3.2 WATER

This section describes existing surface and ground water conditions at the Wood Trails and Montevallo sites, potential impacts to those conditions resulting from the Proposed Action and alternatives, and mitigation measures to address the impacts. Technical reports on drainage and water resource studies conducted for the projects provide additional discussion and data related to the existing site conditions. The original technical reports on drainage submitted by the applicant were included as Appendices E, F, G and H to the Draft EIS. Supplemental documentation on groundwater conditions is included in the Final EIS in Appendix M.

3.2.1 Existing Conditions

3.2.1.1 Little Bear Creek Sub-Basin

Basin Characteristics

The Wood Trails and Montevallo project sites are located within the Little Bear Creek Sub-basin of the Sammamish River Drainage Basin (King County 1998). The Little Bear Creek Sub-basin drains to the Sammamish River, which then drains to the north end of Lake Washington. The basin is approximately 9 miles long and has an area of approximately 15 square miles, with approximately 80 percent of the basin lying in Snohomish County (Kerwin 2001). The basin has been rapidly urbanizing (City of Woodinville 2002). The upper part of the basin is characterized by low-density residential development and hobby farms, while the lower part of the basin includes low-and medium-density residential, commercial and industrial uses. The lower 2.9 miles of the stream have been physically altered to accommodate agricultural and industrial activities. Most of the land in the basin is situated outside of urban growth boundaries and is zoned for rural uses. Little Bear Creek is currently the least developed of the three main north tributaries to the Sammamish River (Swamp and North Creeks are the other two).

Little Bear Creek originates at an elevation of a little over 300 feet about a mile and a half north of Clearview in Snohomish County. The creek flows southward approximately 7.7 miles to join the Sammamish River in King County at river mile (RM) 5.4 (Williams et al. 1975), just west of downtown Woodinville. The creek has an overall gradient of about 0.8 percent. Little Bear Creek is a Type 1 or "Shoreline" stream for a few hundred feet upstream of its mouth, and a Type 2 stream (used by salmonids) along the sections where it is joined by runoff originating from the Wood Trails and Montevallo sites (WMC 21.24.370).

Surface Water Hydrology

Past development within the Little Bear Creek basin has altered the surface water hydrology of the creek and its tributaries. A basic hydrologic change from sub-surface dominated flow paths to surface pathways is indicated throughout the Little Bear Creek basin, with associated adverse effects on instream habitat conditions. These effects are indicated by basin-wide reductions in the extent of forest cover, road densities of up to 5.9 km per square km of basin area, and road crossing frequencies of up to 3.5 crossings per km of stream. Approximately 40 percent of the basin was forested in 2001, and impervious surfaces covered 37 percent of the basin (King County 2006a). Additionally, many tributaries and mainstem creek segments dry up in the summer because base flow storage in upstream floodplain and wetland areas is not adequate to maintain continuous flow (Kerwin 2001).

Both Snohomish County and King County operate streamflow gauging stations on Little Bear Creek. Table 3.2-1 summarizes flow data for the station at SR 202 in Woodinville (at the mouth of the creek) for the period October 1, 1998 through June 1, 2006 (the available period of record for this gauge). The King County data do not indicate the long-term mean annual flow rate for Little Bear Creek. Mean monthly

flows in Little Bear Creek during this period ranged from typical August values of approximately 6 to 9 cfs to an average of over 40 cfs in January (King County 2006b). Mean flows during January 2006 were 79 cfs. Daily data indicate the peak flow during this period was nearly 438 cfs (on January 30, 2006). For the entire 8-year period, flows exceeded 200 cfs on 5 other days and exceeded 100 cfs on 53 other occasions. The lowest flow recorded during this period was 4.49 cfs on August 19, 2004.

Table 3.2-1
Summary of Stream Discharge Data for Little Bear Creek at SR 202 in Woodinville, October 1998-May 2006

Month	Average Monthly Flow (cfs)[1]	Minimum Daily Flow (cfs)	Maximum Daily Flow (cfs)
January	43.4	11.7	437.8
February	34.5	11.3	198.8
March	30.3	10.0	175.8
April	22.3	7.8	86.2
May	15.9	7.6	42.8
June	13.3	5.7	50.2
July	9.9	4.9	56.8
August	8.4	4.5	41.3
September	8.6	5.2	35.5
October	15.7	6.5	181.6
November	32.7	7.0	271.7
December	39	8.1	194.7

[1] Based on average of mean monthly flows for each month during the period.
Source: King County 2006b

Water Quality

Little Bear Creek has been designated a Class AA (Extraordinary) waterbody under the Washington water quality standards adopted in 1997 (Kerwin 2001), which sets maximum numerical levels for various water quality constituents. King County (2006) has monitored water quality at the mouth of the creek since 1976, and water quality observations from various points upstream in the basin are also available. Fecal coliform bacteria levels have routinely exceeded standards throughout the watershed during the period of record, and nitrate levels are among the highest recorded in Snohomish County (Thornburgh and Williams 2000). Dissolved oxygen samples have exceeded standards 8 percent of the time. Concentrations of metals, including copper, lead, zinc, nickel, and chromium have been present in sediments collected at the mouth. Little Bear Creek is on the Washington Department of Ecology's (Ecology's) 2002/2004 303(d) list of impaired waters, and is classified as Category 5 for dissolved oxygen and Category 4a for fecal coliform bacteria (Ecology 2006). Category 5 represents the state's 303(d) list of impaired waters; Category 4a indicates that an approved TMDL (Total Maximum Daily Load) plan for the respective pollutant (fecal coliform) is in place and is being actively implemented.

Ecology (2005b) initiated a TMDL or water cleanup plan for Little Bear Creek in early 2005 to address the high levels of fecal coliform bacteria that had been recorded at various locations in the basin. At that time Ecology issued a fact sheet explaining the TMDL process and inviting the public to attend meetings in March 2005. The fact sheet indicated that failing septic systems are often significant sources of fecal coliform bacteria and other pollutants in non-sewered areas, and that other sources could include improper management of manure and other domestic animal wastes and wastes from natural, non-human sources.

Ecology issued a report with a summary implementation strategy for the cleanup plan in May 2005. The report notes that primary contact recreation is believed to be the beneficial use of the stream that is most sensitive to the impairment of excess fecal coliform bacteria, which are used as an indicator of fecal waste

from humans and warm-blooded animals that may contain pathogens harmful to human health (Ecology 2005b). The analysis of water quality data indicated fecal coliform impairment in each of seven identified stream segments of Little Bear Creek and three tributaries, with at least 9 percent of the samples for each segment exceeding the standards for fecal coliform levels. Among all seven sampling sites the exceedances were more common during the drier April-September portion of the year, compared to the months of October to March, and the highest bacteria levels generally occurred during low flows typical of July and August. Ecology identified a number of potential sources of fecal coliform pollution in Little Bear Creek, including stormwater from urban development and roads, on-site septic systems, agriculture, businesses that produce pet waste (primarily dog kennels), wildlife, and possible sewer leaks or illicit sewer connections. The TMDL analysis did not attempt to identify the specific contributions of these sources to existing fecal coliform contamination in Little Bear Creek, although it did indicate that the most significant sources are probably agricultural and livestock practices, pet wastes, failing on-site septic systems and commercial business. Ecology did calculate target wet and dry season loading capacities and percentage load reductions needed to meet the fecal coliform standards at each station. The target reductions (from the existing load) estimated for the station near the mouth of Little Bear Creek were 88.7 percent for the wet season and 94.5 percent for the dry season (Ecology 2005b). Ecology also assigned specific wasteload allocations (10.7 percent reductions in each case) to Snohomish County, the Washington State Department of Transportation and the City of Woodinville, the three jurisdictions currently holding permits for discharge of municipal stormwater to Little Bear Creek.

The Little Bear Creek Water Cleanup Plan proposes a summary implementation strategy (SIS) of cleanup actions expected to be undertaken by various parties in the basin between 2005 and 2010. High-priority cleanup actions assigned to the City of Woodinville (and other government jurisdictions) include watershed stewardship education, acquisition and/or restoration of wetland and riparian areas, bacteria source detection monitoring, stormwater source control best management practices (BMPs), stormwater treatment BMPs, on-site septic system inspection and repair, and long-term water quality and cleanup effectiveness monitoring (Ecology 2005b). The report notes that Ecology expects the Little Bear Creek system will meet the fecal coliform standards by 2010 if these actions are implemented as expected.

In 2000 King County conducted a Small Streams Toxicity/Pesticide Study to assess the presence of pesticides and other toxicants in Little Bear Creek. The results indicate that a variety of pesticides are present during storm and non-storm events. Toxicity to *C. dubia*, *S. capricornutum*, and *L. minor* was observed early and late during storms and during non-storm conditions (King County unpublished data cited in Kerwin 2001). Observed toxicity to test species represents violation of the State water quality standards (State of Washington 1997).

Groundwater

The glacially-derived geologic deposits in the Puget Sound region (see discussion in Section 3.1) and the area surrounding the project sites form a series of layers that generally contain water (aquifers) or confine it (aquitards). The aquifers are generally coarser, granular deposits through which groundwater can flow, while aquitards consist of relatively impermeable, finer-grained deposits that inhibit the flow of water (King County 2003). Within the general vicinity of the project sites, recent alluvium and recessional outwash deposits of Vashon glacial origin tend to form the aquifers closest to the surface, particularly in and near stream valleys. Uplands within the area typically have a cap of low-permeability glacial till that acts as a regional aquitard. Extensive advance outwash deposits occur in most areas beneath the till and form another aquifer that is typically underlain and confined by an aquitard formed by fine-grained clays deposited as lakebed sediments. Water seepage often emerges from the advance outwash aquifer where it is in contact with an underlying aquitard. The till, advance outwash and clay deposits are all also of Vashon origin. Older glacial and non-glacial sediments in deeper deposits form multiple additional aquifers and confining layers.

Groundwater flow within the region originates from precipitation in upland areas infiltrating the ground until it reaches an aquifer. Groundwater within an aquifer moves horizontally and discharges to the surface through spring flow or seepage, or into alluvium and recessional outwash deposits in stream channels. Groundwater connects with surface water in valleys with perennial streams and groundwater discharge can comprise a substantial portion of the stream flow, particularly during the drier months of the year. The quality of groundwater in the general vicinity is good, and no major sources of contamination have been reported (King County 2003). Individual domestic users and municipal utility systems in the region rely on groundwater for water supply.

3.2.1.2 Wood Trails Site

On Site Basin Characteristics

The Wood Trails site is heavily forested and slopes generally to the west, with slopes ranging from 10 percent to greater than 40 percent. The high elevation along the east boundary is approximately 430 feet and the low elevation along the west boundary is approximately 250 feet. Three on-site drainage basins (Basins A, B and C, from north to south) have been identified, ranging in size from 7.8 to 19 acres. There are no streams or defined stream channels on the Wood Trails site.

An upstream area of approximately 21 acres is tributary to this site. This upstream area consists of neighboring properties of single-family homes, roadways, driveways and lawn/landscaped areas to the east of the site.

Surface Water Runoff

Runoff through the Wood Trails site is generated as precipitation on the site and runoff from the upstream area that drains onto the site. The Wood Trails site itself is currently undeveloped with regard to storm water system infrastructure.

Flows from the upstream area enter the Wood Trails site via sheet flow and through culverts crossing beneath 148th Avenue NE (see Figure 3.2-1). Runoff from the site generally sheet flows west over moderate vegetation toward the existing ravines. Flows through the ravines appear to be dispersed through moderately thick brush near the downstream (western) portion of the site. Once dispersed, runoff exits the site in a sheet-flow manner toward the industrial area to the west. Retaining wall and rockery systems on the industrial properties make up much of the western boundary; the sheet and shallow groundwater flows from the Wood Trails site are intercepted by the drainage systems for these walls and rockeries (see additional discussion of drainage systems in Section 3.2.1.4 below).

The Wood Trails drainage basin was modeled as a 33.2-acre area for analysis of existing and developed hydrologic conditions. This area includes 21.5 acres of on-site area tributary to the proposed stormwater pond and 11.7 acres of upstream area from which flows will be routed through the pond. All 21.5 acres of the on-site area were modeled as forest-on-till surface conditions; the site is predominantly wooded and the surficial materials are generally underlain by a layer of glacial till (see Section 3.1 for additional discussion of geologic conditions). The till provides a hard, compacted layer that retards percolation of runoff into the groundwater. Consequently, the till forest runoff coefficient was applied in the King County Runoff Time Series (KCRTS) analysis, indicating that most precipitation falling on the site discharges as surface runoff rather than infiltrating. Drainage characteristics for the 11.7 acres of upstream area were modeled as under current conditions.

SEC 3, TWNSHP 26N, RNGE 5E, W.M.

UPSTREAM BASIN
A=19.6 AC

R-1
ZONING

CULVERT
12" CMP

CULVERT
12" CMP

DETENTION
POND

SHEET FLOW

SHEET FLOW

RAVINE

RAVINE

RAVINE

TAX LOT 42

TAX LOT 44

TAX LOT 111

HEAVY VEGETATION

HEAVY VEGETATION

HEAVY VEGETATION

R-1
ZONING

INDUSTRIAL
ZONING

TAX LOT 1

TAX LOT 126

TAX LOT 33

TAX LOT 100

LOT 1

LOT 2

LOT 3

LOT 4

KCSP 2611B4
810730865

N

SCALE: 1" = 200'

0 100' 200 400

Figure 3.2-1
Existing On-Site Drainage Conditions, Wood Trails

TRIAD ASSOCIATES
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EXISTING CONDITIONS EXHIBIT

PHOENIX DEVELOPMENT INC.

WOOD TRAILS

CITY OF WOODINVILLE, WASHINGTON

BY CK

NO. DATE REVISION

GEORGE H. NEWMAN
PROJECT MANAGER
BOB E. WALLIS, PLS
PROJECT SURVEYOR
MARK KELLER, PE
PROJECT ENGINEER
PROJECT LANDSCAPE ARCHITECT
FIRST SUBMITTAL DATE:
SCALE: HORIZ.: 1"=200' VERT.: NA

STAMP NOT VALID
UNLESS SIGNED AND DATED

JOB NO. 03-208

SHEET NO 1 OF 1

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Flow from the northern seepage area drains downslope and into the main surface drainage located off-site within Tract A (the 11.8-acre portion of the original Wood Trails property that was removed through a boundary line adjustment). This water flows to the west within the drainage and is directed into a large culvert that connects to the stormwater conveyance system located off site toward the northwest (see Section 3.2.1.4 for additional discussion). Seepage within the central-western portion of the site exists within small erosional swales that trend toward the west. No evidence of stream flow in these areas was observed during spring and summer 2006 field visits. The amount of groundwater flow from these seepage areas is small and appears to be significantly less than the flow from the seepage area located to the north. It appears that the seepage is controlled by subsurface conditions off-site toward the west.

The seepage areas that were mapped from field reconnaissance in the spring were still visible in September, after an extended period of low precipitation during the summer months. The volume of flow from the seepage zones was somewhat greater during spring 2006 observations and appeared to diminish through the summer months. Likewise, the volume of surface water flow observed within the off-site drainage to the north was larger in the spring than during the course of the following months. All of the seepage zones that were active during late-summer field visits were also evident during the spring; there were no additional seepage areas that became active only later in the summer.

The City's geotechnical consultant also reviewed logs from wells in the area and the test pits and borings to investigate groundwater conditions. Appendix M includes maps showing the locations of wells in the general vicinity of the project site and logs documenting conditions encountered in those wells. Figure 3.2-2 is a cross-section through the northern part of the Wood Trails site (and areas to the east) developed through interpretation of the well log data. (Appendix M also includes a similar cross-section through the southern part of the Wood Trails site.)

The geotechnical consultant's interpretation of the applicable groundwater and geologic information is that groundwater exists at two different levels within the project area. The field observations indicate the presence of shallow groundwater, controlled by local geologic conditions, that discharges to the surface at selected locations on and near the Wood Trails site. The well logs indicate there is also a deep aquifer (generally more than 100 feet below the surface) that has been and is being used for domestic water supply purposes.

The near-surface groundwater appears to be derived from precipitation and local near-surface recharge. Most of the Wood Trails site, particularly areas in the eastern and northern parts of the site, is blanketed by dense Glacial Till that has low permeability and infiltrates relatively little water. Therefore, the potential for groundwater recharge over most of the site is limited. On-site recharge likely occurs primarily where the more-permeable Advance Outwash is exposed at or near the surface. Sources for much of the near-surface groundwater appear to be located to the east of the Wood Trails site, where there are topographic low spots that likely collect and infiltrate surface runoff. Elevations for the near-surface groundwater appear to vary from roughly elevation 290 to 360 feet. The Transitional Bed deposits underlying the site are thought to be the controlling factor in the actual elevations of the seepage zones.

The Advance Outwash appears to function as the local shallow aquifer, with the Transitional Beds acting as a local underlying aquiclude (a low-permeability layer blocking the downward infiltration of groundwater). The shallow groundwater is collected within the Advance Outwash deposits and above the Transitional Bed deposits, and flows downslope to the locations identified as seepage areas. Within the northerly (off-site) seepage zone, it appears the groundwater flows within a remnant Advance Outwash channel and toward the north. Flow from the other seepage zones is generally in a westerly direction. The structural high discussed in Section 3.1.1 for the Transitional Bed deposits in the area of the proposed detention pond separates the distinct seepage areas shown in Figure 3.1-1a (Earth Section). No evidence of the Advance Outwash or groundwater was found within this area.

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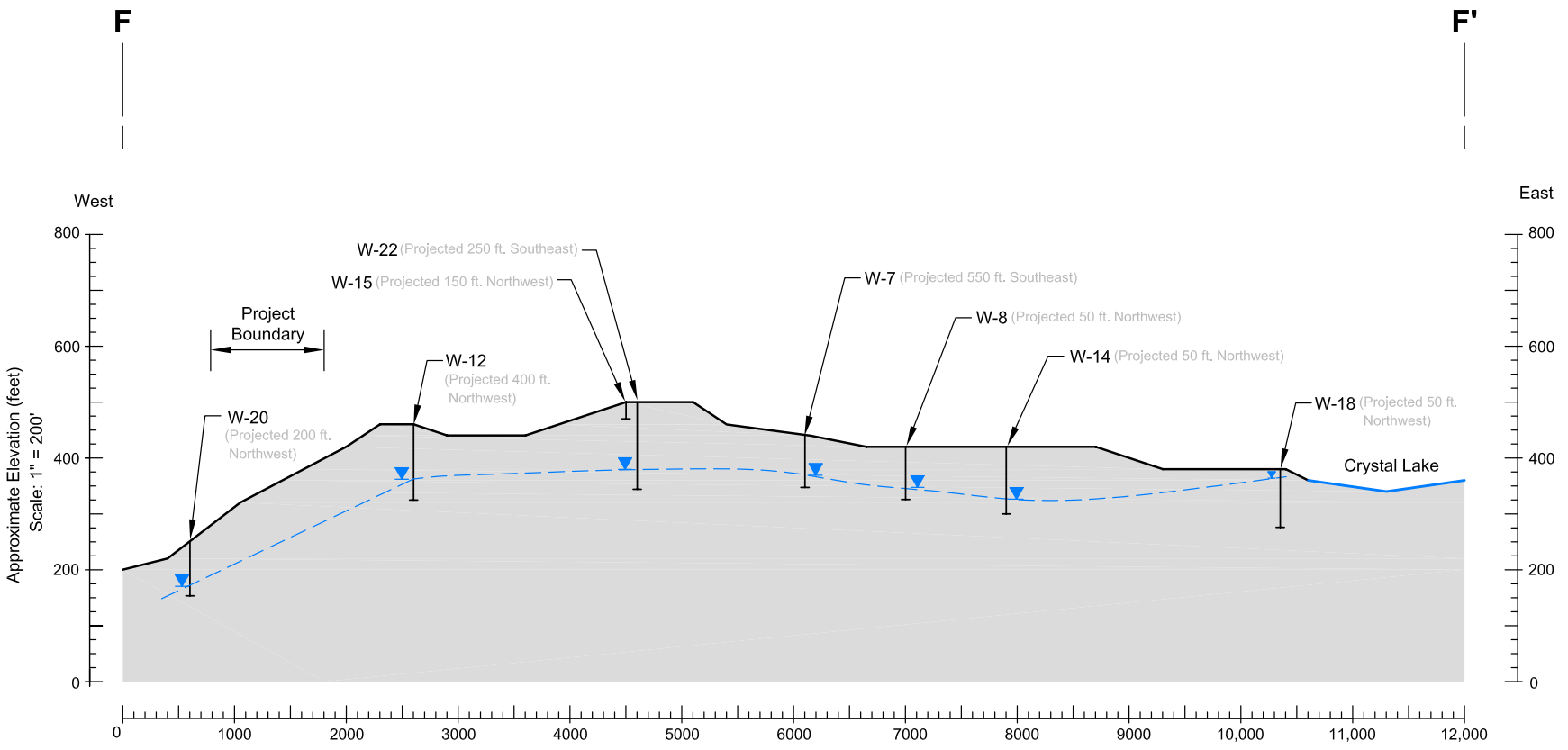

Well Detail

Well Designation → **W-1**

Groundwater Level →

*The maps and cross-sections produced for this study are interpretations based on our review of the provided data. Our conclusions and interpretations should not be construed as a warranty of subsurface conditions.

NOTES:
1) Stratigraphic conditions are interpolated between the explorations. Actual conditions may vary.
2) Elevations are approximate.

Reference: Cross-section based on a map created with TOPO! ®© 2003 National Geographic. Well locations compiled from Department of Ecology website.

No.	Date	Revision	By	CK
1	8/23/06	Original	ACO	BD

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Wood Trails
Cross-Section F-F'

Project Number
409205

Figure 3.2-2
Wood Trails Cross-Section and Groundwater Profile

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Figure 3.2-2 indicates that water surface elevations for the deep aquifer beneath the Wood Trails site range from approximately 160 feet to 320 feet, or approximately 60 to 100 feet below the ground surface. The deep aquifer does not surface within the Wood Trails site or immediate vicinity and is not connected with surface recharge on the site. This is generally evidenced by the presence of the very low-permeability Transitional Bed deposits that underlie the on-site glacial deposits, and are expected to underlie the entire site. The Transitional Bed deposits act as an aquiclude to separate the near-surface groundwater conditions from the deeper groundwater conditions. Based on the deep well data, the general direction of flow within the deep aquifer is toward the northwest. Conditions within the deep aquifer do not appear to be influenced by the upper aquifer or near-surface conditions within the project area.

3.2.1.3 Montevallo Site

Technical reports documenting surface and ground water conditions for the Montevallo site were included as Appendices G and H to the Draft EIS. Additional information on groundwater provided in Appendix M is relevant to the Montevallo site.

On Site Basin Characteristics

The Montevallo site is also located within the Little Bear Creek Sub-basin of the Sammamish River Drainage Basin (King County 1998). Runoff is generated from precipitation on this site in addition to a small upstream area that drains onto the site.

The site currently contains five (5) single-family residences and a barn, along with several miscellaneous outbuildings and various driveways, on approximately 16.5 acres. The site generally slopes from east to west with a high elevation of approximately 490 feet and a low elevation of approximately 430 feet. The primary ground cover on the site is pasture, with scattered fir, maple and cedar trees. Approximately 2.9 acres of the western portion of the site is a wetland and associated buffer area. The entirety of the site drains to the wetland within a single drainage basin (see Figure 3.2-3).

Surface Water Runoff

The site is located near a regional high point. Approximately 0.47 acres of upstream area from the west half of 156th Ave NE drains west onto the site. The wetland also receives inflow from approximately 1.6 acres adjacent to the southwest corner of the site. No additional runoff enters the site from the north or the south.

Runoff from the Montevallo site drains to the onsite wetland occupying the western portion of the site. The only existing drainage infrastructure on the site is related to the roof and footing drains for the existing structures. These are dispersal systems. The wetland drains offsite to the north via a vegetated ditch along the northwest property boundary of the site. Flow from the ditch enters a culvert / ditch system before discharging into a pond located within the southeastern portion of the Wellington Hills Golf Course approximately 350 feet downstream of the site. The discharge from this pond flows to the west through the golf course and the undeveloped parcel immediately to the north of the Wood Trails site, collecting some additional flow from minor intermittent drainages in local ravines. The stream channel enters a large culvert at the eastern edge of the industrial area where it is conveyed by underground pipe and surface ditch and eventually discharges into Little Bear Creek, approximately 1 mile downstream of the Montevallo site.

Existing runoff flows from this drainage area were simulated using the King County Runoff Time Series (KCRTS) program, using hourly time steps. Results from this analysis are summarized in Table 3.2-2 below. The 33.2-acre basin represents approximately 0.3 percent of the total area of the Little Bear Creek drainage basin. If the 438 cfs maximum daily flow recorded in Little Bear Creek in the October 1998-June 2006 period is assumed to be the equivalent to a 10-year storm event, the simulated 2.43-cfs 10-year flow from the Wood Trails Basin would represent 0.6 percent of the discharge volume in Little Bear Creek. Alternatively, if the 438 cfs figure is assumed to represent a 50-year event, the simulated 3.91-cfs 50-year flow from the Wood Trails Basin would amount to 0.9 percent of the corresponding Little Bear Creek flow. In any event, the Wood Trails Basin contributes less than 1 percent to the peak flow volume of Little Bear Creek.

Table 3.2-2
Simulated Existing Condition Peak Flow Rates (cfs), Wood Trails Basin

Basin	Area (acres)	Storm Event			
		2-year	10-year	50-year	100-year
Onsite	21.5	0.6	1.04	1.61	1.74
Upstream	11.7	1.04	1.39	2.3	2.68
Total	33.2	1.64	2.43	3.91	4.42

Flooding

The Wood Trails site is well above the floodplain of the nearest stream (Little Bear Creek) and no evidence of flooding has been found on the site. As noted above, sheet-flow runoff from the site enters existing stormwater management facilities along the western edge of the property.

Water Quality

There are no surface water bodies on the Wood Trails site, and the quality of runoff draining from the site has not been measured. Water quality characteristics of drainage from the site are likely to be typical of stormwater runoff from primarily forested areas in an urban setting.

Groundwater

Supporting documentation on groundwater conditions is provided in Appendix M. Information sources on groundwater include observations from the on-site test pits and borings documented in the applicant's geotechnical reports (Appendices A through D in the Draft EIS), field investigation of the site by the City's geotechnical consultant, and review of well logs and literature. Groundwater conditions for the Wood Trails site are related to and largely determined by the geologic conditions described in Section 3.1 and the corresponding technical appendices.

The City's geotechnical consultant noted seepage areas and flow conditions at several locations on the Wood Trails site during the spring and summer of 2006. These locations are indicated on the site geologic map included previously as Figure 3.1-2. The seepage zones are concentrated in a drainage swale located in the adjacent parcel toward the north of the Wood Trails site, downslope from the northerly development cluster of the proposed subdivision. Other areas of seepage were noted in smaller swales draining from the western slope of the site. The seepage zones are areas of groundwater discharge and are indicative of locations of relatively shallow groundwater beneath the surface.

Flow from the northern seepage area drains downslope and into the main surface drainage located off-site within Tract A (the 11.8-acre portion of the original Wood Trails property that was removed through a boundary line adjustment). This water flows to the west within the drainage and is directed into a large

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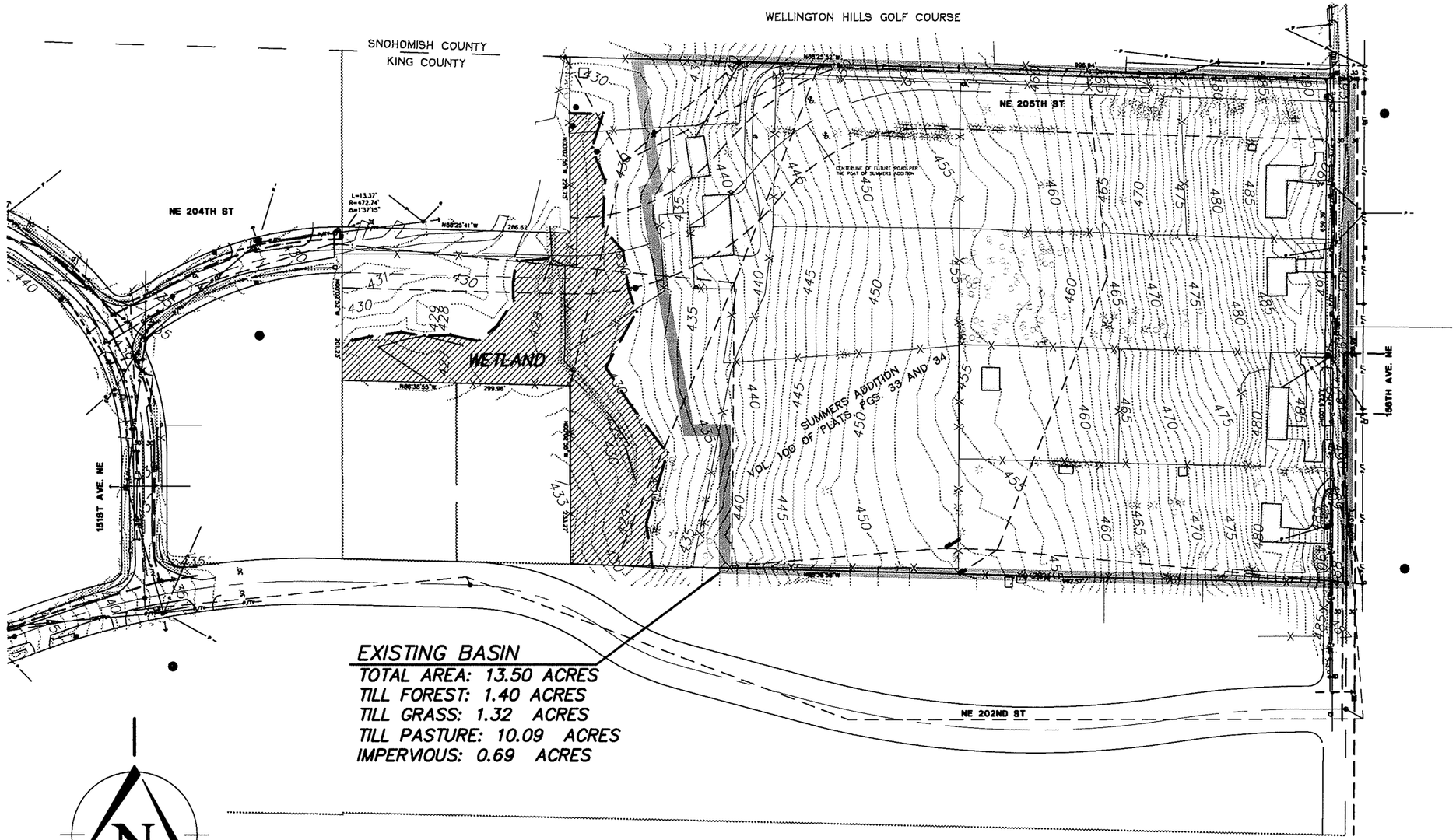

Figure 3.2-3
Existing On-Site Drainage Conditions, Montevallo

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Land Development Consultants

EXISTING CONDITIONS EXHIBIT

MONTEVALLO

CITY OF WOODINVILLE, WASHINGTON

BY | CK

NO. | DATE | REVISION

PROJECT MANAGER
PROJECT SURVEYOR
PROJECT ENGINEER
PROJECT LANDSCAPE ARCHITECT
FIRST SUBMITTAL DATE:
SCALE: HORIZ.: 1"=150' VERT.:

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existing conditions

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The existing basin has been modeled with developable portions of the site east of the onsite wetland, including half of the area along 156th Avenue NE fronting the site. The total existing basin area is 13.5 acres, including 1.4 acres of till forest, 0.69 acres of impervious surface, 1.32 acres of till grass and 10.09 acres of till pasture (refer to Figure 3.2-3).

Existing runoff flows from this drainage area were simulated using the King County Runoff Time Series (KCRTS) program, using hourly time steps. Results from this analysis are shown below in Table 3.2-3. The 13.5-acre basin represents approximately 0.1 percent of the total area of the Little Bear Creek drainage basin. If the 438 cfs maximum daily flow recorded in Little Bear Creek in the October 1998-June 2006 period is assumed to be the equivalent to a 10-year storm event, the simulated 1.02-cfs 10-year flow from the Montevallo Basin would represent less than 0.3 percent of the discharge volume in Little Bear Creek. Alternatively, if the 438 cfs figure is assumed to represent a 50-year event, the simulated 1.62-cfs 50-year flow from the Montevallo Basin would amount to less than 0.4 percent of the corresponding Little Bear Creek flow. In any event, the Montevallo Basin contributes less than one-half of 1 percent to the peak flow volume of Little Bear Creek.

Table 3.2-3
Simulated Existing Condition Peak Flow Rates (cfs), Montevallo Basin

Basin Area (Acre)	Storm Event			
	2-year	10-year	50-year	100-year
13.5	.57	1.02	1.62	1.92

Flooding

There is no evidence of past flooding on the Montevallo site. As indicated previously, the site is near a regional high point and is a considerable distance from the nearest stream. Some public comments on the Draft EIS reported observations of water ponding in areas adjacent to the site, such as in topographic low spots along NE 202nd Street. To the extent that such events have occurred, it would appear that they are related to the functioning of drainage facilities serving the adjacent neighborhood. Please refer to additional discussion in Section 3.2.1.4.

Water Quality

The quality of water within and draining from the on-site wetland has not been measured. With respect to most constituents, water quality characteristics of drainage from the site are likely to be typical of stormwater runoff from low-density residential areas with primarily lawn and pasture cover. Existing water quality on and downstream from the Montevallo site is likely to reflect the influence of a gray-water discharge from the residence in the western part of the site, and the contribution of bacteria from use of much of the site by horses.

Groundwater

Section 3.1.1 includes an overview of groundwater conditions under the Montevallo site, based on regional geologic information and subsurface exploration conducted for the applicant. Information on well locations and logs provided in Appendix M also includes the area around the Montevallo site.

In summary, the Montevallo site is underlain primarily by Glacial Till deposits, which are dense and have low permeability. Surficial materials above the till showed evidence of shallow, seasonal, perched groundwater. In some locations there may be lenses of permeable material within the till that also contain perched groundwater. Shallow groundwater levels under the site likely fluctuate with the season, precipitation and surface runoff patterns and other factors, and are likely to be higher in the wetter months

of October to May. A relatively deep test pit near the location proposed for the stormwater vault did not encounter persistent or chronic groundwater seepage.

The cross-section shown in Figure 3.2-2 also runs through the Montevallo site (which is not identified on the graphic, but lies just to the west [left] of the W-15 and W-22 well locations). As discussed for the Wood Trails site, the well logs indicate there is a deep aquifer beneath the Montevallo site. The water surface elevation of the deep aquifer is generally near elevation 360 feet, or about 75 to 130 feet below the ground surface of the site. The deep aquifer is likely to be overlain by an impermeable layer, and conditions within the deep aquifer do not appear to be influenced by the upper aquifer or near-surface conditions within the project area.

3.2.1.4 Existing Stormwater Management Facilities

The proposed project sites are not currently served by storm sewers or similar constructed stormwater management facilities. While there is some existing residential development on the Montevallo site, there are no existing stormwater management facilities on the site, other than the roof and footing drains for the existing structures. The Wood Trails site is undeveloped and runoff from the site flows by natural drainage means. Storm drainage facilities have been constructed in the industrial area to the west and downstream of the Wood Trails site.

Wood Trails Area

Runoff from the Wood Trails site currently flows into three separate off-site conveyance systems serving properties along 144th Avenue NE, each comprised of a combination of pipes and open ditches. They are identified as System A, System B and System C in Figure 3.2-4, and are described in Appendices E and F to the Draft EIS. Basin A on the Wood Trails site drains into System A, Basin B into System B and Basin C into System C. All three of these existing conveyance systems ultimately drain into Little Bear Creek, approximately 0.4 mile west of 144th Avenue NE.

The capacity of drainage System A varies with location in the system, which consists of a combination of 12-inch and 18-inch culverts, open-channel ditches and a grass-lined channel. The maximum flow rate this system can convey is not specifically identified in Appendix E or F to the Draft EIS. System B includes a 24-inch pipe beneath NE 200th Street that daylights to an open ditch along the east side of the Woodinville-Snohomish Road. The conveyance capacity of this system is estimated at 17.3 cfs, while the design-storm discharge from the tributary area to this system is estimated at 13.4 cfs (see Appendix F). Drainage System C begins as a 24-inch pipe beneath the east side of 144th Avenue NE that subsequently discharges to an open swale via an 18-inch culvert. The capacity of the latter culvert is estimated at 22 cfs.

A fourth conveyance system, termed System AA, serves the industrial property situated adjacent to the northwest corner of the Wood Trails site. The stream flowing through the undeveloped parcel north of the Wood Trails site discharges into a large-diameter drainage pipe (which appears to be 30 or 36 inches in size) at the eastern edge of the industrial property. System AA conveys runoff via underground pipes and surface ditches to a discharge point on Little Bear Creek near the discharges for Systems A, B and C. This system would not receive flows from the proposed Wood Trails development and characteristics of the system are not identified in the drainage technical reports. Based on the size of the culvert at the east edge of the adjacent industrial property, the capacity of System AA appears to be substantially larger than the capacity of System C.

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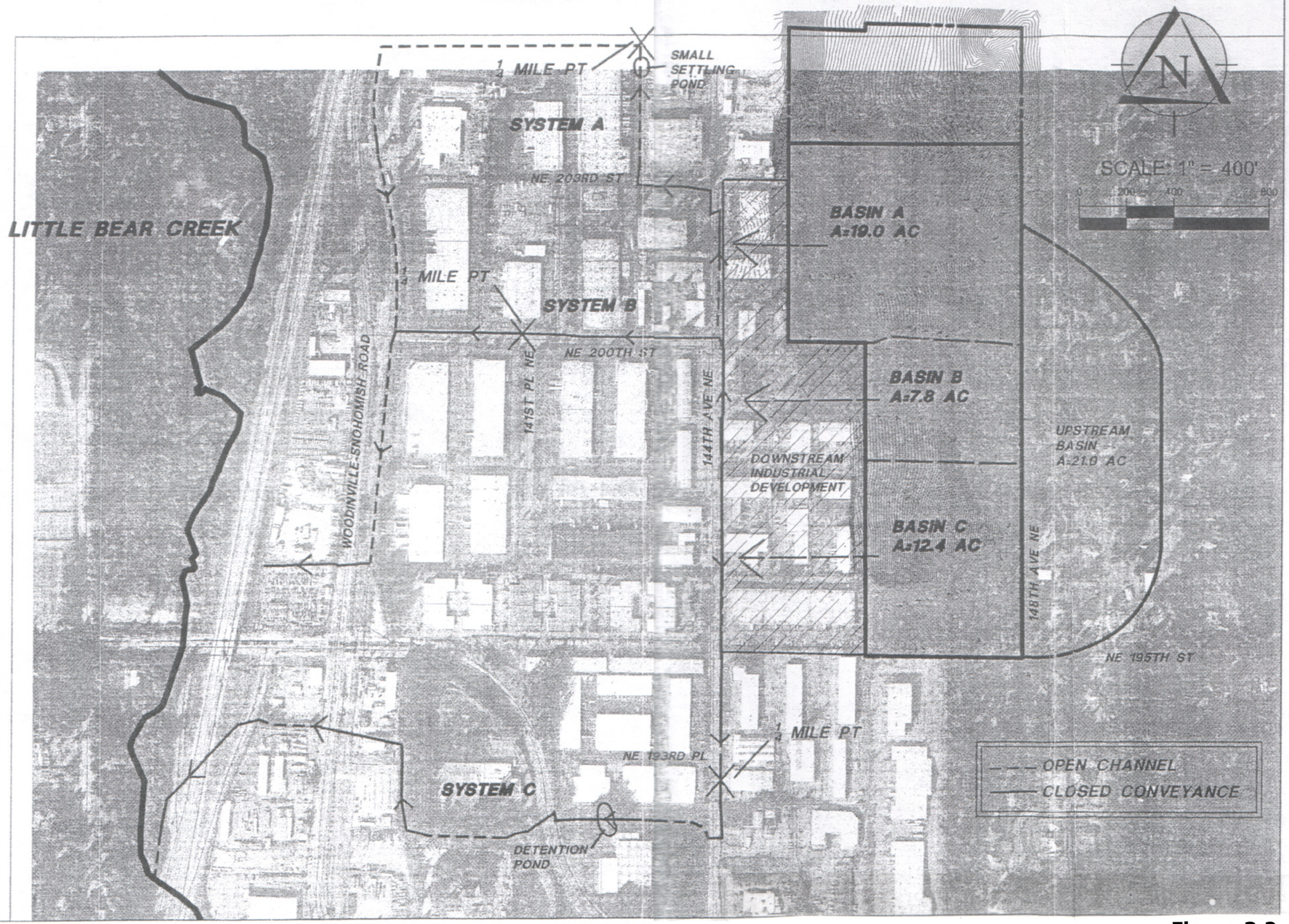

Figure 3.2-4
Existing Downstream Drainage Conditions, Wood Trails

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DOWNSTREAM DRAINAGE EXHIBIT

PHOENIX DEVELOPMENT INC.

WOOD TRAILS

CITY OF WOODINVILLE, WASHINGTON

BY | CK

DATE | REVISION | NO.

GEORGE H. HEYMAN
PROJECT MANAGER
BOB E. MILLER, PLS
PROJECT SURVEYOR
MARK KELLER, PE
PROJECT ENGINEER
PROJECT LANDSCAPE ARCHITECT
FIRST SUBMITTAL DATE:
SCALE: HORIZ: 1"=XXX' VERT: N/A

STAMP NOT VALID UNLESS SIGNED AND DATED

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Drainage facilities in adjacent neighborhood area are limited primarily to roadside ditches and occasional culverts under roadways. A King County map of stormwater facilities included in Appendix F to the DEIS indicates there is a residential stormwater facility (presumably a detention pond) adjacent to the Wood Trails site on the north side of NE 198th Street, and two other facilities farther to the east on NE 201st Street.

Some public comments on the Draft EIS reported observations of drainage problems in areas adjacent to the Wood Trails site. One reviewer described stormwater facility overflows near NE 144th Street in the industrial area west of the Wood Trails site. In response, City Public Works Department staff searched the City's database of reported drainage problems, but could not find any instances of reported problems from areas near the Wood Trails site. Similarly, Appendix E to the Draft EIS documents results of a search of the King County Land and Water Resources Division's drainage complaint database. This search indicated no significant drainage problems had been identified downstream of the Wood Trails site.

Montevallo Area

As described previously, flows from the wetland on the Montevallo site drain into a vegetated ditch that flows to the north and west onto the Wellington Hills Golf Course property. Flows continue through the golf course via a series of 12-inch concrete and metal culverts, a pond, open ditches, a section of 15-inch underground metal pipe and a grass-lined channel. At or near the west edge of the golf course this conveyance system discharges into the natural drainage that flows through the parcel adjacent to the Wood Trails site on the north and then into System AA.

Drainage facilities in adjacent neighborhood area are limited primarily to roadside ditches and occasional culverts and catch basins at roadway crossings. A King County map of stormwater facilities included in Appendix H to the DEIS indicates there is a County-owned stormwater facility (presumably a detention pond) southwest of the site on the south side of NE 201st Street.

Some public comments on the Draft EIS reported observations of drainage problems in areas adjacent to the Montevallo site, such as in topographic low spots along NE 202nd Street. To the extent that such events have occurred, it would appear that they are related to the functioning of drainage facilities serving the adjacent neighborhood, which primarily consist of roadside ditches. In response, City Public Works Department staff searched the City's database of reported drainage problems, but could not find any instances of reported problems from areas near the Montevallo site. Appendix H to the DEIS includes King County documentation of drainage (ponding) problems in December 1993 and December 1995 reported by a property owner on NE 202nd Street west of the Montevallo site. The problems appeared to involve a blockage in a 12-inch conveyance pipe between NE 202nd and NE 204th Streets, and/or sediment accumulation in two catch basins. The records search did not indicate any drainage problems in the area subsequent to 1995.

3.2.2 Impacts of the Proposed Action

Implementing of any of the development alternatives would alter the land use of the site and the surface characteristics that determine drainage conditions. In the short term, surface disturbance from construction of the proposed subdivisions could result in temporary changes in quantity and/or quality characteristics for surface water and groundwater. The long-term conversion of forest or pasture lands to pavement, rooftops, landscaping and lawns would change the hydrologic response and runoff characteristics of the sites. Infiltration of rainfall would likely be decreased in the developed areas of the sites, relative to existing conditions. Storm water would run off these developed areas more quickly and would be collected in constructed drainage systems that would be directed to a detention facility. The constructed water quality and detention facilities would require on-going maintenance. The types of

potential impacts to surface and groundwater and their likely significance are addressed below for each proposed development.

3.2.2.1 Wood Trails

Construction Impacts

Construction activity on the Wood Trails site would create the potential for short-term impacts to water resources, primarily through sedimentation that could result from erosion of disturbed surfaces. Accidental releases of contaminants such as fuels or other petroleum products are also typical concerns associated with construction activities. Erosion and sediment control at construction sites is critical because erosion rates on uncontrolled construction sites are many times higher than erosion rates from undeveloped land (King County 2005). Implementing erosion and sediment control measures at construction sites can limit rates of erosion and transport of sediment to off-site surface waters to acceptable levels, however.

Construction of the Wood Trails subdivision would require the applicant to obtain a temporary National Pollutant Discharge Elimination System (NPDES) permit, under the Washington Department of Ecology's general permit for construction stormwater. A condition of that permit would be that the applicant submit and receive approval for a Stormwater Pollution Prevention Plan (SWPPP) that was consistent with Ecology's standards for management of construction stormwater. The SWPPP must specify the control measures that would be applied during construction to minimize discharge of pollutants to runoff from the site. The project must also meet the City's construction stormwater requirements, which incorporate the requirements of the King County Surface Water Design Manual (KCSWDM) and are consistent with Ecology's stormwater management requirements.

Determination of the expected water resource impact level from construction of the Wood Trails subdivision is based on the regulatory approach of the agencies with permit jurisdiction, which in this case are Ecology and the City. Stormwater discharges from construction sites are subject to State water quality standards. Ecology's construction stormwater general permit does not authorize violations of the standards, even on a temporary basis. Ecology (and local government agencies) rely on the use of approved stormwater pollution control measures to minimize water resource impacts from construction activities and maintain compliance with State water quality standards. Those measures are identified in Section 3.2.5.

The *Stormwater Management Manual for Western Washington*(Ecology (2005c) presents documentation that "minimization of stormwater flows, prevention of soil erosion, capture of water-borne sediment that has been unavoidably released from exposed soils, and protection of water quality from on-site pollution sources are all readily achievable when the proper BMPs are planned, installed and properly maintained." The *Manual* indicates that Ecology expects that use of the "appropriate BMPs outlined in this volume …will result in compliance with water quality standards." Furthermore, the *Manual* explains that RCW Chapter 90.48 directs that *compliance with water quality standards shall be presumed* (emphasis added) when the permittee is in compliance with permit conditions and following approval of its stormwater management practices, unless site specific information demonstrates otherwise.

As discussed in Section 3.1.2, erosion and associated sedimentation impacts from construction on the Wood Trails site would be minimized through use of BMPs required as conditions of the project construction stormwater permit. Similar BMPs would be employed to minimize the potential for spills and resulting contamination during construction. Based on the technical and regulatory guidance provided by Ecology and the applicable provisions of Washington law, the City concludes that the required stormwater pollution prevention measures would be sufficient to minimize water quality impacts from

construction and maintain compliance with water quality standards. Therefore, potential water quality impacts from project construction on the Wood Trails site would be insignificant.

Developed-Condition Impacts

The potential for long-term water resource impacts from the proposed action on the Wood Trails site would be related to the long-term conversion of approximately 17 acres of forested area to impervious and/or less pervious areas, the collection of off-site storm water flows that currently discharge onto the surface along the eastern boundary for bypass through the project area, and the alteration of flow rates through portions of the downstream stormwater system. The proposed action would create approximately 8.91 acres of impervious surfaces in the form of rooftops, roadway and sidewalk, and the detention pond (see Figure 3.2-5). Without adequate management, runoff from these surfaces could cause adverse impacts to surface water hydrology (water quantity) and/or water quality. Depending on site-specific circumstances, urban development can also cause substantial changes to groundwater conditions.

Downstream Stormwater Facilities

Changes in flow rates for downstream runoff also raise the potential for impacts to the stormwater drainage systems serving the industrial properties to the west of the Wood Trails site. To avoid this potential impact, the large majority of the runoff from the developed area of the site would be collected within on-site drainage systems and routed around the downstream development into an existing closed conveyance system within the NE 203rd Street right-of-way (identified as System B). Some of the existing flows from on-site or upstream areas would be bypassed to System C, while some flows from the Wood Trails site that currently drain to Systems A and C would be routed to System B in the developed condition. Small portions of the developed area of the site would be managed as bypass areas; dispersion trenches serving four lots would dissipate flows to the undeveloped area of the site in a pattern similar to existing conditions, while runoff from four other lots would be bypassed to the conveyance facilities of System C.

Modeling analysis documented in Appendix F indicates the with-project peak flows though System B would remain within the capacity of the system (18.8 cfs, compared to a capacity of 17.3 cfs). With-project flows in System C would approach the current capacity, but not exceed it. Consequently, adverse impacts to the existing stormwater management facilities on the downstream properties are not expected. The applicant will conduct a more detailed downstream capacity analysis for both Systems B and C as a part of final engineering for the stormwater system.

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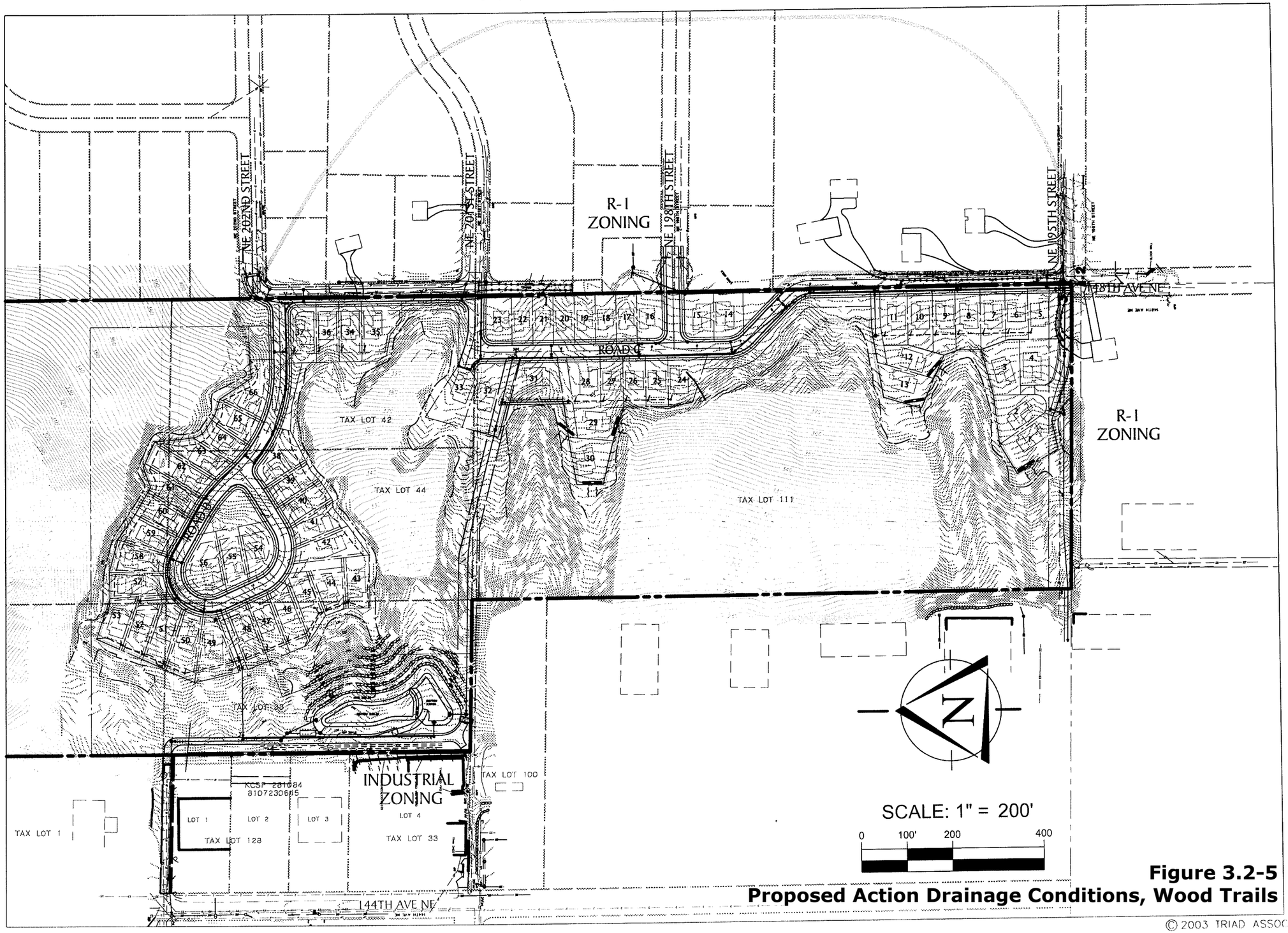

Figure 3.2-5
Proposed Action Drainage Conditions, Wood Trails

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DEVELOPED BASINS EXHIBIT

PHOENIX DEVELOPMENT INC.

WOOD TRAILS

CITY OF WOODINVILLE, WASHINGTON

NO.	DATE	REVISION

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Water Quantity/Flow Control

The City's stormwater management requirements for new development incorporate those of the King County Surface Water Design Manual (KCSWDM). Based on the regulations in force at the time the plat applications were filed, the City's review of the Proposed Action is based on the 1998 Surface Water Design Manual (King County 1998). (The requirements set forth in the 1998 KCSWDM are very similar to those in the updated 2005 KCSWDM, which was modified for consistency with the 2005 Ecology manual.) The KCSWDM establishes eight core requirements that stormwater management systems for new developments must meet. Core Requirement #3 directs proposed development projects to provide on-site flow control facilities sufficient to mitigate the impacts of increased stormwater runoff generated by the addition of new impervious surface and any related land cover conversion.

Based on the geographic location of the Wood Trails site within an identified stream protection area, the project is subject to the Level 1 and Level 2 flow control standards. The Level 1 standard requires the developed-condition peak discharge rates to match those of the existing site conditions for 2-year and 10-year return periods. Level 1 flow control is intended to protect the flow capacity and limit increased erosion within the conveyance system downstream of the project. The Level 2 flow control standard also adds the requirement that developed-condition peak discharge durations match the pre-developed discharge durations for all discharge rates from 50 percent of the 2-year peak flow up to the full 50-year peak flow. This requirement is intended to prevent increased erosion or stream channel instability by limiting the amount of time that developed flows exceed the erosion-causing threshold (which is 50 percent of the 2-year peak flow) to the same duration as under pre-developed conditions. The KCSWDM also includes directions conducting the flow-control analysis for a project, and prescriptions concerning acceptable or required bypassing of flows from on-site or upstream areas.

Analysis of the performance of the proposed stormwater management system for the Wood Trails development is documented in Appendices E and F to the Draft EIS. The proposed facilities were sized and configured to meet the flow control requirements identified in the Manual. The model analysis demonstrated that the proposed system would meet the Level 1 and Level 2 flow control requirements. Discharges from the project site would match pre-development flow rates and durations for all storm events but those with the highest return periods. While discharge rates and durations would be higher than existing conditions for rare storm events, the incremental increase from the site on those occasions would be extremely small in relation to the corresponding flows in downstream waters, specifically Little Bear Creek. The modeling analysis indicated the 100-year peak developed flow rate from the detained area (inflow to the detention pond) would be 8.33 cfs, and the peak outflow would be 4.78 cfs. Even with the added peak flow of 0.64 from the bypassed area, the total 100-year peak flow from the site would be 5.01 cfs. That figure is only 0.6 cfs more than the 100-year peak flow under existing conditions. That incremental volume of water would likely not even be measurable in Little Bear Creek during 100-year peak flow conditions.

The modeling analysis demonstrates that the proposed Wood Trails development would cause essentially no change in discharge rates or patterns over most of the range of flow conditions, and only minimal change at flow conditions with the highest return intervals. Therefore, impacts of the Proposed Action on water quantity characteristics would be insignificant.

Water Quality

Urban stormwater runoff can contain a variety of pollutants that can degrade the quality of surface waters receiving the runoff. Typical pollutants in runoff include sediment; nutrients such as nitrogen and phosphorus; organic matter that consumes oxygen when it decays; several types of metals, including lead, copper, zinc and cadmium; oils, greases and fuels; pesticides and other toxic organic compounds; and harmful bacteria, such as fecal coliform bacteria (King County 2005). Research based on field sampling

has shown that urban stormwater pollutant concentrations can exceed the State and federal water quality standards (Ecology 2005). Ecology (2005) identifies total suspended solids (TSS), pesticides/herbicides and nutrients as the primary pollutants of concern in stormwater from residential development. Based on the current situation with water quality in Little Bear Creek and the TMDL plan, fecal coliform bacteria is considered a key constituent for the Wood Trails project.

To limit pollutants generated by urban development and protect water quality, the City and other local jurisdictions include water quality treatment measures and standards in their stormwater management requirements. Core Requirement #8 in the KCSWDM directs that all proposed projects must provide water quality facilities to treat runoff from new impervious surfaces and pollution-generating impervious surfaces (King County 1998). The intent of this requirement is to obtain efficient, cost-effective water quality treatment tailored to the resource protection needs of the downstream receiving water to which a project drains. Core Requirement #8 includes a Basic Water Quality menu applicable to all areas and projects. Enhanced water quality treatment measures are also required for project sites in areas draining to sensitive lakes, "regionally significant" streams or sphagnum bog wetlands. Based on the significance of Little Bear Creek, the Wood Trails development is subject to the Resource Stream Protection menu in addition to the Basic Water Quality menu.

The KCSWDM treatment goal for facilities listed on the Basic Water Quality menu is 80 percent removal of total suspended solids (TSS) for a typical rainfall year. The 80 percent threshold is based on the assumption that pollutant concentrations in project runoff will be typical for the urban area; TSS concentrations in untreated runoff in the Seattle area typically range from 30 to 100 milligrams per liter (mg/L). TSS is used in the treatment goal as a general performance indicator because it is the most obvious pollutant of concern. The absence of other pollutants should not be interpreted to mean that facilities on the Basic Water Quality menu only treat TSS; the types of facilities on this list typically remove substantial percentages of other pollutants in addition to TSS. Based on applicable research, King County set the 80 percent removal objective as the treatment level expected to result in good stormwater quality for all but the most sensitive water bodies.

Development of the Resource Stream Protection menu in the KCSWDM followed a similar approach. The Manual specifies a treatment goal of 50 percent reduction of total zinc for project flows up to and including the water quality design flow. Again, zinc is used as an indicator for a wider range of metals that are potentially toxic to aquatic life and are typically found in urban runoff. While zinc is not the most toxic metal in stormwater, it is a practical and reliable indicator because it is usually present in significant amounts. Many metals are readily adsorbed onto particulates in the runoff, usually the finer particulates. Facilities on the basic menu remove some of these particulates (in the process of removing TSS), while facilities on the Resource Stream Protection menu remove more of the particulates, including the finer fraction. The KCSWDM identifies three options for this menu, including one option to provide a two-facility treatment train consisting of one of the basic treatment options followed by a leaf compost filter or one of several types of sand filter. The science supporting the Manual indicates this additional level of water quality treatment will result in discharge water quality needed to meet stream protection goals.

In addition to the treatment goals for the basic and enhanced treatment options, the KCSWDM prescribes design flow rates and treatment flow volumes to be applied to the water quality facilities for a project. The design flow rate is set at 60 percent of the 2-year peak flow rate if the treatment facilities are located upstream of the project's detention facility, and the full 2-year release rate of the detention facility if located downstream of the detention facility. Flows above this level are allowed to be bypassed around the treatment facilities, based on research demonstrating the increasing level of dilution of pollutant concentrations with increasing flows. In addition, it is generally recognized that the first flush of stormwater (resulting from the initial ¼ inch or ½ inch of rainfall) has the greatest potential to mobilize dust and other contaminants from previously dry surfaces, and therefore is the primary concern in treatment of runoff (Lehner, et al. 1999). Analysis of flow patterns and facilities sized according to this

design flow level indicates compliant facilities will actually treat 95 percent of the average annual runoff volume for the site.

The two-facility water quality treatment train for the Wood Trails subdivision is a basic wetpond followed by a leaf compost filter, with the facilities sized to meet the water quality design flow and treatment volume requirements. The analysis documented in Appendices E and F to the Draft EIS demonstrates that the proposed facilities would comply with Core Requirement #8 of the KCSWDM. Wetponds treat water by both gravity settling and biological uptake of algae and microorganisms (King County 1998). Leaf compost filters remove pollutants through filtration, ion exchange, adsorption and microbial degradation. Based on research on the effectiveness of various types of treatment facilities at removing pollutants, Ecology (2005c) has identified wetponds as a "major process" for removal of TSS and a "minor process" for removal of dissolved metals, total phosphorus, pesticides/fungicides and hydrocarbons. Compost filters are identified as a "major process" for removal of TSS, pesticides/fungicides and hydrocarbons, and a "minor process" for removal of dissolved metals. In combination, they will meet the KCSWDM and Ecology treatment goals, based on indicator pollutants, of 80 percent removal of TSS and 50 percent removal of zinc. As discussed previously, the treatment processes that will occur in the wetpond and compost filter will also successfully remove substantial portions of a variety of other pollutants in the stormwater, including bacteria.

As is the case for construction stormwater management, the State and local regulatory agencies employ a presumptive–compliance approach to water quality treatment in long-term stormwater management (Ecology 2005). That approach is based on the best available science, which identifies the pollutants of concern and the effectiveness of the various types of treatment facilities available for removal of those pollutants. Applicable science is also used to identify goals for the volume of stormwater runoff from a site to be treated and establish design criteria to achieve desired performance goals for pollutant removal. Based on the science, stormwater management regulations and manuals identify default water quality treatment practices that are known to be capable of satisfying State and federal water quality requirements. The approved treatment practices provided in the manuals are presumed to adequately protect water quality and instream habitat. Likewise, development plans that are consistent with the manuals and employ approved stormwater management practices are presumed to be in compliance with water quality standards. (Conversely, if a developer chooses not to follow the approved practices outlined in the manuals, he/she must demonstrate the project will not adversely affect water quality.)

The regulatory agencies understand, however, that some level of water quality degradation will occur even with application of the approved stormwater management practices. Stormwater runoff from the Wood Trails site in the developed condition would likely include more pollutants than does existing runoff from the site. Because the Wood Trails project would employ water quality treatment measures consistent with the City and KCSWDM requirements, the discharge from those facilities is presumed to be in compliance with water quality standards and adequately protective of downstream receiving waters. Long-term water quality impacts from the project would therefore be insignificant.

Limitations to Proposed Surface Water Facilities

Because of the on site steep slopes and the adverse impacts of erosion, a storm water detention facility would be better suited for this site instead of the proposed detention pond. (See Plants & Animals 3-74) Additionally, dispersion trenches would not be advised for the same reasons and sized vaults for these areas designed with the outfall tied into the existing storm drainage system on 144th Ave.

Groundwater

Effects on groundwater conditions are a common concern associated with urban development primarily because land conversion and construction of impervious surfaces can reduce groundwater recharge on the

development site. To the extent this occurs, reduced recharge can change subsurface groundwater levels, flow patterns and conditions at discharge points. Where groundwater discharge contributes to the baseflow of streams, changes in discharge conditions can also affect surface water hydrology.

The potential for the Wood Trails development to alter groundwater conditions would be determined by the relationship of the development plan to the recharge characteristics of the site and groundwater levels and flow conditions. As described in Section 3.2.1.2, recharge on the site is limited by the extensive presence of glacial till at or near the surface of the site. Recharge occurs primarily in the areas where advance outwash deposits are at or near the surface; this condition occurs in a roughly rectangular lobe within the northeastern portion of the site and on the slopes in the southwestern part of the site (see Figure 3.1-1). Recharge from these areas appears to supply only the shallow aquifer under the site, as the transitional bed deposits provide an aquiclude under the advance outwash. Development activities for the Proposed Action, including excavation activities, would occur well above the level of the deep aquifer and would have no effect on it.

The proposed development would have both positive and negative effects on recharge volume within the site. In the southern part of the site, recharge would be increased slightly by routing surface water runoff from four lots below ground through the use of dispersion trenches. Conversely, a portion of the area of advance outwash deposits on the northerly part of the site would be covered by impervious surfaces, and runoff from that area would be diverted to the project's stormwater system. On balance, the net change would probably be a slight decrease in the volume of groundwater recharge within the site.

That change would not be likely to have any adverse environmental consequences. The shallow aquifer on site is not used for consumptive purposes. The discharge from the shallow aquifer at the on-site and off-site seepage areas is small in volume and contributes a very small percentage of the flow on the off-site stream to the north of the Wood Trails site. That stream ceases to exist as a natural drainage at the eastern edge of the industrial area, where it enters drainage System AA and is conveyed westward to Little Bear Creek. Discharge from the Wood Trails stormwater system would also be conveyed to Little Bear Creek, via other existing drainage facilities, and would enter the creek at essentially the same location. Therefore, the ultimate effect of the reduction in recharge within the northern cluster of the proposed subdivision would be to shift a minor volume of groundwater recharge (under existing conditions) to surface water runoff. That surface runoff would reach the same point in Little Bear Creek, although likely with somewhat of a shift in timing. Based on the limited magnitude of the change and the minimal downstream consequence, the impacts of the Wood Trails development on groundwater would be insignificant.

3.2.2.2 Montevallo

Construction Impacts

Potential short-term water resource impacts for the Montevallo site would be of the same type and origin as described previously for the Wood Trails site. Construction activities on the Montevallo site would likewise be governed by the conditions of a construction stormwater permit, which would require development of an SWPPP and use of BMPs during construction. Following the presumptive-compliance approach described in Section 3.2.2.1, the City concludes that the required stormwater pollution prevention measures would be sufficient to minimize water quality impacts from construction and maintain compliance with water quality standards. Therefore, potential water quality impacts from project construction on the Montevallo site would be insignificant.

Developed-Condition Impacts

The potential for long-term water resource impacts from the proposed action on the Montevallo site would be related to the conversion of approximately 12.5 acres of forest and pasture areas to impervious and/or less pervious areas and the alteration of flow rates through the onsite wetland. The proposed action would create approximately 7.2 acres of impervious surfaces (see Figure 3.2-6). The analysis approach for the long-term water resource impacts from the Montevallo subdivision is the same as presented in Section 3.2.2.1 for Wood Trails. Relevant issues include potential effects on downstream stormwater facilities, water quantity, water quality and ground water.

The stormwater management system proposed to serve the Montevallo subdivision has been designed to comply with the King County Surface Water Design Manual and to result in a discharge regime that closely matches existing flow conditions on the site. The project must meet the Level 1 and Level 2 flow control requirements set forth in the KCSWDM, as discussed previously for Wood Trails. The modeling analysis indicated that the conveyance and detention facilities were appropriately sized and would meet the flow control requirements, matching peak flows up to and including the 50-year peak. The 100-year peak outflow from the developed site would be 3.14 cfs, or 1.22 cfs above the 100-year peak flow under existing conditions. Under those flow conditions a 1-cfs flow increase would have minimal impact in the drainage course downstream from the on-site wetland or in Little Bear Creek. Consequently, the Proposed Action is not expected to result in a significant change from existing runoff patterns or in water quantity impacts in downstream areas.

The proposed drainage plan for Montevallo (see Figure 2.1-4) indicates that the runoff from the site will continue to flow to the onsite wetland. The runoff from the majority of the site will be routed through a water quality and detention vault and an additional leaf compost filter prior to being discharged to the wetland via a level spreader. In addition, runoff from 12 of the lots (Lots 10 through 21) adjacent to the wetland would discharge their clean-water roof and footing drains through a series of level spreaders outside the on-site wetland buffer. This design provision is intended to dissipate runoff flows and maintain water inflow to the wetland similar to the existing conditions, but it raises the question of potential surface water or groundwater changes to adjoining properties. The applicant has indicated that the number of lots (clean runoff only) that would drain to the wetland in the final drainage plan will be selected to match runoff and recharge volumes and flow rates under existing conditions, thereby avoiding potential drainage-related water quantity impacts on adjacent properties. The dispersal flows from these lots would be small, calculated at 0.27 cfs for the 25-year peak flow and 0.42 cfs for the 100-year peak flow.

The proposed Montevallo development would result in relocation of the horses currently pastured on the property and the removal of the gray water discharge from one of the existing houses on the property. These existing uses have the potential to adversely affect the quality of the water draining to the on-site wetland and downstream to Little Bear Creek. Development of Montevallo as proposed would also eliminate five existing septic systems serving the current residences and provide sanitary sewer service to the new subdivision. Consequently, the drainage and utility features of the Proposed Action could potentially improve water quality in the on-site wetland, and correspondingly decrease the fecal coliform levels reaching Little Bear Creek, by removing existing potential sources of water pollution.

At the same time, development of 66 new residences on the Montevallo site would likely result in an increased pet population in the local area, which would contribute to fecal coliform sources and could partially offset the positive changes related to elimination of livestock use and the gray water discharge.

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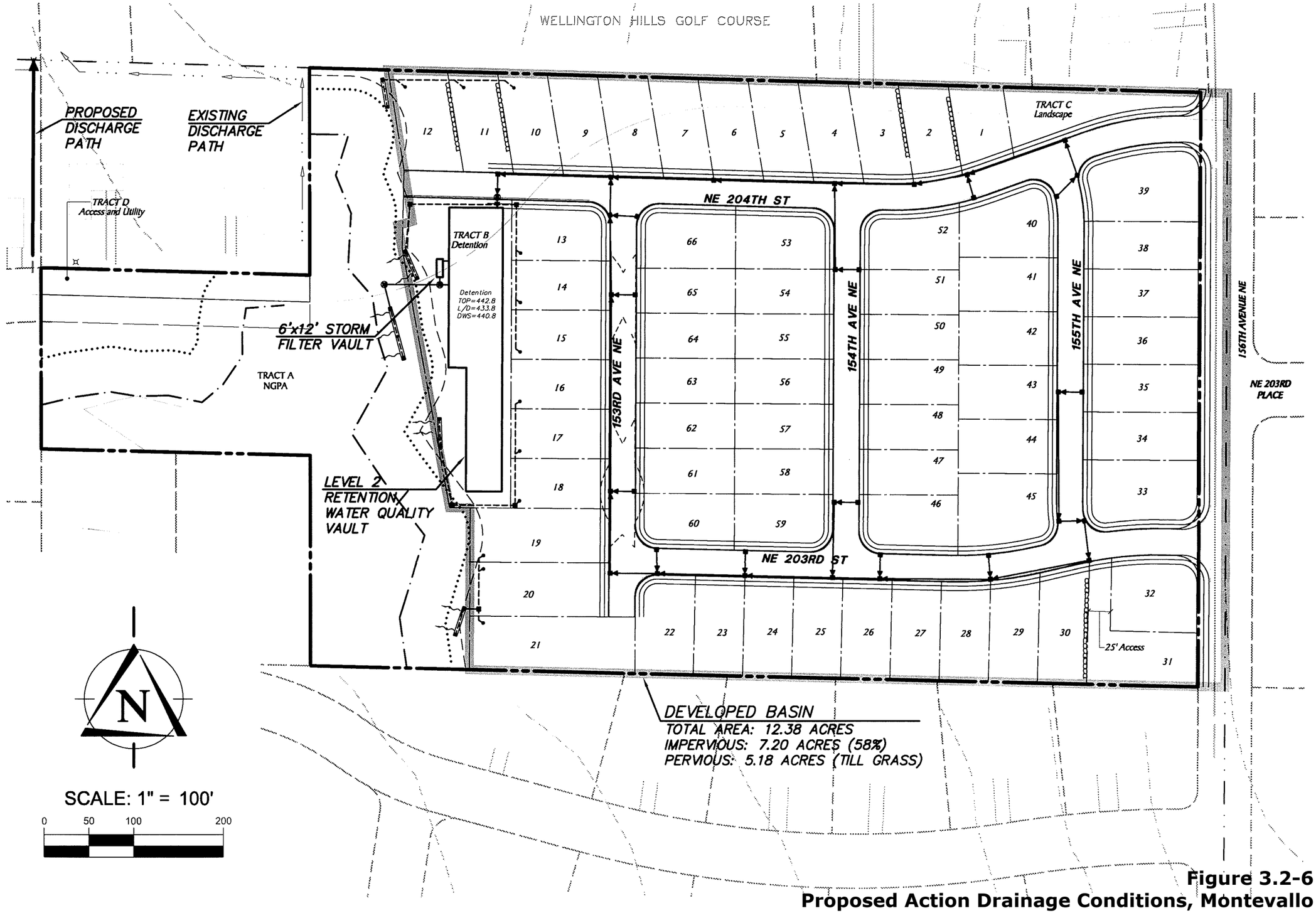

Figure 3.2-6
Proposed Action Drainage Conditions, Montevallo

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DEVELOPED CONDITIONS EXHIBIT

MONTEVALLO

CITY OF WOODINVILLE, WASHINGTON

NO.	DATE	REVISION	BY	CK

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PROJECT LANDSCAPE ARCHITECT
FIRST SUBMITTAL DATE:
SCALE: HORIZ.: 1"=100' VERT.: N/A

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JOB NO. 03-248

SHEET NO. 1 OF 1

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The Montevallo subdivision would also be subject to the water quality requirements of the Resource Stream Protection menu, as discussed previously for Wood Trails. Because the project would employ water quality treatment measures consistent with the City and KCSWDM requirements, the discharge from those facilities is appropriately presumed to be in compliance with water quality standards and adequately protective of downstream receiving waters. Long-term water quality impacts from the project would therefore be insignificant.

The potential for the Montevallo development to alter groundwater conditions would be determined by the relationship of the development plan to the recharge characteristics of the site and groundwater levels and flow conditions. As described in Section 3.2.1.3, recharge on the site is limited by the extensive presence of glacial till at or near the surface of the site. Any recharge that does occur on the site appears to supply only the areas of shallow, seasonal perched groundwater. Development activities for the Proposed Action, including excavation activities, would occur well above the level of the deep aquifer and would have no effect on it.

The proposed development could cause a slight decrease in the volume of shallow groundwater recharge within the site. To the extent that might occur, the ultimate effect would be to shift a minor volume of groundwater recharge (under existing conditions) to surface water runoff. That surface runoff would reach the on-site wetland, which also likely receives some contribution through seepage from shallow groundwater. Based on the limited magnitude of the change and the apparent balancing of the shift on the site, the impacts of the Montevallo development on groundwater would be insignificant.

Limitations to Proposed Surface Water Facilities

To avoid significant adverse impacts to the wetland, a detention pond (as opposed to a wet vault) would create a more natural system given the constraints of this site. This would assure appropriate hydrological discharge to the wetland with better water quality and lessen the concern that the area may not receive enough water from roof drains on private lots that could be constrained at any time.

3.2.3 Impacts of the Alternatives

3.2.3.1 R-1 Zoning Alternative

Wood Trails

The water resource impacts of developing the Wood Trails site at 1–acre densities would generally be the same as those identified for the Proposed Action with respect to type, timing and duration. The area of ground disturbance during construction would be slightly less, and short-term impacts during construction would likewise be insignificant, as discussed in Section 3.2.2. Under this alternative, the impervious surface areas created in the form of rooftops, roadway and sidewalk, and the detention pond would be approximately 5.78 acres, or 65 percent of the amount of impervious area that would result from the Proposed Action. Consequently, long-term changes in surface water runoff rates from this alternative would be proportionately less compared to the Proposed Action. As discussed previously, the stormwater management system would meet flow control requirements to match discharge rates and durations up to the 50-year peak flow for the site, resulting in insignificant changes in water quantity conditions. Changes to groundwater recharge conditions would be similar, although somewhat reduced, and would likewise result in insignificant impacts.

Water quality treatment facilities within the on-site drainage system would meet the stormwater management requirements for water quality, and are presumed to result in insignificant water quality impacts and compliance with water quality standards for stormwater. The individual septic systems installed under this alternative would need to meet water quality and health-based standards at the time of

development. Septic system performance can diminish over time, particularly if the system is not properly maintained, and malfunctioning septic systems are often identified as potential sources of contamination in cases of bacterial pollution of water bodies (as in the Little Bear Creek TMDL, for example). Because the subsurface conditions on the Wood Trails site are characterized as limited for septic systems (see Section 3.1.3.1), the sewage disposal provisions of this alternative represent a possible long-term source of bacterial pollution and decreased water quality in downstream receiving waters.

Montevallo

Under this alternative construction disturbance on the Montevallo site would be less extensive and the new impervious area created would be approximately 50 percent of that for the Proposed Action. The potential for runoff-related changes to water quantity and quality would be correspondingly reduced. As was the case for the Proposed Action, use of construction stormwater pollution prevention measures and implementation of approved long-term flow control and water quality treatment measures would result in insignificant impacts to water quantity and quality. This alternative would still alter the source of flows to the on-site wetland, but would avoid significant changes by diverting some clean runoff to the wetland rather than conveying all runoff to the on-site flow control and treatment facilities. As discussed for the Wood Trails site, use of on-site septic systems under this alternative would create a long-term potential for decreased water quality through bacterial contamination. Changes to groundwater recharge conditions would be similar to those of the Proposed Action, although somewhat reduced, and would likewise result in insignificant impacts.

3.2.3.2 Attached Housing Alternative

The water resource impacts of developing 85 townhouses on the Wood Trails site and 47 detached residences on the Montevallo site would be the same as those identified for the Proposed Action with respect to type, timing and duration. However, the impervious surface areas in this case would be 7.1 acres at Wood Trails and 6 to 7 acres at Montevallo, or approximately 80 percent of the amount for the Proposed Action. Initial changes to surface runoff rates would be somewhat less than those for the Proposed Action and somewhat more than for the R-1 Zoning Alternative. Based on use of the same types of short-term and long-term control measures as described previously, water quantity and quality impacts from this alternative would also be insignificant. Changes to groundwater conditions would be less than for the Proposed Action, and would likewise be insignificant.

3.2.3.3 No Action Alternative

There would be no identifiable change to the existing site conditions or increase in impervious surfaces due to this alternative. Consequently, current surface water quantity and quality and groundwater/seepage characteristics for these properties would continue for the foreseeable future.

3.2.4 Secondary and Cumulative Impacts

Possible adverse secondary and cumulative water resource impacts from the projects relate to long-term stormwater runoff under the developed condition for these sites. Any of the development alternatives would create the potential for changes in surface water flow patterns and water quality, specifically increased levels of pollutants reaching Little Bear Creek (both projects) and the wetland on the Montevallo site (which drains to Little Bear Creek). Pollutants flowing into Little Bear Creek could reach the Sammamish River and ultimately Lake Washington. Increased pollutants in runoff from the subdivisions would add to pollution from existing and future urban development and other human activities in the watershed, and contribute to degradation of water quality and aquatic habitat.

Conversely, there is a possible positive cumulative/secondary impact associated with sewage disposal systems. Little Bear Creek is on the 303(d) list for fecal coliform bacteria and is the subject of a water cleanup plan. Much of the existing residential development in the watershed is served by septic systems. Septic systems can fail or be inadequately maintained and are documented to be a major contributor to fecal coliform levels in surface water bodies in many cases. Similarly, the Environmental Protection Agency has identified septic systems as the second largest threat to groundwater quality in the U.S. (Woodinville Water District 2006c). Therefore, failing septic systems could be a source of fecal coliform pollution in Little Bear Creek. Development of the Wood Trails and Montevallo sites under the Proposed Action or the Attached Housing Alternative would bring public sanitary sewer service to an area of Woodinville that is currently on septic systems, and would eliminate a small number of septic systems currently in use on the Montevallo site. Either of these action alternatives would result in less potential for fecal coliform pollution compared to development served by septic systems. Extension of public sewer facilities would also allow for existing residences to connect to the public sewer system and decommission their individual septic systems, if they so desired. To the extent that this occurred over time, this could promote long-term improvement in water quality.

The analysis of impacts documented in Sections 3.2 and 3.3 indicates that the changes to surface water quantity or quality and groundwater conditions from any of the action alternatives would be quite small. Compared to existing conditions, discharge rates from the project sites would be different (higher) only at flow rates above the 50-year peaks. Under those conditions the volume change would not be noticeable in Little Bear Creek and would not contribute measurably to cumulative changes within the stream. While the quality of runoff from the projects would be somewhat less than under the existing conditions, the discharge would meet requirements for water quality treatment and would receive a higher level of treatment than most runoff to Little Bear Creek. In that context, the proposal would be unlikely to exacerbate water quality degradation in the watershed.

3.2.5 Mitigation Measures

3.2.5.1 Construction

As noted in Section 3.2.1, the project would need to prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) as a condition of the NPDES construction stormwater permit that would be required from Ecology. The project must also meet the City's construction stormwater requirements, which incorporate the requirements of the King County Surface Water Design Manual (KCSWDM) and are consistent with Ecology's stormwater management requirements. Specifically, the project's construction plans must be consistent with KCSWDM Core Requirement #5: Erosion and Sediment Control. The KCSWDM identifies the following basic principles for erosion and sediment control (King County 2005):

- design the project to fit the natural conditions of the site;
- emphasize erosion control over sediment control;
- minimize the extent and duration of exposed areas;
- keep runoff velocities low;
- retain sediment on the site;
- monitor and maintain all erosion and sediment control measures; and
- schedule major earthwork during the dry season.

Appendix D of the KCSWDM provides detailed information on specific types of measures that must be considered for use in project plans in order to meet the erosion and sediment control principles. The key types of measures identified in the manual are:

1. Clearing limits - clearly mark the physical limits of the areas to be cleared on the site.
2. Cover measures – prevent erosion by covering areas exposed during construction.
3. Perimeter protection – use barriers to filter sediment draining from all disturbed areas.
4. Traffic area stabilization – use gravel or other means to stabilize areas used by construction equipment to minimize erosion and tracking of sediment off-site.
5. Sediment retention – construct temporary facilities (sediment ponds or traps) to collect and retain sediment draining from disturbed areas on the site.
6. Surface water collection – intercept all surface water draining from disturbed areas route it to sediment retention facilities.
7. Dewatering control – treat flows created by construction site dewatering activities.
8. Dust control – use preventive measures to minimize transport of soil particles from the site by wind.
9. Flow control – route water draining from disturbed areas through flow-control facilities to maintain site discharges within the applicable peak-flow limits.

Mitigation measures for erosion and sediment control employed during construction for the Wood Trails and Montevallo subdivisions would include appropriate specific measures selected from the menu provided in the KCSWDM. The SWPPP for each project would be reviewed by regulatory agency (City and Ecology) staff to ensure it was consistent with erosion and sediment control standards.

3.2.5.2 Developed Conditions

Storm water detention facilities would be provided for any of the development alternatives to mitigate the increased storm water runoff rates caused by development. In accordance with the City of Woodinville Municipal Code, Level 2 (Flow Reduction) detention standards would control future runoff rates for the 2- and 10-year storm events so as to not exceed the existing flow rates for those events. In addition, the discharge durations from the developed site would match those of the pre-developed durations for the range of the pre-developed discharge rates from 50 percent of the 2-year peak flow up to the full 50-year peak. The facilities would also be designed to detain up to the 100-year event. Based on implementation of these measures in accordance with the WMC, there would be no adverse water quantity impacts from any of the development alternatives.

Wood Trails

Under all three development alternatives, trench dams would be installed to prevent the interception of subsurface flows by the granular bedding materials used in the utility trenches. This would allow much of the offsite area to continue to recharge the undisturbed areas of the site. Mitigation for any areas from which runoff would bypass the water quality/detention facilities would occur through compensatory storage and treatment in the constructed storm water facilities.

The proposed storm system would discharge to the existing stormwater conveyance facilities west of the Wood Trails site. No impacts to the capacity or effectiveness of this system are expected, and no mitigation measures for this discharge are identified.

Montevallo

All storm discharge would continue to flow to the on-site wetland, which is the natural location. The majority would be routed through a water quality/detention vault, and a portion of the clean storm water (roof runoff and footing drains) from residences developed on the Montevallo site would be directed to trenches along the wetland to maintain the wetland hydrology. This runoff would be collected in pipes and dispersed through washed-rock trenches along the wetland buffer edges. As a condition of the preliminary plat or building permit, the roofing materials on the lots draining directly to the wetland could

be restricted to non-leaching materials. The wetland and buffer area could also be marked with permanent signage to discourage residents' use of fertilizers, pesticides and herbicides, and thereby reduce the potential for adverse water quality effects from chemical use. With these provisions, it is expected that there would be no adverse water quality or quantity impacts to the on-site wetland.

3.2.6 Significant Unavoidable Adverse Impacts

All of the development alternatives would result in unavoidable changes to the natural hydrologic regime by decreasing the amount of water that infiltrates the soil and recharges the groundwater. Because infiltration on the project sites is limited by impermeable materials, these changes would be minor. Nevertheless, there would be increased surface runoff from the new impervious surfaces on the sites. Required flow control measures would maintain existing discharge rates and durations under most conditions, although flows in the downstream systems for storms exceeding the 50-year recurrence interval would be slightly higher. Overall, water quantity impacts would be insignificant. The quality of runoff water from the sites would be less than under existing conditions. With implementation of required stormwater quality mitigation measures, however, these impacts would be reduced to a level of insignificance. Changes to groundwater conditions would be minimal.

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