases the chance of erosion and sediment transport, and makes it more difficult to protect water quality from other potential construction effects such as contaminant spills. Construction within or near both fish-bearing and non-fish-bearing streams can eliminate nutrient input,

primary productivity, and macro-invertebrate production which contribute to the productivity of local fish populations.

Onsite development under the Proposed Action includes three tasks where construction in, near or over a waterbody could directly impact fish-bearing streams:

- Installation of a new stormwater discharge outfall to Stream S-4;
- A new stream crossing of Stream S-4; and
- A new stream crossing of Stream S-5.

The new Stream S-4 outfall would be constructed on the west bank of the channel just upstream (south) of the northern property boundary. Under standard Best Management Practices (BMP) the new outfall would be created in uplands near the creek. A short channel from the new outfall to the existing channel would then be provided to convey storm water releases. This minimizes construction activity in the natural channel because virtually all work on the outfall and new channel can be kept isolated from the natural channel by leaving the bank at the future confluence undisturbed. The final construction action would be to remove the bank between the new outfall channel and the natural channel and cover disturbed substrate with a stream gravel mix. Stream S-4 in this area provides moderate quality fish rearing and migration habitat and some care would be required in siting the actual outfall. But there are no steep slopes that might be disturbed or unusually valuable habitat. No significant adverse effects are expected.

The Stream S-4 and S-5 crossings are over stream reaches believed to be used by salmonids. The Stream S-4 crossing would consist of a full span bridge or bottomless arch-culvert covering a stream length of approximately 50 feet. The structure would meet all regulatory requirements for passage of flow and debris and little to no work below OHW would be required. The Stream S-5 crossing would occur at or near an existing logging road crossing and would replace the crossing. Suitable mitigation could include removal of the existing crossing and restoration of the riparian corridor once the new crossing is serviceable. A full span bridge or bottomless arch-culvert covering a stream length of approximately 50 feet would be used with all utilities contained in the crossing. If the Stream S-5 crossing occurs at the existing crossing location, instream work would be required to remove the existing culvert and create a new fish-passable stream channel. BMPs require work be completed when the stream is either naturally dry or by bypassing all instream flow around the work area. Because the Stream S-5 channel is small and contains little if any flow during the summer, common TESC measures are expected to provide adequate protection of downstream habitat. If the Stream S-5 crossing occurs at a new crossing location, no instream work would be required. However, mitigation could include removal of the existing crossing which would require the same instream effort described above. Because of the small channel size, absence of significant habitat, and minor flow volumes, neither situation is expected to result in significant adverse effects to fish or aquatic habitat.

Several tasks are proposed near non-fish-bearing streams and wetlands that could indirectly affect fish habitat downstream:

- A crossing of Stream S-2 is proposed. This watercourse is non-fish-bearing with all flow infiltrating to ground water. Thus, any work near this watercourse has a very low risk of affecting fish.
- A number of non-fish-bearing wetlands would be impacted by some minor filling (Wetland Resources Inc. 2008). Of the wetlands that would be impacted, only Wetland S-18 is directly tributary to a fish-bearing creek (Stream S-4). Wetland S-18 consists of fringe wetlands running in a narrow band along both sides of Stream S-4 and supported by flows in the creek. Thus, the minor impacts (less than 0.05 acres of wetland disturbance) caused by the road crossing and outfall placement are not expected to have a significant effect on fish habitat.

Off-site road improvements could include paving and shoulder work along portions of the Auburn-Black Diamond Road. Work near the existing Rock Creek crossing and one or two small tributaries to Rock Creek may be necessary. While no specific plans are available, it is assumed that any work would consist of minor road improvements with possible short extensions to existing crossings. Culvert or bridge extensions would require Hydraulic Project Approval from WDFW and possibly federal permits if wetlands were affected. Maintenance or enhancement of fish passage would be required and mitigation typically includes riparian enhancement. These minor off-site improvements are not expected to have a significant adverse effect on fish or fish habitat.

Stream (ditch) S-3 contains a natural source of water but is isolated, seasonal, and non-fish-bearing. The ditch was formed when a logging road passed through a wetland. Flow from the wetland runs down an old logging road before infiltrating when the road reaches the recessional outwash soils near the toe of the slope. The portion of ditch not conveyed within the wetland is proposed to be filled to help protect wetland hydrology. Because the channel is isolated and non-fish-bearing, no impacts to fish are possible.

The conceptual design shows a total of approximately 0.6 acres over 9 wetlands would be filled for the project (Wetlands Resources Inc. 2008). None of the wetlands would be filled in their entirety. Impacted wetlands are for the most part well removed from fish-bearing waters and do not provide habitat for fish. Some minor loss of hydrologic function could be expected. However, mitigation to include wetland replacement, buffer enhancement, and hydrologic supplementation, along with the relatively miniscule effect within each contributing basin precludes overall impacts to fisheries resources from being significant.

With proposed Temporary Erosion and Sediment Control (TESC) BMPs (A.C. Kindig & Co. 2008) it is unlikely that any significant direct adverse effects on fisheries resources would result from construction under the Proposed Action.

Impacts to Fine Sediment Recruitment

The greatest risk to fish habitat resulting from land development construction activities is the potential for fine sediments to be mobilized from newly exposed soils by rainfall or stormwater

runoff. Fine sediments less than 0.85 mm in diameter (fine sand and smaller) can impair water quality and degrade salmonid spawning habitat and spawning success if heavy sedimentation of gravels occurs during spawning and incubation (Chapman 1988, Tappel and Bjornn 1983). Fine sediments in large volumes can reduce summer and winter rearing capacities by filling pools, embedding stream substrates, and decreasing food production (Peterson et al. 1992, Lisle and Hilton 1992).

Very fine sediments, which elevate turbidity for a sustained period, can directly affect fish behavior and physiology, or indirectly decrease food supply, habitat availability, or the ability of fish to find prey. Turbidity can also exacerbate existing problems, such as poor DO levels or high temperatures, and lower fish tolerance to other water quality parameters. Behavioral modifications include cessation of feeding and outmigration. Physical reactions include excessive mucus secretion, excretory interference and respiratory complications resulting in possible suffocation (Redding et al. 1987).

The impact of any fine sediment transported to fish habitat depends in part on the time of year, watercourse gradient, and habitat type. If TESC measures failed, sediment would be transported to fish-bearing waters primarily during the winter when there would be sufficient stream energy available to mobilize and transport the material. Fine sediments are deposited in low-gradient streams (those with less than approximately 1 percent slope), which means that Black Diamond Lake, Black Diamond Creek, Rock Creek, and Streams S-4 and the lower part of Stream S-5 are potentially vulnerable.

Spawning habitat used or potentially used by anadromous salmon and/or resident trout is present on the project site in Rock Creek, Stream S-4, and Stream S-5. None of these streams contain regionally significant spawning habitat but may be important in maintaining local resident populations and contributing to the larger basin production for migratory species (Kerwin and Nelson 2000, USFWS and NMFS 2000, Williams et al. 1975, WDFW and WWTIT 1994). Thus, the highly vulnerable incubation stage of the salmonid lifecycle is potentially at risk of being affected by construction under the Proposed Action.

A National Pollutant Discharge Elimination System (NPDES) Permit is required for this project from the Washington State Department of Ecology (Ecology) for discharge of stormwater. The NPDES permit requires preparation of a stormwater pollution prevention plan (SWPPP). TESC BMPs would be implemented and maintained in accordance with the SWPPP. Clearing and grading for construction exposes erodible soils and increases the rate of surface water runoff from storms because of soil compaction and removal of vegetation. The most significant increase in erosion potential would be during the early construction phase when earthwork activities near onsite watercourses commence. BMPs described by A.C. Kindig & Co. (2008) would be implemented to prevent or minimize impacts to water quality from grading and construction work.

A.C. Kindig & Co. (2008) evaluated the risk of erosion due to construction activities considering site-specific conditions and assuming BMPs required under an NPDES permit and the King County Surface Water Design Manual (SWDM) were implemented. The TESC BMPs are

described in Section 3.1 of the water quality analysis (A.C. Kindig & Co. 2008). With the use of BMPs, proper site inspection, and implementation of the SWPPP, Hydraulic Permit Approval (HPA), and Section 404 and 401 permit conditions, impacts due to sediment releases are unlikely to cause significant adverse effect to aquatic habitat (A.C. Kindig & Co. 2008). Thus, the potential for adverse effects on fish is not considered significant.

Impacts to Coarse Sediment Recruitment

Coarse sediments enter the stream network naturally through bank erosion, mass wasting events, and catastrophic landscape events such as dam-break floods and debris torrents. Land use changes can influence delivery of coarse sediments to streams by altering natural rates of bank erosion, mass wasting, and catastrophic events. The most notable practices are generally related to disturbances of steep slopes and bank protection to shield project features from floods. Whereas fish habitat is to a large extent dependent on sufficient coarse sediment in streams (spawning gravels, deformable bed thickness capable of creating deep pools, etc.), too much coarse sediment can reduce the fish production capacity of a stream. Sediments can fill pools or deposit amounts that change bed elevations and alter stream courses. Dry reaches can result where summer low flows are inadequate to fill increased interstitial spaces in deposits of coarse sediment. Coarse sediment volumes deposited in thickness greater than the height of channel obstructions (large woody debris, boulders, etc.) would reduce the hydrologic value of the obstructions. Such deposits are considered too great a volume to benefit fish habitat.

Under existing conditions, there are no significant deposits of coarse sediments found on the project site that adjacent streams are capable of transporting. Rather, coarse sediment is recruited at low levels from channel banks throughout the system. Only Stream S-5 is steep enough to mobilize and carry coarse sediment. But this creek drains directly to Black Diamond Lake were any larger particles would deposit without further movement. The very large wetlands that form the headwaters of Stream S-4 provide an unusually stable stream flow in this channel and buffer the stream from larger storm events. An examination of substrate in this channel found that most particles larger than an inch in diameter were moss or algae covered indicating a lack of transport (AESI 2008). Any sediment that did move downstream through Stream S-4 would deposit in Jones Lake. Thus, it is unlikely that construction of the new stream crossings or outfalls would interrupt any significant supply of coarse sediment from the site.

Landslide hazard areas were described and ranked by AESI (2008 - see Section 4.4.2). High hazard areas that could potentially deliver sediment to waterbodies are present near Black Diamond Lake and Black Diamond Creek, as well as in the Green River Valley. The risk of initiating landslides in these area during construction was evaluated by AESI (2008 – see Section 6.3). AESI determined that the stability of slopes potentially contributing mass quantities of sediments would not be affected by development of the Proposed Action or No Action alternatives. This was based on the proposed design which avoids work near steep slopes and keeps stormwater away from high hazard slopes and streams, as well as from uplands where infiltration could lead to increased groundwater or spring discharge onto or near steep slopes.

Impacts to Water Quality

Water quality components that are critical to fish habitat and most often affected by land development include water temperature, turbidity, toxic chemicals, metals, DO, nutrients, and pH. Construction measures designed to protect water quality and their expected efficacy are described by A.C. Kindig & Co. (2008 – See Section 3.1). The analysis reached a conclusion that with proper control of stormwater drainage, BMPs defined for culvert work below the OHWM, and good accidental spill response planning, adverse impacts from fine sediment, alkaline (high) pH, and construction-related accidental hazardous material spills would be reasonably expected to be avoided or limited to small short-term and mainly onsite occurrences with no lasting adverse effects. Some minor introductions of fine sediments to stormwater leaving the site during heavy rainstorms may occur from time to time, but stringent implementation of SWPPP measures and countermeasures required by federal, state, and City of Black Diamond permits should identify and rapidly correct such occurrences so that they would not adversely affect habitat through water quality impacts. Therefore, no significant adverse construction-related water quality impacts to fish or fish habitat are expected.

Impacts to Listed Species

No listed fish species are found on the project site. Indirect (off-site) impacts were evaluated above. Construction impacts described in Section 3.1 are not likely to result in adverse effects to listed species or their habitat due to the provision of water quality and water quantity mitigation; the reasonable likelihood that proposed mitigation measures would adequately protect aquatic habitat; and the absence of spawning habitat for listed species within, adjacent to, or within a reasonable distance downstream of the project site. Thus, no significant construction-related adverse impacts to listed species are expected.

3.1.2 No Action Alternative

The No Action Alternative is defined by what would be most likely to happen if the Villages MPD did not occur. Logging activities could continue to take place onsite in the future and some of the area could be developed as individual or small clusters of parcels. Sensitive area buffers would be protected the same as with the other alternatives, but the larger open space parcels adjacent to sensitive areas and elsewhere would not be created. There would be no coordinated opportunity to deal with stormwater treatment and detention, so much of the area would be dealt with on a lot-by-lot basis.

Development of the No-Action Alternative has less potential for impact to water quality than construction under the Proposed Action because of the absence of large-scale grading and the staggered timing of potential impacts. However, separate ownership and isolated development of parcels could lead to a less cohesively planned roadway and driveway layout and the lack of an integrated drainage and erosion control plan. Roadway or driveway access could cross or drain to wetlands and/or streams and cause localized sediment introduction or turbidity. If the roadways or driveways are unpaved, sediment introduction, though minor, could be chronic where such impacts occurred.

The No-Action Alternative could have a slightly greater risk to fisheries resources due to the less-coordinated approach to stream and buffer protection during construction. However, the risk of large scale impacts due to a catastrophic rainfall event is less, as less overall grading would occur. Therefore, construction effects on water quality, if any, would most likely be relatively small.

3.2 Post-construction Impacts Analysis

This section evaluates long-term impacts on fisheries resources of the developed project (post-construction) for the Proposed Action and No Action Alternatives. Direct and indirect effects of the altered landscape and land use are examined. Impacts related to water quality, water quantity, and sediment input are summarized from other reports or other portions of the EIS.

The following text compares aquatic habitat-related functions and values of onsite and off-site watercourses under both existing and proposed conditions utilizing best available science.

3.2.1 Proposed Action

Under the post-development condition, all infrastructure and mass grading would have been completed and major disturbed areas would have been stabilized and revegetated. It is expected that individual site development and onsite road construction could continue for many additional years but this would occur with only minor localized grading in upland areas and using established stormwater controls. The stormwater system would be fully constructed and would be managed consistent with the Ecology 2005 Manual as described by Triad (2008).

Direct Impacts

No major direct changes (e.g., channel moving) to any regional streams are anticipated under either alternative. Two new or upgraded stream crossings (Streams S-4 and S-5) and one new stormwater outfall (Stream S-4) are the only projects proposed that would require work within or above a stream channel (Figure 2).

Both new stream crossings are over reaches believed to be used by salmonids. Due to the small stream sizes, fish use is likely by resident trout only, or could possibly include juvenile coho use in Stream S-4. Both crossings would consist of full span bridges or bottomless arch-culverts covering a stream length of around 50 feet. The structures would meet all regulatory requirements for passage of fish, flow, and debris. The bridges would reduce habitat quality over the covered section of each stream. Neither affected stream reach provides a regionally significant resource or contains unusually rare or sensitive habitat or species. As such, the impacts are not expected to be significant on a regional scale.

The stormwater outfall would be built away from the channel in an upland area and then connected to Stream S-4 with a new channel. Some minor hydrologic effects on Stream S-4 in the vicinity of the outfall channel connection are possible. The addition of a second flow source at this location could influence habitat type and quality in the connection area. However, habitat in this channel consists almost entirely of riffle or run morphologies and is fairly stable based on

the moss and algae covered substrates. Hydraulic changes given the minor overall change in flow are expected to be minor (AESI 2008).

Increased development in the region would also bring additional people in closer contact with local rivers and streams. Angling in streams draining the site is against state law, though poaching and legal angling pressure on regional fisheries would be expected to increase. Increased human activity near the streams can also add stress to fish populations and result in significant degradation to the banks, stream channels, and riparian vegetation. No individual lots would be directly adjacent to fish-bearing stream riparian corridors so homeowners can not extend landscaping and other disturbances into these buffers to the detriment of fish habitat. New trail systems would be designed to focus human activity in locations away from streams to help avoid unregulated use of the riparian corridors.

No significant direct adverse effects to streams or fisheries resources are expected as a result of the proposed action. Mitigation measures suggested in Section 4.2 would further reduce any minor long-term effects.

Impacts to Fine Sediment Recruitment

Most of the existing roads on the project site were built for past forest management activities. The road bases consist of native material or native material overlain with gravel. Past traffic on these roads including heavy trucks, bicycles, horses, and off-road vehicles has accelerated the production and transportation of fine sediments. Drainage ditches collect the fine material and transport it during rain events to natural surface drainages. These roads would be eliminated as the surrounding portions of the site were developed. This would reduce the recruitment of fine material to area rivers, especially where existing dirt roads are within 200 feet of surface drainages (Burroughs and King 1989).

The risk of long-term erosion under a post-development scenario is likely to decrease for a site with the long-term disturbance history that occurred due to logging. Under existing conditions, there are many miles of dirt road and areas with poorly vegetated slopes. Once buildings and roadways are completed and landscaping and other vegetative cover established, the risk of erosion is expected to be similar to or less than existing conditions. Groundwater fed spring flows and instream flows are not expected to change significantly, thus instream erosion and sediment transport would not be affected (AESI 2008).

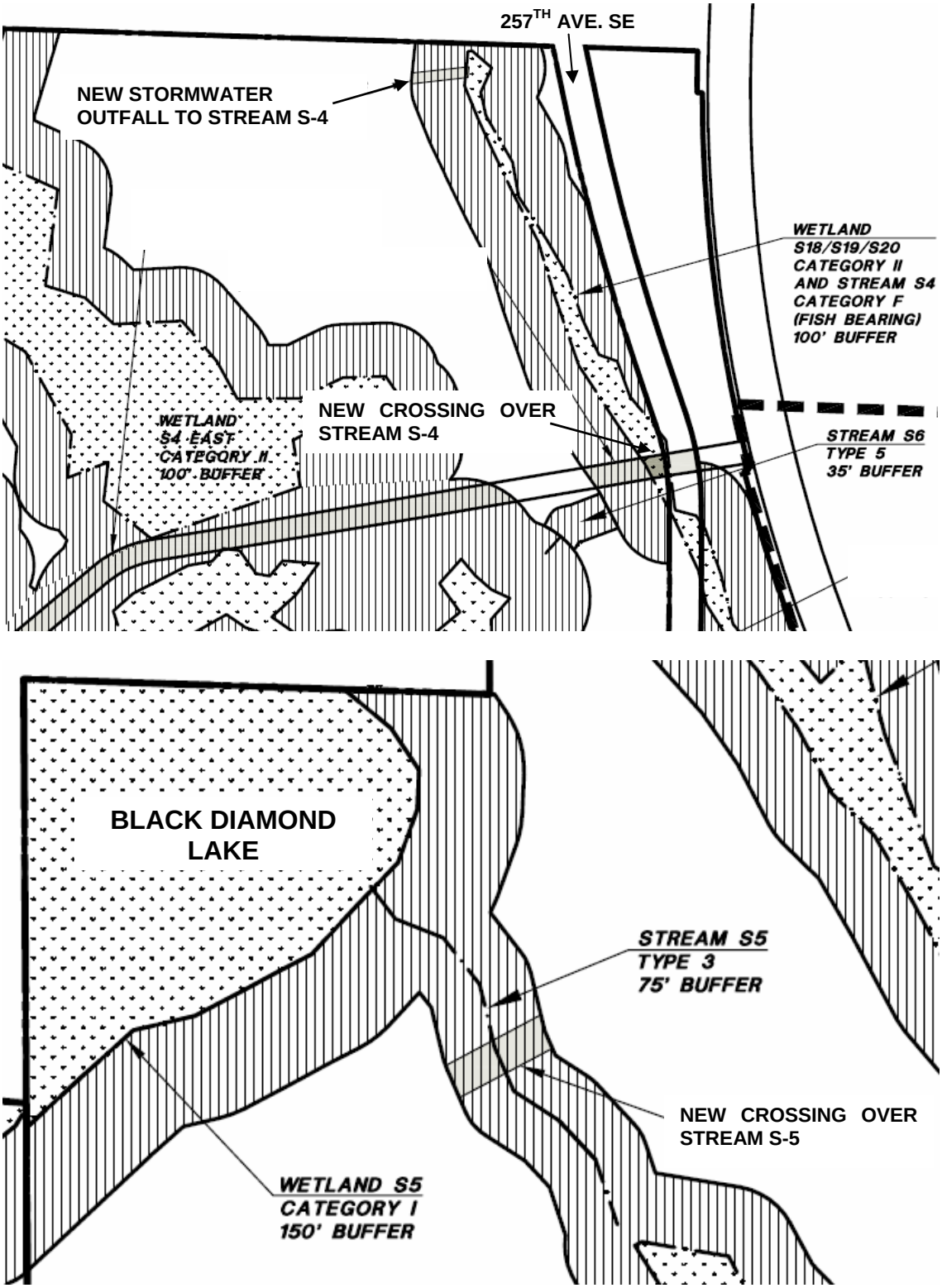

Figure 2. Proposed stream impact locations.

Impacts to Coarse Sediment Recruitment

As discussed in Section 3.1, there are no onsite channels with the capacity to transport coarse sediment to areas with regionally important salmonid habitat (e.g. Rock, Crisp, and Covington Creeks). Coarse sediment supply to these creeks and fluvial transport mechanisms are not expected to be affected for the following reasons:

- There are no significant sources of potential coarse sediment recruitment on the site.
- Lakes that would intercept coarse sediment and prevent further downstream transport are found downstream of channels with some capacity to transport coarse sediments (e.g. Black Diamond Lake, Jones Lake).
- AESI (2008) reviewed areas of potentially unstable slopes near waterbodies and found that stability is not expected to change with development.
- Large buffers would be maintained adjacent to high landslide hazard areas thereby maintaining slope stability on the banks and steep slopes near waterbodies.
- Although minor changes to instream flows are predicted, flows would not change sufficiently to affect sediment transport characteristics.

Thus, development-related changes to the watercourses are not expected to have a significant impact on coarse sediment recruitment.

Impacts to Riparian Functions

Riparian buffers perform many functions essential to fish survival and productivity. Vegetation in riparian areas shades streams and maintains cool water temperatures needed by most fish native to the Pacific Northwest. Plant roots stabilize stream banks and help control erosion and sedimentation. Adjacent vegetation creates overhanging cover for fish. Riparian habitat contributes leaves, twigs, and insects to streams, thereby providing basic food and nutrients that support fish and aquatic wildlife. Large trees that fall into streams create pools, riffles, backwater, small dams, and off-channel habitat that are needed by fish for cover, spawning, rearing, and protection from predators. Pools help maintain riffles, where gravel essential for spawning accumulates. Riparian vegetation, litter layers, and soils filter incoming sediments and pollutants, thereby assisting in the maintenance of high water quality needed for healthy fish populations. Riparian habitat moderates stream volumes by reducing peak flows during flooding periods and by storing and slowly releasing water into streams during low flows (Knutson and Naef 1997).

The proposed riparian corridors and buffer widths adjacent to onsite streams have been designed to accommodate the proposed development and maintain significant functionality based on Best Available Science (Table 3). Most of the proposed buffer widths are a minimum but under developed conditions would actually exceed that value. For example, Rock Creek, which is the largest fish-bearing stream onsite, is surrounded by wetlands between the channel and proposed

development activities. The proposed 150-foot buffer would begin from the edge of the fringing wetlands. The actual channel ranges around 200 feet to almost 1,000 feet away from the wetland edge. So in reality, the Rock Creek buffer would be between 350 feet and 1,150 feet. The second largest fish-bearing watercourse is Stream S-4. Development is proposed along only one side of about half of the length of the onsite channel. Therefore, for about 25 percent of the Stream S-4 channel length, the minimum buffer would be 100-feet. For 75 percent of the channel length the buffer would remain untouched for a distance up to 2,000 feet.

The following discussion provides a brief analysis of the science that went into the evaluation of impacts to changes in riparian functions and values.

- Large Woody Debris

Large woody debris consists of downed tree stems and branches and is a functionally important structural component of stream channels in the Pacific Northwest (Fetherston et al. 1995, Naiman and Beechie 1992). Once large woody debris reaches a stream it may remain in place or migrate downstream depending on the size of the wood and stream energy. Large woody debris can have a major effect on the quality of fish habitat within a stream, as it influences the routing of water and sediment, helps trap and stabilize coarse gravel deposits, plays a role in the development of channel morphology, is an important source of overhead and velocity cover for fish, and acts as a surface for biological activity (which contributes to the productivity of a stream system) (Bisson et al. 1987, Beschta et al. 1987, Sullivan et al. 1987, Bilby and Ward 1991).

Table 3
Proposed Stream Buffers

Waterbody	**Proposed Buffer**	**Comments**
Stream S-2	50 feet	All surface water infiltrates before reaching fish-bearing waters
Stream S-4	100+ feet	Fish-bearing; no development proposed along most of this channel
Stream S-5	75+ feet	Fish-bearing; located within high landslide hazard area; no development proposed along most of this channel
Stream S-6	50+ feet	No development proposed along most of this channel
Stream S-7	--	No development proposed in this basin
Rock Creek	150+ feet	Fish-bearing; channel surrounded by Category 1 wetlands
Black Diamond Lake	150+ feet	Fish-bearing; fringing wetlands expand buffer in some locations

The probability that a falling tree will reach a creek is a function of its distance from the creek, tree size, ground slope near the stream, and predominant wind direction. In a mature coniferous forest, the majority (70 to 90 percent) of large woody debris in a stream comes from within 50 feet of the stream; 90 to 99 percent comes from within 100 feet; and virtually all large woody debris contributing to streams in a typical Puget Sound lowland forested region comes from within a distance equal to approximately 150 feet (Murphy and Koski 1989, McDade et al. 1990, Robison and Beschta 1990, Federal Ecosystem Management Assessment Team [FEMAT] 1993, Fetherston et al. 1995). As a forested riparian stand ages and trees get taller, proportionally more of the large woody debris contribution comes from farther away (Fetherston et al. 1995).

The average buffer for Rock Creek, Black Diamond Lake and Stream S-4 would exceed 150 feet so the proposed development would have no measurable adverse effect on future woody debris recruitment in these fish-bearing waters. The proposed buffer on Stream S-5 could be as little as 75-feet in places though it is expected to average more than that as needed to protect steep slopes. This very small stream does not have the power to transport large woody debris but the material would function locally to provide fish habitat. The proposed development could have a small adverse effect on woody debris recruitment to this creek.

- Temperature and Shade

Riparian vegetation can affect water temperature by blocking solar radiation (Beschta et al. 1987, Sullivan et al. 1990). Overhanging vegetation shades streams until the channels become so broad that, like lakes, most of the water surface is exposed to the sun. By intercepting solar radiation, vegetation prevents heat energy from reaching streams, maintaining cooler water. Because salmonids are cold-blooded, stream temperature is an extremely important factor affecting production, metabolism, growth, survival, behavior, and habitat utilization. Shade benefits of streamside vegetation vary with season, channel orientation, and forest structure among other things. Of primary concern to fisheries resources are the potential increases in water temperature that typically occur during the late summer (August-September) low-flow/peak temperature period. Solar radiation is strongest during this period.

Although there is a considerable amount of variability in research results based on topographic elevation, adjacent land uses, vegetation type, and numerous other factors, most studies found up to 100 percent temperature moderation function within 100 feet of the stream under forested conditions (Brazier and Brown 1973, Barton et al. 1985, Beschta et al. 1987, Johnson and Ryba 1992, FEMAT 1993). Pollock and Kennard (1998) believe that 50 percent shade function requires 50 feet of forest shade.

Riparian buffers adjacent to most onsite streams are moderately to well densely vegetated with a predominately mixed deciduous-coniferous tree canopy with some native understory. Only Stream S-5 contains a significant proportion of exotic plants where Himalayan blackberry makes up a considerable portion of the stream cover in places.

Proposed buffers adjacent to all fish-bearing waters are wide enough to be fully protective of stream temperatures. While narrower buffers are proposed near Streams S-2 and S-6, infiltration

of all flow in Stream S-2 means ground temperatures are reached before discharge to fish-bearing waters, and Stream S-6 is dry during the warmer summer months so temperature is not an issue.

- Beneficial Nutrient Contribution

Vegetation and plant material falling into streams form an important component of the aquatic ecosystem food chain. Particulate matter delivered by the adjacent riparian area provides nutrients for organisms that eventually are consumed by fish. Insects living in the vegetation are also eaten by fish.

Little research has been done examining particulate contribution from riparian zones (FEMAT 1993). However, it is likely that the majority of material comes from directly over, or within a very short distance of the stream. FEMAT (1993) suggests that most leaf material is contributed by trees located within approximately 50 feet. Other studies have shown that benthic invertebrate communities in streams with riparian buffers greater than 100 feet are indistinguishable from those in streams in unlogged watersheds (Ermann et al. 1977).

Existing riparian buffers contain a good assortment of different plant types, thus both vegetative litter and insect population abundance and diversity are likely of good quality. Proposed buffers adjacent to all fish-bearing waters with the exception of Stream S-5 are wide enough to protect existing nutrient contributions. Stream S-5 has a riparian buffer dominated by Himalayan blackberry so may have a lower existing function. With the proposed 75 foot buffer, existing functions are likely to remain low for this small tributary. However, no significant adverse effects to fish habitat are expected.

- Sediment and Pollutant Control

Buffer widths ranging from 30 to 100 feet are described in the literature as satisfactory for removing the majority of sediment and pollutants from surface water (summarized in Knutson and Naef 1997). The majority of pollutants are typically removed in the first 30 to 60 feet; complete removal requires more than 100 feet. Up to about ninety percent of sediment removal occurs within 100 feet; larger distances are required for steeper slopes, very heavy loadings, and poorly vegetated areas.

The proposed development alternative would eliminate natural infiltration pathways to streams by changing the hydrologic flow paths to piped drainage systems. These systems would bypass the riparian water quality function in favor of engineered facilities. Much of the natural buffer functions for hydrologic and water quality functions (peak flow attenuation, base flow releases, and water quality treatment) would be removed from riparian buffer control by storm drain systems. Stormwater detention and water quality treatment requirements are regulated under City and State codes without reliance on riparian buffer function. For these areas, the natural sediment and pollution control functions would be provided at up to 100 percent of their natural function by the proposed treatment facilities.

The exception is found within the riparian buffer to onsite streams. Rain falling in these areas would still reach the creek via natural flow paths. Under existing conditions, runoff from native surface roads in this area contributes fine sediment and any petroleum drippings from vehicles. This would be reduced under the developed scenario as the existing roads are eliminated. With the relatively large remaining buffers, treatment and infiltration of most stormwater runoff, and elimination of native surfaced roads, the Proposed Action is expected to provide nearly 100 percent of the natural water quality function of fully intact buffers.

- Bank Stability

Roots from vegetation growing along the streambank help stabilize soils and reduce erosion. Overhanging roots also provide habitat for fish where streams undercut the root balls. The soil stabilizing benefits of root structures is greatest within one-half of the crown diameter of the vegetation growing along the bank (Burroughs and Thomas 1977). Assuming that the largest plants growing along stream banks are trees, and the maximum crown diameter of a mature fir tree is approximately 80 feet, root strength benefits would be low beyond 40 feet from the channel. Smaller vegetation growing near the creek also strongly influences bank stability at distances nearer than 40 feet.

All onsite channels would be permanently protected with buffers in excess of 50-feet so increased channel erosion due to bank disturbance is not expected to be an issue. Stormwater discharge would be regulated at rates designed to avoid increases in channel erosion (Triad 2008). An evaluation of channel stability in Stream S-4 showed that the minor increase in some predicted flow rates is not expected to affect bed stability under the developed condition for the Proposed Action (AESI 2008). Possible channel stability concerns were identified for the steep slopes downgradient of springs discharging from the pre-Olympia aquifer. These springs discharge to Crisp Creek and to small tributaries on the northern Green River Valley wall. With infiltration of excess stormwater to this aquifer, a slight rise in spring discharge was predicted (AESI 2008). The predicted increase in volume represents approximately 0.4 to 0.7 percent of the total volume of the aquifer so spring discharge increase is not expected to be large. A change in flow rates of less than 1 percent is unlikely to change channel erosion rates in Crisp Creek or the other Green River tributaries.

Impacts to Water Quality

Treated stormwater quality post-construction was quantitatively estimated for the Proposed Action and No Action Alternative after buildout by A.C. Kindig & Co. (2008). A complete description of the stormwater treatment system, methods used for the water quality evaluation, and results are described in the Water Quality Technical Analysis (A.C. Kindig & Co. 2008). The following section summarizes the results of the analyses.

Stormwater quality discharge to all receiving waters would comply with state water quality standards prior to any mixing or dilution, with some possible exceptions for fecal coliforms. Most discharge parameters would be less than or near background water quality averages for the receiving waters for most of the stormwater outlets, except for total suspended solids, fecal coliforms, and total phosphorus, which would have slightly higher concentrations in most

discharges. However, none of the parameters are expected to rise to levels that would degrade aquatic habitat or adversely affect regional fish populations.

Fecal coliforms originate from wildlife, including bird droppings, and thus occur wherever storm runoff is generated from impervious surfaces. Pet waste exacerbates fecal coliform concentrations when it is left to run off with stormwater in residential areas. Although predicted fecal coliform levels could exceed the state standard during peak storm runoff periods, fecal coliform bacteria do not represent a threat to fish or fish habitat value (Snohomish County 2000, Teel 1998). Their presence may indicate other problems such as low DO or high toxic (unionized ammonia) loadings (Brown and Caldwell 1999). The Department of Ecology recognizes fecal coliform contamination only as an impairment to recreational use and not as affecting salmonid habitat quality. Thus, the periodic storm-related peaks in fecal coliform levels as a result of the project would not pose a threat to salmonids or salmonid habitat.

Phosphorus occurs in stormwater runoff from roadways, from fertilizers used in landscaping, from exterior use of detergents, and from sediment erosion. Phosphorous is not directly harmful to fish in itself but can lead to increased algal growth under the right conditions, which in turn can degrade aquatic habitat due to decreased DO levels. This is commonly observed in lakes subject to increased nutrient loads from underperforming septic drainfields. Impacts of increased phosphorus loading on Jones Lake and Lake Sawyer are evaluated by A.C. Kindig & Co. (2008). They concluded that while phosphorus loading increases are expected with future development, including The Villages, the source control and phosphorus removal measures proposed would maintain those increases to levels the Lake Sawyer Management Plan (King County 2000) expects to maintain the current lake condition and beneficial uses, including fish habitat.

Impacts to Groundwater Quantity

Development of this site has the potential to change the amount of groundwater recharge. Replacing forestland with impervious surfaces (such as streets, parking lots, and buildings) reduces evapotranspiration and has the potential to reduce groundwater recharge and increase stormwater runoff. Maintaining groundwater flow quantities is important in the protection of fish habitat, especially during the summer low-flow period when much of the flow in local streams is derived from aquifer discharge. Reduced groundwater flows could lead to increases in summer water temperatures, with possible reductions in DO levels.

Crisp Creek and Green River in particular are highly dependant on spring flow to maintain summer baseflow levels and cool water temperatures. Smaller onsite streams are more dependant on interflow and shallow aquifer contributions.

AESI (2008) spent considerable effort evaluating existing groundwater conditions and potential effects of the development on this site. Section 7 of AESI (2008) provides a detailed analysis of expected impacts and mitigation measures. Extensive coordination between the resource analysts (fisheries and wetlands), project engineers/designers, and AESI helped ensure that potentially sensitive resources, possible impacts, and suitable mitigation were identified and provided. Mitigation designed to protect aquatic resources includes the following:

- The stormwater management plan developed for the site (Triad 2008) calls for extensive infiltration of stormwater runoff from the site using several small shallow dispersed LID infiltration facilities and several sites where excess stormwater would infiltrate to the deeper pre-Olympic aquifer. The only instances where stormwater would not be infiltrated occur where wetland hydrology balance must be maintained (roof water delivered to level spreaders within wetland buffers) and the single outfall to Steam S-4.
- Wetland and stream buffers would be largely avoided by the proposed development.
- Road designs would include provisions, where necessary, to maintain natural subsurface drainage pathways (interflow). This could include modified road prisms and use of free-draining sands as fill material.

The water balance analysis completed by AESI (2008) showed that the mitigated developed condition recharge into the shallower aquifers (Qvr and Qvic) would closely match pre-developed condition recharge. This results in no probable significant impacts to the shallower aquifers from development under the Proposed Action.

Excess runoff from throughout the site would be routed to large infiltration facilities in Basin 3 and to a site west of the Main Property. The excess stormwater infiltrated in this area would recharge the pre-Olympia aquifer. The mitigated developed condition recharge in the pre-Olympia aquifer would increase about 650 acre-feet/year. This volume amounts to approximately 0.4 to 0.7 percent of the total volume of the pre-Olympia aquifer tributary to the Crisp Creek springs and to a number of springs along the northern Green River valley slope. This small increase (less than 1 percent) is not expected to result in a significant impact to any downstream waterbody (AESI 2008).

Under the Proposed Action for the North Property, runoff collected in the storm water collection system would be discharged back into onsite wetland buffers to maintain wetland hydrology and routed to infiltration systems for infiltration into coarse-grained Vashon recessional outwash sediment. Recharge eventually contributes to Ravensdale Creek baseflow and/or to Lake Sawyer. Water balance results for this area indicates that an overall insignificant increase in the amount of water delivered to the aquifer would occur as a result of development (AESI 2008). No probable significant impacts to downgradient watercourses are expected.

Impacts to Surface Water Quantity

Stormwater management and drainage facilities planning are summarized in the Technical Information Report (Triad 2008). In general, flow release from detention ponds would be as allowed by the Ecology 2005 Manual and per Black Diamond Code (Triad 2008). Releases from the detention ponds would match flows from half of the 2-year flow to the 50-year flow.

Stormwater falling onto most of the site currently infiltrates near the contact point or after a short period of transport if the initial contact was onto till-mantled areas. Only small areas of the site that drain on the surface to Streams S-4 and S-5, and the areas that contain Black Diamond Lake

and Rock Creek and their associated wetlands are known to contribute surface flow to these watercourses. No development is proposed in any of these areas.

As described above, the vast majority of stormwater collected from new impervious surfaces of the project would be treated and then infiltrated. Clean roof water would also be used to maintain water balances to wetlands. Some treated water would be released via level spreaders into the large wetland buffers adjacent to Rock Creek. The only new surface water discharge (other than wetlands) would occur from a small (9.4 acre) portion of the site near the eastern boundary (Basin 6). Water would be treated and detained before release to Stream S-4 near the northeastern property corner.

Stormwater control standards are designed primarily to protect channel stability from peak storm flows. Fish habitat quality is also dependent on the more commonly experienced flows (e.g., base flow) which affect day-to-day habitat conditions about 90 percent of the time. For this analysis, we looked at both storm flows and base flows where data support an analysis. Because there is no existing stream flow information available for Stream S-4, much of the impacts analysis depended on modeled flows which were based on contributing basin area and condition, along with regional rainfall patterns.

Triad Associates, Inc. (Triad) conducted hydrologic modeling to calculate future instream flows from Basin 6 under pre- and post-development conditions (Triad 2008). Further refinements to the onsite drainage facilities would occur with site-specific engineering design of the stormwater system; thus, these figures may not be final. However, the rates shown in Table 4 reflect an advanced state of analysis, and no significant changes are expected.

Where possible, the 90 percent, 50 percent, and 10 percent exceedence flows (as measured at the discharge location for each sub-basin) are selected to evaluate the most common base flow rates contributed from a project site. The 90 percent exceedence flow represents the flow rate that is exceeded 90 percent of the time (flows are below this rate only 10 percent of the time). The 90 percent exceedence flow is often looked at as the summer low flow. Because Stream S-6 has a relatively small contributory basin, it experiences very low flows, especially during the dry season. As such, it was not possible to calculate or predict either the 90 or 50 percent exceedence flows. The 10 percent exceedence flow is a fairly normal winter flow rate, such as might be experienced during a typical period of average rainfall.

Table 4
Instream Flow Analysis for Basin 6 (Surface Discharge to Stream S-4)

Return Period	Existing (cfs)	Future (cfs)	Change
90% Exceedence [a]	<0.1 [a]	<0.1 [a]	--
50% Exceedence	<0.2 [a]	<0.2 [a]	--
10% Exceedence	0.84	0.91	8%
2-year	8.00	7.76	- 3%
10-year	12.90	12.90	0%
25-year	15.32	14.95	-2%
100-year	22.22	22.08	-1%

[a] Flows are too low to model accurately with available information

The instream flow analysis for Basin 6 (Table 4) show that excess water volumes created by new development would be released at very low flow levels thereby increasing flows rates slightly throughout non-storm event periods (<10% exceedence). In its analysis of potential channel geomorphologic changes, AESI (2008) predicted that these small changes in rates would have no adverse effect on the physical structure of Stream S-4 (see *Impacts to Channel Erosion and Sedimentation Processes* below). Once this flow increase reached Jones Lake and the greater Rock Creek system it would be immeasurable.

Surface release of flows would occur elsewhere on the site as needed to maintain wetland hydrology. Water would be released via level spreaders to wetland buffers throughout the site including wetlands associated with Rock Creek, Black Diamond Lake, and small tributaries draining south towards the Green River. All water would be released at rates needed to maintain wetland hydrology at or near existing conditions. With attenuation provided by flow through the buffers and wetlands, no measurable change in flow rates leaving the wetlands is expected.

As discussed under Impacts to Groundwater Quantity above, AESI (2008) predicted only a very small increase (0.4 to 0.7 percent) in flows to the Crisp Creek and northern Green River valley slope springs. This small increase (less than 1 percent) is not expected to result in a significant impact to any downstream waterbody.

Impacts to Stream Baseflows

AESI (2008) evaluated the potential for added impervious surfaces under the Proposed Action to reduce groundwater recharge that could affect base flows in local streams. The assessment concluded that no reduction in base flow contribution to Rock Creek, Ravensdale Creek, Stream 4, Horseshoe Lake, Black Diamond Lake, Crisp Creek or the Green River would occur as a

result of the Proposed Action. Recharge to Black Diamond Lake and Horseshoe Lake would be balanced by design of the stormwater system to avoid increasing inflow to those waterbodies.

Impacts to Channel Erosion and Sedimentation Processes

A stream erosion and sedimentation analysis was conducted by AESI (2008 – Section 6.2.1) for surface water drainages potentially affected by development of the project. The purpose of this analysis was to identify existing erosion, landslide, and sediment transport hazards in drainage channels that originate on the site with the goal of protecting aquatic habitat. AESI (2008) evaluated hydraulic and geomorphic conditions in potentially susceptible stream channels, and determined erosion thresholds for existing and proposed conditions. Their analysis is summarized below.

Streams S-2, S-5, S-6, S-7 and Rock Creek are either buffered or located within wetland buffers/Sensitive Area Tracts. The streams are either formed by wetland discharge (S-2, S-5, S-6 and S-7) or flow through a large wetland complex onsite (Rock Creek), but could be susceptible to erosion from uncontrolled storm water discharge. Existing condition wetland hydrology would be maintained as discussed in Wetland Resources (2008) and Triad (2008). No direct discharge is planned to Stream S-2, S-5, S-6, S-7 and Rock Creek. Therefore, no stream erosion impacts are anticipated.

Stream S-4 was found to be relatively stable along the channel length between onsite wetlands and the southern property boundary. Under the proposed stormwater plan (Triad 2008), peak flows within Stream S-4 would remain unchanged or somewhat decreased. In most cases, a stream that is at equilibrium could experience channel aggradation by a decrease in peak flow. Because the headwaters for Stream S-4 are located in on and off-site wetlands, much of the natural hydrology would remained unchanged. The likely decrease in peak flows as allowed by code is not considered to be an adverse impact to stream erosion (AESI 2008).

Crisp Creek and spring-fed tributaries to the Green River do not receive any direct surface water runoff under existing conditions from The Villages; however, both receive ground water contributions to baseflow from the pre-Olympia aquifer proposed to receive stormwater infiltration (AESI 2008). Crisp Creek is relatively stable in the upper portion of the channel. Downstream of the pre-Olympia aquifer spring discharge zone at approximately elevation 370 to 400 feet mean sea level (fmsl), several landslides and other erosion features are present. The channel is susceptible to stream incision, sidebank destabilization, and channel degradation as a result of significant increases in baseflow from elevated spring flow.

Under the Proposed Action for The Villages, a portion of the stormwater runoff from Basins 1-4 would be treated and infiltrated. This infiltrated water would flow vertically downward to the pre-Olymipa aquifer water table, and eventually re-emerge as spring flow within Crisp Creek and unnamed tributaries to the Green River (see AESI 2008, Figure 4). While a 0.4 to 0.7 percent increase of the total volume of the pre-Olympia aquifer is expected, attenuation due to (1) the distance between the nearest infiltration point and the spring discharge zones, and (2) the vertical and lateral ground water flow components, would make any measurable change in Crisp Creek

or unnamed tributary spring flow unlikely. Therefore, no probable significant impacts to erosion within Crisp Creek and the unnamed tributaries to the Green River have been identified.

Impacts to Listed Species

No listed fish species are found on the project site. Indirect impacts were evaluated above. Post-construction impacts described in Section 3.2 are not likely to result in adverse effects to listed species or their habitat due to the protection measures being implemented for both the quantity and quality of water leaving the site. The proposal to use the most current stormwater protection measures, including extensive infiltration, should adequately protect aquatic habitat downstream. Given the absence of habitat used by listed species within, adjacent to, or within more than one mile downstream of the project site, no significant post-construction-related adverse impacts to listed species are expected.

3.2.2 No Action Alternative

Under the No Action Alternative, development would occur under standard City sensitive areas regulations, but under a less coordinated approach than for the two development alternatives. Individual lot development could include more wetland filling, more stream crossings, continued logging, development closer to the streams, and continued use of native surface roads in places. It is assumed that existing road and wetland crossings would be utilized where appropriate, and new crossings would be created where allowed by law. Sensitive area buffers would be protected as required under the code, but there would be no coordinated opportunities to protect larger parcels as public open space. Less open space would be provided than under the MPD requirements.

Stormwater would be dealt with on a lot-by-lot basis without the requirement for a regional protection treatment and detention facilities or implementation of LID measures. This could result in adverse effects on the quantity and quality of flow in regional streams as each lot owner deals with stormwater runoff independently (A.C. Kindig & Co. 2008).

Piecemeal applications for development of the parcels could result in more overall direct aquatic resource impacts at wetland or wetland buffer crossings than a design under the MPD.

Overall, it is likely that the developed condition under the No Action Alternative would have a higher potential for impacts to fish and aquatic habitat than for the Proposed Action.

3.3 Basinwide and Cumulative Effects

The correlation between watershed development and the aquatic habitat condition has been investigated for over two decades (Booth and Jackson 1997). It is well substantiated that stream and wetland ecosystem impairment begins when total impervious area (TIA) in a basin exceeds about 10 percent (Horner et al. 1997). These impacts have been largely the result of unmitigated modifications to the land surface that alter both the magnitude and type of runoff processes. The cumulative effects of these alterations produce an instream habitat significantly different from

that in which salmonids and other aquatic organisms have evolved. Some of these impacts include the alteration of peak and base flow conditions and the duration of flow attenuation.

The Villages Project site and proposed development actions are significantly different from the projects evaluated in earlier studies. First, entire drainage basins were evaluated, not individual projects. Second, most of the projects reviewed by those authors were developed during the 1980s and earlier and contained no water quality or water quantity protection features. As a result, this style of land development resulted in large-scale impacts to instream habitat and significant channel degradation.

The Villages Project would not contain any new unmitigated impervious surface. Unusually wide riparian buffers, along with the use of stringent stormwater detention and treatment measures, would help ensure that regional waterbodies continue to function in a manner consistent with a relatively natural hydrological flow regime. As a result, the Villages Project is not expected to contribute to the adverse basin effects of the type created by development prior to 1990.

Cumulative effects on fish habitat are possible with additional development proposed in the Black Diamond area. The rapidly developing area would include the proposed Lawson Hills Project. The Lawson Hills Project would deliver flow to both Rock Creek and Ravensdale Creek. Treatment and detention requirements have been designed to meet all current standards and should be fully protective of aquatic habitat (A.C. Kindig & Co. 2008). The Lawson Hills Project would also consist of a coordinated approach to dealing with potential development effects on the natural environment. This approach generally provides greater protection than piecemeal lot-by-lot development. Assuming both developments occur under Master Planned Community programs as currently proposed, no significant adverse cumulative effects on fish habitat are expected.

4.0 MITIGATION MEASURES

4.1 Construction

- All areas that are to remain undisturbed during site clearing and grading (e.g., sensitive areas and their buffers) would be delineated and fenced with highly visible material prior to construction.
- The stream crossing over Stream S-5 would be constructed (if practicable) at the location of the existing crossing structure. If this is not practical, the existing crossing and portions of dirt road outside the future road alignment but within the riparian buffer would be removed as mitigation.
- Stream crossings over Stream S-4 and S-5 should be full span structures designed to be fish passable, and with a capacity to pass 100-year storm flows and expected debris.

- The new outfall to Stream S-4 would be sited after consideration of potential disturbance to adjacent wetlands, unstable slopes, significant trees, and instream habitat.
- All construction at or below the OHWM of any waterbody, (as needed to install the new outfall on Stream S-4 and new stream crossings) would observe the following conditions:
    - Work would take place during the summer low flow season or as otherwise allowed by the WDFW under conditions of an Hydraulic Project Approval (HPA) permit.
    - Measures would be implemented to control sediment introduction by bypassing flow around the work site or by completing all work before allowing flow to contact the work area. Where necessary, fish would be removed from the work site before work begins.
    - If work is completed in a fish-bearing stream, all fish would first be removed from the instream work area prior to commencing the work and moved to a non-impacted area. Fish removal methods would follow standard WDFW protocols. Captured fish would be transported in coolers to an area outside of the work area (as specified by WDFW) and released back into suitable habitat.
    - Flow would be diverted around the work site and measures conducted as needed to contain all expected flows.
    - Instream work shall be conducted by equipment positioned on the bank. No equipment (with the exception of clean excavator buckets) shall work below the OHWM.
    - The excavator bucket and boom shall be first thoroughly cleaned of all visible petroleum products and a floating oil boom placed downstream of the work area.
    - Excess material shall be end-hauled off-site to an upland location.
    - Temporary and permanent ground cover measures shall be provided in a timely manner to protect disturbed areas. Cover methods shall include mulch, erosion control blankets, plastic covering, sodding, hydroseeding, jute matting, and clear plastic sheeting where necessary and if inclement weather conditions threaten exposed soils.
    - All areas of affected streambank would be revegetated with native species and maintained as required by City ordinance.
- No surface water runoff from construction areas would be discharged directly to onsite or off-site waterbodies without first being treated.
- Additional mitigation measures provided in A.C. Kindig & Co. (2008), AESI (2008), Wetland Resources (2008), and Triad (2008) to protect water quality, water quantity, stream channel stability, riparian buffers, and wetland attributes during construction are also relevant and incorporated herein by reference.
- New stormwater outfalls would be designed to minimize potential impacts to existing aquatic habitat. New outfalls would be sited and designed to avoid sensitive instream habitat and riparian buffers.

- Wetland and stream buffers would avoided to the greatest extant practicable by the proposed development.
- Road designs would include provisions, where necessary, to maintain natural subsurface drainage pathways (interflow). This could include modified road prisms and use of free-draining sands as fill material.

4.2 Post-Construction

- The project would employ extensive infiltration of stormwater runoff from the site using several small shallow dispersed LID infiltration facilities and several sites where excess stormwater would infiltrate to the deeper pre-Olympic aquifer. Wetland hydrology balance would be maintained using roof water delivered to level spreaders within wetland buffers.
- Mitigation measures provided in A.C. Kindig & Co. (2008), AESI (2008), Wetland Resources (2008), and Triad (2008) to provide long-term protection of water quality and water quantity are also relevant to the protection of fisheries resources and are incorporated herein by reference.

5.0 UNAVOIDABLE SIGNIFICANT ADVERSE IMPACTS

The Proposed Action is not likely to result in significant adverse effects to fish habitat for the following reasons:

- Only two fish-bearing stream crossings would occur. Both would be full span structures designed to avoid impacts to the creek channel below.
- Few fish-bearing watercourses exist on the site. No listed fish species are found on or within more than one mile of the site.
- A high level of stormwater detention and treatment would be provided. The project would infiltrate most of the excess stormwater to large aquifers under the site. Infiltration provides the highest level of fish protection possible for a development and is the preferred method to protect aquatic habitat where conditions are suitable.
- The project design includes stream buffers much larger than are normally provided adjacent to watercourses. Most stream reaches on the site would contain buffers in excess of widths recommended by WDFW for the protection of aquatic habitat (Knutson and Naef 1997).

This analysis relies heavily on the analyses and conclusions of the water quality, hydrologic, erosion control, and geotechnical experts as to how the project might affect the quantity and quality of water delivered to off-site streams. No unavoidable significant adverse impacts were identified during their analyses of the Proposed Action.

In summary, development of the Villages Project under the Proposed Action is not expected to result in any significant unavoidable adverse impacts to fisheries resources.

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