April 16, 2007

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The City of WOODINVILLE

"Citizens, business and local government; a community commitment to our future"

Office of the Hearing Examiner
City of Spokane
808 West Spokane Falls Blvd, Room 605
Spokane, WA 99201

Attn: Greg Smith, Hearing Examiner

RE: WOOD TRAILS / MONTEVALLO

During the City of Woodinville's most recent update of the critical area ordinance in Year 2005, a collection of material regarding best available science was used. For the record, attached please find the following:

1. WAC 365-195-905 through WAC 365-195-925 (pages 35 through 39) (6/13/03)
2. Wetlands BAS Technical Memorandum – excerpt, Attachment D, Pages 9 and 10
3. King County Ordinance 15051 (pages 188, 189, 191, 192, 209)
4. Snohomish County Planning Commission Recommendation 7/5/06 (Pages 23 and 24)
5. City of Bellevue's Final Version Critical Areas Ordinance – 20.25H, June 26, 2006 (pages 30 thru 35)
6. City of Bellevue's Final Version Critical Areas Ordinance – 20.25H, June 26, 2006 (pages 36 thru 42, 46, and 47)
7. City of Redmond's Critical Areas Ordinance, Ordinance No. 2259 – Exhibit 4, 4/25/05, Final Regulations – Pages 23, 24, 29 thru 34)
8. City of Bothell (3 pages)
9. City of Woodinville Planning Commission Special Meeting Packet September 22, 2004

If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

Cindy Baker

Cindy Baker

CB:slg

Enclosures

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The implementing regulation should call for a specific finding on all three of the above limitations whenever an impact fee is imposed.

(3) Impact fees may be collected and spent only for the following capital facilities owned or operated by government entities: Public streets and roads; publicly owned parks, open space, and recreation facilities; school facilities; and fire protection facilities in jurisdictions that are not part of a fire district. These facilities must have been addressed in a capital facilities plan element which identifies:

(a) Deficiencies in public facilities serving existing development and the means by which existing deficiencies will be eliminated within a reasonable period of time;

(b) Additional demands placed on existing public facilities by new development; and

(c) Additional public facility improvements required to serve new development.

(4) The local ordinance by which impact fees are imposed shall strictly conform to the provisions of RCW 82.02.060. The department recommends that jurisdictions include the authorized exemption for low-income housing.

[Statutory Authority: RCW 36.70A.190 (4)(b). 93-17-040, § 365-195-850, filed 8/11/93, effective 9/11/93.]

WAC 365-195-855 Protection of private property. In the drafting of development regulations, consideration should be given to the attorney general's process of evaluation issued pursuant to RCW 36.70A.370, to assure that governmental actions do not result in an unconstitutional taking of private property. Procedures for avoiding takings, such as variances or exemptions, should be built into the overall regulatory scheme.

[Statutory Authority: RCW 36.70A.190 (4)(b). 93-17-040, § 365-195-855, filed 8/11/93, effective 9/11/93.]

WAC 365-195-860 Housing for persons with handicaps. No county or city planning under the act may enact or maintain an ordinance, development regulation, zoning regulation or official control, policy, or administrative practice which treats a residential structure occupied by persons with handicaps differently than a similar residential structure occupied by a family or other unrelated individuals. As used in this section, "handicaps" are as defined in the federal fair housing amendments of 1988 (42 U.S.C. Sec. 3602).

[Statutory Authority: RCW 36.70A.190 (4)(b). 93-17-040, § 365-195-860, filed 8/11/93, effective 9/11/93.]

WAC 365-195-865 Supplementing, amending and monitoring. (1) New development regulations may be adopted from time to time as the need for supplementing the initial implementation strategy becomes apparent. However, because development regulations must be consistent with the comprehensive plans, substantive amendments to such regulations will frequently need to be accompanied by a comprehensive plan amendment. Since comprehensive plans can be amended only once a year (except in emergencies), consideration of significant changes in the land use management scheme will, by and large, become an annual affair.

(2) Cities and counties should institute an annual review of growth management implementation on a systematic basis. To aid in this process, planning jurisdictions should consider establishing a growth management monitoring program designed to measure and evaluate the progress being made toward accomplishing the act's goals and the provisions of the comprehensive plan. This program should be integrated with provisions for continuous public involvement. (See WAC 365-195-600 (2)(b).)

[Statutory Authority: RCW 36.70A.190 (4)(b). 93-17-040, § 365-195-865, filed 8/11/93, effective 9/11/93.]

PART NINE
BEST AVAILABLE SCIENCE

WAC 365-195-900 Background and purpose. (1) Counties and cities planning under RCW 36.70A.040 are subject to continuing review and evaluation of their comprehensive land use plan and development regulations. Every five years they must take action to review and revise their plans and regulations, if needed, to ensure they comply with the requirements of the Growth Management Act. RCW 36.70A.130.

(2) Counties and cities must include the "best available science" when developing policies and development regulations to protect the functions and values of critical areas and must give "special consideration" to conservation or protection measures necessary to preserve or enhance anadromous fisheries. RCW 36.70A.172(1). The rules in WAC 365-195-900 through 365-195-925 are intended to assist counties and cities in identifying and including the best available science in newly adopted policies and regulations and in this periodic review and evaluation and in demonstrating they have met their statutory obligations under RCW 36.70A.172(1).

(3) The inclusion of the best available science in the development of critical areas policies and regulations is especially important to salmon recovery efforts, and to other decision-making affecting threatened or endangered species.

(4) These rules are adopted under the authority of RCW 36.70A.190 (4)(b) which requires the department of community, trade, and economic development (department) to adopt rules to assist counties and cities to comply with the goals and requirements of the Growth Management Act.

[Statutory Authority: RCW 36.70A.190 (4)(b). 01-08-056, § 365-195-900, filed 4/2/01, effective 5/3/01; 00-16-064, § 365-195-900, filed 7/27/00, effective 8/27/00.]

WAC 365-195-905 Criteria for determining which information is the "best available science." (1) This section provides assessment criteria to assist counties and cities in determining whether information obtained during development of critical areas policies and regulations constitutes the "best available science."

(2) Counties and cities may use information that local, state or federal natural resource agencies have determined represents the best available science consistent with criteria set out in WAC 365-195-900 through 365-195-925. The department will make available a list of resources that state agencies have identified as meeting the criteria for best avail-

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able science pursuant to this chapter. Such information should be reviewed for local applicability.

(3) The responsibility for including the best available science in the development and implementation of critical areas policies or regulations rests with the legislative authority of the county or city. However, when feasible, counties and cities should consult with a qualified scientific expert or team of qualified scientific experts to identify scientific information, determine the best available science, and assess its applicability to the relevant critical areas. The scientific expert or experts may rely on their professional judgment based on experience and training, but they should use the criteria set out in WAC 365-195-900 through 365-195-925 and any technical guidance provided by the department. Use of these criteria also should guide counties and cities that lack the assistance of a qualified expert or experts, but these criteria are not intended to be a substitute for an assessment and recommendation by a qualified scientific expert or team of experts.

(4) Whether a person is a qualified scientific expert with expertise appropriate to the relevant critical areas is determined by the person's professional credentials and/or certification, any advanced degrees earned in the pertinent scientific discipline from a recognized university, the number of years of experience in the pertinent scientific discipline, recognized leadership in the discipline of interest, formal training in the specific area of expertise, and field and/or laboratory experience with evidence of the ability to produce peer-reviewed publications or other professional literature. No one factor is determinative in deciding whether a person is a qualified scientific expert. Where pertinent scientific information implicates multiple scientific disciplines, counties and cities are encouraged to consult a team of qualified scientific experts representing the various disciplines to ensure the identification and inclusion of the best available science.

(5) Scientific information can be produced only through a valid scientific process. To ensure that the best available science is being included, a county or city should consider the following:

(a) **Characteristics of a valid scientific process.** In the context of critical areas protection, a valid scientific process is one that produces reliable information useful in understanding the consequences of a local government's regulatory decisions and in developing critical areas policies and development regulations that will be effective in protecting the functions and values of critical areas. To determine whether information received during the public participation process is reliable scientific information, a county or city should determine whether the source of the information displays the characteristics of a valid scientific process. The characteristics generally to be expected in a valid scientific process are as follows:

1. **Peer review.** The information has been critically reviewed by other persons who are qualified scientific experts in that scientific discipline. The criticism of the peer reviewers has been addressed by the proponents of the information. Publication in a refereed scientific journal usually indicates that the information has been appropriately peer-reviewed.

2. **Methods.** The methods that were used to obtain the information are clearly stated and able to be replicated. The methods are standardized in the pertinent scientific discipline or, if not, the methods have been appropriately peer-reviewed to assure their reliability and validity.

3. **Logical conclusions and reasonable inferences.** The conclusions presented are based on reasonable assumptions supported by other studies and consistent with the general theory underlying the assumptions. The conclusions are logically and reasonably derived from the assumptions and supported by the data presented. Any gaps in information and inconsistencies with other pertinent scientific information are adequately explained.

4. **Quantitative analysis.** The data have been analyzed using appropriate statistical or quantitative methods.

5. **Context.** The information is placed in proper context. The assumptions, analytical techniques, data, and conclusions are appropriately framed with respect to the prevailing body of pertinent scientific knowledge.

6. **References.** The assumptions, analytical techniques, and conclusions are well referenced with citations to relevant, credible literature and other pertinent existing information.

(b) **Common sources of scientific information.** Some sources of information routinely exhibit all or some of the characteristics listed in (a) of this subsection. Information derived from one of the following sources may be considered scientific information if the source possesses the characteristics in Table 1. A county or city may consider information to be scientifically valid if the source possesses the characteristics listed in (a) of this subsection. The information found in Table 1 provides a general indication of the characteristics of a valid scientific process typically associated with common sources of scientific information.

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Table 1	CHARACTERISTICS					
SOURCES OF SCIENTIFIC INFORMATION	Peer review	Methods	Logical conclusions & reasonable inferences	Quantitative analysis	Context	References
A. Research. Research data collected and analyzed as part of a controlled experiment (or other appropriate methodology) to test a specific hypothesis.	X	X	X	X	X	X
B. Monitoring. Monitoring data collected periodically over time to determine a resource trend or evaluate a management program.		X	X	Y	X	X
C. Inventory. Inventory data collected from an entire population or population segment (e.g., individuals in a plant or animal species) or an entire ecosystem or ecosystem segment (e.g., the species in a particular wetland).		X	X	Y	X	X
D. Survey. Survey data collected from a statistical sample from a population or ecosystem.		X	X	Y	X	X
E. Modeling. Mathematical or symbolic simulation or representation of a natural system. Models generally are used to understand and explain occurrences that cannot be directly observed.	X	X	X	X	X	X
F. Assessment. Inspection and evaluation of site-specific information by a qualified scientific expert. An assessment may or may not involve collection of new data.		X	X		X	X
G. Synthesis. A comprehensive review and explanation of pertinent literature and other relevant existing knowledge by a qualified scientific expert.	X	X	X		X	X
H. Expert Opinion. Statement of a qualified scientific expert based on his or her best professional judgment and experience in the pertinent scientific discipline. The opinion may or may not be based on site-specific information.			X		X	X

X =
characteristic must be present for information derived to be considered scientifically valid and reliable

Y =
presence of characteristic strengthens scientific validity and reliability of information derived, but is not essential to ensure scientific validity and reliability

(c) **Common sources of nonscientific information.** Many sources of information usually do not produce scientific information because they do not exhibit the necessary characteristics for scientific validity and reliability. Information from these sources may provide valuable information to supplement scientific information, but it is not an adequate substitute for scientific information. Nonscientific information should not be used as a substitute for valid and available scientific information. Common sources of nonscientific information include the following:

(i) Anecdotal information. One or more observations which are not part of an organized scientific effort (for example, "I saw a grizzly bear in that area while I was hiking").

(ii) Nonexpert opinion. Opinion of a person who is not a qualified scientific expert in a pertinent scientific discipline (for example, "I do not believe there are grizzly bears in that area").

(iii) Hearsay. Information repeated from communication with others (for example, "At a lecture last week, Dr. Smith said there were no grizzly bears in that area").

(6) Counties and cities are encouraged to monitor and evaluate their efforts in critical areas protection and incorporate new scientific information, as it becomes available.

[Statutory Authority: RCW 36.70A.190 (4)(b). 00-16-064, § 365-195-905, filed 7/27/00, effective 8/27/00.]

WAC 365-195-910 Criteria for obtaining the best available science. (1) Consultation with state and federal natural resources agencies and tribes can provide a quick and cost-effective way to develop scientific information and recommendations. State natural resource agencies provide numerous guidance documents and model ordinances that incorporate the agencies' assessments of the best available

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science. The department can provide technical assistance in obtaining such information from state natural resources agencies, developing model GMA-compliant critical areas policies and development regulations, and related subjects. The department will make available to interested parties a current list of the best available science determined to be consistent with criteria set out in WAC 365-195-905 as identified by state or federal natural resource agencies for critical areas.

(2) A county or city may compile scientific information through its own efforts, with or without the assistance of qualified experts, and through state agency review and the Growth Management Act's required public participation process. The county or city should assess whether the scientific information it compiles constitutes the best available science applicable to the critical areas to be protected, using the criteria set out in WAC 365-195-900 through 365-195-925 and any technical guidance provided by the department. If not, the county or city should identify and assemble additional scientific information to ensure it has included the best available science.

[Statutory Authority: RCW 36.70A.190 (4)(b). 00-16-064, § 365-195-910, filed 7/27/00, effective 8/27/00.]

WAC 365-195-915 Criteria for including the best available science in developing policies and development regulations. (1) To demonstrate that the best available science has been included in the development of critical areas policies and regulations, counties and cities should address each of the following on the record:

(a) The specific policies and development regulations adopted to protect the functions and values of the critical areas at issue.

(b) The relevant sources of best available scientific information included in the decision-making.

(c) Any nonscientific information—including legal, social, cultural, economic, and political information—used as a basis for critical area policies and regulations that depart from recommendations derived from the best available science. A county or city departing from science-based recommendations should:

(i) Identify the information in the record that supports its decision to depart from science-based recommendations;

(ii) Explain its rationale for departing from science-based recommendations, and

(iii) Identify potential risks to the functions and values of the critical area or areas at issue and any additional measures chosen to limit such risks. State Environmental Policy Act (SEPA) review often provides an opportunity to establish and publish the record of this assessment.

(2) Counties and cities should include the best available science in determining whether to grant applications for administrative variances and exemptions from generally applicable provisions in policies and development regulations adopted to protect the functions and values of critical areas. Counties and cities should adopt procedures and criteria to ensure that the best available science is included in every review of an application for an administrative variance or exemption.

[Statutory Authority: RCW 36.70A.190 (4)(b). 00-16-064, § 365-195-915, filed 7/27/00, effective 8/27/00.]

WAC 365-195-920 Criteria for addressing inadequate scientific information. Where there is an absence of valid scientific information or incomplete scientific information relating to a county's or city's critical areas, leading to uncertainty about which development and land uses could lead to harm of critical areas or uncertainty about the risk to critical area function of permitting development, counties and cities should use the following approach:

(1) A "precautionary or a no risk approach," in which development and land use activities are strictly limited until the uncertainty is sufficiently resolved; and

(2) As an interim approach, an effective adaptive management program that relies on scientific methods to evaluate how well regulatory and nonregulatory actions achieve their objectives. Management, policy, and regulatory actions are treated as experiments that are purposefully monitored and evaluated to determine whether they are effective and, if not, how they should be improved to increase their effectiveness. An adaptive management program is a formal and deliberate scientific approach to taking action and obtaining information in the face of uncertainty. To effectively implement an adaptive management program, counties and cities should be willing to:

(a) Address funding for the research component of the adaptive management program;

(b) Change course based on the results and interpretation of new information that resolves uncertainties; and

(c) Commit to the appropriate timeframe and scale necessary to reliably evaluate regulatory and nonregulatory actions affecting critical areas protection and anadromous fisheries.

[Statutory Authority: RCW 36.70A.190 (4)(b). 00-16-064, § 365-195-920, filed 7/27/00, effective 8/27/00.]

WAC 365-195-925 Criteria for demonstrating "special consideration" has been given to conservation or protection measures necessary to preserve or enhance anadromous fisheries. (1) RCW 36.70A.172(1) imposes two distinct but related requirements on counties and cities. Counties and cities must include the "best available science" when developing policies and development regulations to protect the functions and values of critical areas, and counties and cities must give "special consideration" to conservation or protection measures necessary to preserve or enhance anadromous fisheries. Local governments should address both requirements in RCW 36.70A.172(1) when developing their records to support their critical areas policies and development regulations.

(2) To demonstrate compliance with RCW 36.70A.172(1), a county or city adopting policies and development regulations to protect critical areas should include in the record evidence that it has given "special consideration" to conservation or protection measures necessary to preserve or enhance anadromous fisheries. The record should be developed using the criteria set out in WAC 365-195-900 through 365-195-925 to ensure that conservation or protection measures necessary to preserve or enhance anadromous fisheries are grounded in the best available science.

(3) Conservation or protection measures necessary to preserve or enhance anadromous fisheries include measures

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that protect habitat important for all life stages of anadromous fish, including, but not limited to, spawning and incubation, juvenile rearing and adult residence, juvenile migration downstream to the sea, and adult migration upstream to spawning areas. Special consideration should be given to habitat protection measures based on the best available science relevant to stream flows, water quality and temperature, spawning substrates, instream structural diversity, migratory access, estuary and nearshore marine habitat quality, and the maintenance of salmon prey species. Conservation or protection measures can include the adoption of interim actions and long-term strategies to protect and enhance fisheries resources.

[Statutory Authority: RCW 36.70A.190 (4)(b). 00-16-064, § 365-195-925, filed 7/27/00, effective 8/27/00.]

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Science Technical Memorandum Excerpt re: Stream Buffers

Table 2. Range of Effective Buffer Widths

Function	Riparian Buffer Function and Appropriate Widths Identified by May (2000)	Riparian Buffer Function and Appropriate Widths Identified by Knudson and Naef (1997)
Sediment Removal/Erosion Control	26 – 600 feet	N/A
Sediment Removal	N/A	26 – 300 feet
Erosion Control	N/A	100 – 125 feet
Pollutant Removal	13 – 860 feet	13 – 600 feet
Large Woody Debris	33 – 328 feet	100 – 200 feet
Water Temperature	36 – 141 feet	35 – 151 feet
Wildlife Habitat	33 – 656 feet	25 – 984 feet

A general relationship between buffer width and buffer effectiveness is apparent in the research findings. Studies indicate that buffers 100-to 150-feet (30 to 45 meters) wide provide most (on the order of 80 percent) of the potential functions (Horner and May, 2000; Knutson and Naef, 1997; and Leavitt, 1998). However, there is little research on effectiveness of riparian buffers in urban environments (Herson-Jones et al., 1995). Buffer distances should be viewed mainly as guidelines, as the literature shows that site-specific factors may impact buffer effectiveness just as much as buffer width (Naiman et al., 1992; Castelle et al., 1994).

2.3.1 Application of Buffer Widths

An overall conclusion of the review of scientific literature is that, to protect a given habitat function or group of functions, the width of effective buffers depends on numerous site-specific factors. The importance of riparian functions can vary by stream size and channel width. Small headwater tributary streams are strongly influenced by riparian vegetation, where such vegetation provides shading of waters and contributes large amounts of organic material (Washington Department of Game, 1984). Temperatures in larger streams below headwaters benefit less from overhanging vegetation. In general, as stream size increases, the importance of shading and terrestrial organic inputs decrease, with a increasing significance of algal or rooted vascular plant production and organic transport from upstream (Vannote, et al., 1980). Aspect, soil type and slope all play a role in buffer effectiveness. In riparian areas located on steep slopes and/or highly erodible soils, larger buffers may be appropriate to reduce risks of erosion and delivery of fine sediment to streams. Gravel recruitment naturally occurs through undercutting of banks and scouring, but larger riparian widths in steep slope areas are required to protect the unstable soils (Budd et al., 1987).

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Studies of buffer widths for moderation of stream temperatures generally range from 35 to 150 feet (Knutson and Naef, 1997). Much of the variability in the literature is related to the presence or absence of a mature tree canopy. For example, forested buffers of 75 to 100 feet were found to provide 60 to 80 percent of the shade conditions found in fully forested watersheds (Brazier & Brown, 1973; Steinblums et al., 1984).

Recommended buffer widths for sediment and pollutant retention vary from 15 to 860 feet (URS, 2002; Knutson and Naef, 1997). This wide variation is due in general to the particular pollutant being evaluated. Doyle et al. (1977) found that buffers less than four meters (approximately 13 feet) reduced Nitrogen (N), Phosphorus (P), Potassium (K) and fecal bacteria levels. Wooded riparian buffers in Maryland coastal region were found to remove as much as 80 percent of excess P and 89 percent of excess N in the first 19 meters (approximately 62 feet) (Shisler et al.,1987). Buffers of 50 to 100 feet may provide substantial pollutant removal benefits, and can remove 75 to 80 percent of pollutants depending on site-specific conditions and buffer type (Lynch et al., 1985; Castelle & Johnson, 2000; Wong & McCuen, 1982; Castelle et al., 1992). Studies have concluded that buffers of 100 feet can achieve sediment removal efficiencies of 75 to 100 percent. Most papers also conclude that larger buffers are required on steeper slopes to reach the same level of pollutant removal.

Riparian vegetation may contribute up to 90 percent of the biotic input in headwater stream systems (Budd et al., 1987). Recommended buffers for maintenance of benthic communities range from 33 feet to greater than 100 feet. However, most studies found that buffers of 100 feet were necessary to maintain healthy benthic communities (Roby et al., 1977; Newbold et al., 1980; Castelle & Johnson, 2000).

Because riparian areas store and slowly release water, they provide a continuous flow of water to streams. The effectiveness of the buffer for this function is significantly influenced by site-specific conditions such as soil type, subsoil permeability, and topography, including the morphology of the streambed and floodplain area, among other factors. Riparian areas with properly functioning conditions (PFC's) can reduce the effects of flood flows and desynchronize peak crests and flow rates of floods (Novitzki, 1979).

Riparian buffer widths for wildlife habitat vary greatly depending on individual wildlife species, but are generally on the order of 25to 984 feet (Knutson and Naef, 1997). Studies have found that a buffer of 100 feet is optimum for maintaining macro-invertebrate diversity (Gregory et al.,1980 and May et al., 1997). Riparian buffers provide wildlife habitat, which is discussed in the Wildlife Best Available Science Technical Memorandum (Adolfson, 2003).

2.4 Stream Management in Urban Environments

Two recent studies have focused on the general effects of urbanization on streams in the lowland Puget Sound region, Booth, 2000, and Horner and May, 1999. In these

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studies, a general trend has emerged that places a greater emphasis on evaluation of buffer effectiveness in the context of other watersheds and evaluation of landscape-level alterations to watersheds (Roni et al., 2002; Richards et al., 1996).

The loss or disturbance of native riparian area is closely tied to urbanization in a watershed (Horner and May, 1999; Leavitt, 1998). However, cumulative impacts to water quality and increasing amounts of impervious area have also been associated with stream degradation and impacts to native riparian areas. The adverse impacts of impervious area and water quality functions are compounded by degradation of riparian areas (Bledsoe and Watson, 2001; May et al., 1997).

Land uses, such as high-density residential development or commercial development, located adjacent to riparian areas can result in greater impacts than lower density single-family residential uses (Pitt et al., 1986).

In most urban areas, prescriptive buffers may not be adequate to restore streams because most of the functions of buffers have been compromised by past land use actions. For example, restoration of the natural woody debris recruitment function of riparian areas is difficult in areas that lack mature forested streamside vegetation (Larson, 2000). New watershed-based strategies may need to be implemented that would address hydrology, water quality, and riparian functions to successfully address management of buffer width and quality, land use controls, and stormwater management (Booth, 2000; Horner and May, 1999). When applied in the context of a basin-wide change, these strategies may most effectively address protection, enhancement, and restoration of stream systems.

Barriers like lengthy and/or inappropriately installed culverts and stormwater control structures can inhibit fish migration and prohibit fish from accessing upstream habitats. Barriers that do not prevent the migration of fish may limit many natural processes necessary for salmonid fish production including the natural redistribution of substrate and woody debris. Restoring fish passage is an effective way to increase the quality and accessibility of habitat and can result in relatively large increases in potential fish production at a nominal cost (Roni et al., 2002). Stream channels with high quality habitat (low gradient, high pool frequency, high woody debris recruitment from riparian areas produce greater benefits (Roni et al., 2002). Land use actions or incentives that address such issues can help conserve and enhance Woodinville stream functions necessary to maintain and restore populations of anadromous fish.

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King County

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4007 SECTION 184. Ordinance 10870, Section 479, and K.C.C. 21A.24.320 are each
4008 hereby repealed.
4009 NEW SECTION. SECTION 185. There is hereby added to K.C.C. chapter
4010 21A.24 a new section to read as follows:
4011 **Wetland – buffers.** Except as otherwise provided in this section, buffers shall be
4012 provided from the wetland edge as follows:
4013 A. In the Urban Growth Area, buffers for wetlands shall be established in
4014 accordance with the following standards:
4015 1. The standard buffer widths of the following table shall apply unless modified
4016 in accordance with subsection A.2, A.3, C. or D. of this section:

WETLAND CATEGORY AND CHARACTERISTICS	BUFFER
Category I	
Natural Heritage Wetlands	215 feet
Bog	215 feet
Estuarine	175 feet
Coastal Lagoon	175 feet
Habitat score from 29 to 36 points	225 feet
Habitat score from 20 to 28 points	150 feet
Category I wetlands not meeting any of the criteria below	125 feet
Category II	
Estuarine	135 feet
Habitat score from 29 to 36 points	200 feet

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Habitat score from 20 to 28 points	125 feet
Category II wetlands not meeting any of the criteria below	100 feet
Category III	
Habitat score from 20 to 28 points	125 feet
Category III wetlands not meeting any of the criteria below	75 feet
Category IV	50 feet

2. If a Category I or II wetland with habitat score greater than twenty points is located within three hundred feet of a priority habitat area as defined by the Washington state Department of Fish and Wildlife, the buffer established by subsection A.1. of this section shall be increased by fifty feet unless:

a. the applicant provides relatively undisturbed vegetated corridor at least one hundred feet wide between the wetland and all priority habitat areas located within three hundred feet of the wetland. The corridor shall be protected for the entire distance between the wetland and the priority habitat through a conservation easement, native growth protection easement or the equivalent; and

b. the applicable mitigation measures in subsection A.3.b. of this section are provided; and

3. Buffers calculated in accordance with subsection A.1. and A.2. of this scetion shall be reduced as follows:

a. Buffers for all categories of wetlands shall be reduced by twenty-five feet if the applicant implements all applicable mitigation measures identified in subsection A.3.b. of this section, or if the applicant proposes alternate mitigation to reduce the

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Pets and Human disturbance	Privacy fencing or landscaping to delineate buffer edge and to discourage disturbance of wildlife by humans and pets	Residential areas
Dust	BMP's for dust	Tilled fields
Degraded buffer condition	Nonnative plants to be removed and replaced with native vegetation per an approved landscaping plan to be bonded and monitored for a three year period after completion to assure at least 80% survival of plantings	All activities potentially requiring buffers

B. For a wetland located outside the Urban Growth Area:

1. The buffers shown on the following table apply unless modified in accordance with subsections C. and D. of this section:

WETLAND CATEGORY AND CHARACTERISTICS	**INTENSITY OF IMPACT OF ADJACENT LAND USE**		
	HIGH IMPACT	MODERATE IMPACT	LOW IMPACT
Category I			
Category I wetlands not meeting any of the criteria below	100 feet	75 feet	50 feet
Natural Heritage Wetlands	250 feet	190 feet	125 feet

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Bog	250 feet	190 feet	125 feet
Estuarine	200 feet	150 feet	100 feet
Coastal Lagoon	200 feet	150 feet	100 feet
Habitat score from 29 to 36 points	300 feet	225 feet	150 feet
Habitat score from 20 to 28 points	150 feet	110 feet	75 feet
Category II			
Category II wetlands not meeting any of the criteria below	100 feet	75 feet	50 feet
Estuarine	150 feet	110 feet	75 feet
Interdunal	150 feet	110 feet	75 feet
Habitat score from 29 to 36 points	300 feet	225 feet	150 feet
Habitat score from 20 to 28 points	150 feet	110 feet	75 feet
Category III			
Category III wetlands not meeting any of the criteria below	80 feet	60 feet	40 feet
Habitat score from 20 to 28 points	150 feet	110 feet	75 feet
Category IV	50 feet	40 feet	25 feet

2. For purposes of this subsection B., unless the director determines a lesser level of impact is appropriate based on information provided by the applicant, the intensity of impact of the adjacent land use is determined as follows:

a. high impact includes:

(1) sites zoned commercial or industrial;

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3. If the aquatic area buffer includes a steep slope hazard area or landslide hazard area, the aquatic area buffer width is the greater of either the aquatic area buffer in this section or twenty-five feet beyond the top of the hazard area.

B. Within the Urban Growth Area, aquatic area buffers shall be as follows:

1. A type S or F aquatic area buffer is one-hundred-fifteen-feet;

2. A type S or F aquatic area buffer in a basin or shoreline designated as "high" on the Basin and Shoreline Conditions Map is one-hundred-sixty-five-feet;

3. A type N aquatic area buffer is sixty-five-feet; and

4. A type O aquatic area buffer is twenty-five-feet.

C. Outside the Urban Growth Area, aquatic area buffers shall be as follows:

1. A type S or F aquatic area buffer is one-hundred-sixty-five-feet;

2. A type N aquatic area buffer is sixty-five-feet; and

3. A type O aquatic area buffer is twenty-five-feet.

D. Within the Bear Creek drainage basin a type N aquatic area buffer in a designated regionally significant resource area is one-hundred-feet.

E. The department may approve a modification of buffer widths if:

1. The department determines that through buffer averaging the ecological structure and function of the resulting buffer is equivalent to or greater than the structure and function before averaging and meets the following standards:

a. The total area of the buffer is not reduced;

b. The buffer area is contiguous; and

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and longshore transport of sediment and nutrients. Buffer ~~RHA~~ width recommendations vary by function as described in the BAS, pages 85 and 88, and summarized in the table below.

RHA Function	RHA Width Recommended to Perform Function		
	May	Knutson/Naef	FEMAT
Erosion / Sediment Control Bank Stabilization	26-600' 98'min (80%)	100-125' (erosion) 26-300' (sediment)	1.0 SPTH (sediment -200') 0.50 SPTH[1] (bank stabilization – 100')
Pollutant Removal	13-860' 98' min (80%)	13-600'	1.0 SPTH
Large Woody Debris Recruitment	33-328' 1.0 SPTH – 262'	100-200	1.0 SPTH (200')
Water Temperature / Shade	36-141' 98' min.	35-151	0.75 SPTH (150')
Organic Litter	n/a	n/a	0.5 SPTH (100')
Microclimate	148-656' 328' min.	200-525'	up to 3.0 SPTH (up to 600')
Habitat	33-656' 328' min.	25-984'	98-600'

[1]SPTH means site potential tree height.

e. Proposed buffer ~~RHA~~ widths for streams, lakes and marine waters:

Water Type	Buffer ~~RHA~~ Width (ft.)
Type ~~1~~ S	150
~~Type 2~~	~~150~~
Type ~~3~~F (w/ salmonids)	150
Type ~~3~~F (w/out salmonids)	100
Type ~~4~~ Nf	50
Type ~~5~~ Ns	50

i. The maximum buffer ~~RHA~~ width is equivalent to 1 SPTH for 100 year old tree (Revised Draft Summary of Best Available Science *(March 28, 2006)* pg. 86-87). SPTH for 100-year old Douglas Fir in Alderwood soils, the dominant soil type in Snohomish County, is 146' (Id. at pg. 86). All functions, with the exception of microclimate

functions, are on average protected by a riparian habitat area width equivalent to one SPTH. (Id. at pg. 86-87). A riparian habitat area width equal to one SPTH would provide for a broad range of riparian functions important for sustaining salmonids.

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f. Proposed RHA widths for wetlands:

Wetlands		
Wetlands containing anadromous or resident salmonids		150
Category ~~1~~ I	Washington Natural Heritage Program/DNR high quality *wetlands*	190
	Bogs	190
	Estuarine (greater than 1 acre) & Coastal Lagoons	150
	High Level Habitat Function (habitat function score is 29-36)	225
	Moderate Level Habitat Function (habitat function score is 20-28)	110
	Not meeting above criteria	75
Category ~~2~~ II	Estuarine (less than 1 acre)	110
	High level of function for habitat (habitat function score is 29-36)	225
	Moderate level of function for habitat (habitat function score is 20-28)	110
	High level of function for water quality improvement and low for habitat (water quality function score is 24 – 32 and habitat function score is less than 20)	75
Category ~~3~~ III	Moderate Level Habitat Function (habitat function score is 20-28)	110
	Not meeting above criteria	60
Category ~~4~~ IV	Total score for all functions less than 30 points	40

i. The proposed buffer ~~RHA~~ widths associated with wetlands are increased based on guidance from DOE in *Wetlands in Washington State Volume 2: Guidance for Protecting and Managing Wetlands, Appendix 8-C, Guidance on Buffers and Ratios*, April, 2005.

ii. The buffer ~~RHA~~ widths in the proposed regulations reflect the buffer recommendations for moderate land use intensity from Alternative 3 in *Wetlands in Washington State Volume 2: Guidance for Protecting and Managing Wetlands, Appendix 8-C, Guidance on Buffers and Ratios*, April, 2005, pg. 6-8.

iii. These buffer ~~RHA~~ widths are consistent with General Policy Plan Policy ED 2.A.1, NE 1.A.1 and RCW 36.70A.020(7). They provide an increased level of protection for wetlands over requirements in the current regulations.

iv. These buffer ~~RHA~~ recommendations are sufficient to protect the functions necessary to sustain salmonids consistent with RCW 36.70A.172, preserve water quality and quantity functions and provide additional habitat functions for other water and riparian associated

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A. Definition of Stream. An aquatic area where surface water produces a channel, not including a wholly artificial channel, unless the artificial channel is:

1. Used by salmonids; or

2. Used to convey a stream that occurred naturally before construction of the artificial channel.

B. Designation of Streams. The following streams are hereby designated as critical areas subject to the regulations of this Part 20.25H.

1. **"Type S Water"** means all waters, other than shoreline critical areas designated under LUC 20.25E.017, within their bankfull width, as inventoried as "shorelines of the state" under chapter 90.58 RCW and the rules promulgated pursuant to chapter 90.58 RCW including periodically inundated areas of their associated wetlands.

2. **"Type F Water"** means all segments of waters that are not Type S Waters, and that contain fish or fish habitat, including waters diverted for use by a federal, state, or tribal fish hatchery from the point of diversion for one thousand five hundred feet or the entire tributary if the tributary is highly significant for protection of downstream water quality.

3. **"Type N Water"** means all segments of waters that are not type S or type F waters and that are physically connected to a type S or F waters by an above ground channel system, stream or wetland.

4. **"Type O Water"** means all segments of waters that are not type S, F or N waters and that are not physically connected to type S, F or N waters by an above ground channel system, stream, or wetland.

C. Designation of Stream Critical Area Buffers. The following critical areas buffers are established.

1. Stream Critical Area Buffers:

a. General -- Open Streams (Except West Tributary in the Kelsey Basin).

i. Undeveloped site. An undeveloped site is a site that contains no primary structure. Open streams on undeveloped sites shall have the following critical area buffers, measured from the top-of-bank:

Type S	100 feet
Type F	100 feet
Type N	50 feet
Type O	25 feet

ii. Developed site. A developed site is a site that contains a primary structure or any site where the stream and stream buffer have been included within an approved

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and recorded NGPE or NPGA prior to August 1, 2006. Lots created through subdivision, short subdivision, or the Planned Unit Development process from a developed site shall be considered undeveloped and subject to the requirements of subsection (i) above, except that the lot containing the existing primary structure shall be considered developed. Open streams on developed sites shall have the following critical area buffers, measured from the top-of-bank:

Type S 50 feet or the buffer established with the existing NGPE/NGPA, whichever is greater
Type F 50 feet or the buffer established with the existing NGPE/NGPA, whichever is greater
Type N 25 feet or the buffer established with the existing NGPE/NGPA, whichever is greater
Type O 25 feet or the buffer established with the existing NGPE/NGPA, whichever is greater

b. **General -- Closed Stream Segments** . Regardless of type, closed stream segments shall have no critical area buffer and shall have the structure setback established in LUC 20.25H.075.D.2.b.

c. **West Tributary, Kelsey Basin – Open Streams.** Regardless of type, open stream segments of the West Tributary on developed and undeveloped sites shall have a stream critical area buffer of 50 feet, measured from the top-of-bank.

~~c~~d. **Buffer and Setback on Sites with Existing Primary Structure(s).** Where a primary structure legally established on a site prior to ~~[insert effective date]~~August 1, 2006 encroaches into the critical area buffer or structure setback established in this section, the critical area buffer and/or structure setback shall be modified to exclude the footprint of the existing primary structure. Expansion of any existing structure into the critical area buffer or critical area structure setback shall be allowed only pursuant to the provisions of LUC 20.25H.055 (single family primary structures) or LUC 20.25H.230 (all other primary structures).

~~d~~e. **Measurement of buffer on eroding stream bank**. A stream critical area buffer and any applicable structure setback may be measured from a fixed location representing the historic location of the top-of-bank where an applicant demonstrates that:

i. The location of the top-of-bank has changed over the time as a result of natural stream processes; and

ii. The applicant provides existing surveys, maps or other information acceptable to the director, which accurately determines the historic location of the top of bank.

~~e~~f. **Buffers Modified Under Prior LUC 20.25H.070.A.2.d.** Where the critical area buffer on a site was modified through an approved reach study and restoration plan pursuant to the city's previous critical areas regulations (prior LUC section 20.25H.070.A.2.d), the critical area buffer for that site shall be as determined in that adopted reach study and restoration plan.

2. **Buffer Modification.** Modifications to the stream critical area buffer may be approved pursuant to this section. Modifications to the stream critical area buffer that do not meet the

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criteria of this subsection may be considered through a critical areas report, LUC 20.25H.230:

a. **Buffer averaging.** Buffer averaging may be allowed if all the following criteria are satisfied. Proposals to average the stream critical area buffer under this subsection shall require a critical areas land use permit, provided that a mitigation or restoration plan is not required for buffer averaging.

   i. Buffer averaging may be approved only if the applicant demonstrates that a modification to non-protected area setbacks pursuant to LUC 20.25H.040 would not accommodate the proposed development in a manner consistent with its intended use and function.

   ii. Through buffer averaging, the ecological structure and function of the resulting buffer is equivalent to or greater than the structure and function before averaging;

   iii. The total buffer area is not reduced;

   iv. The buffer area is contiguous;

   v. Averaging does not result in any impact to slope stability and does not increase the likelihood erosion or landslide hazard;

   vi. Averaging does not result in a significant adverse impact to habitat associated with species of local importance; and

   vii. At no point is the critical area buffer width less than 75% of the required buffer dimension.

b. **Transportation or Utility infrastructure.** Where a legally established right of way, railroad right of way or other similar infrastructure of a linear nature crosses a stream critical area buffer, the edge of the improved right of way shall be the extent of the buffer, if the part of the critical area buffer on the other side of the right of way provides insignificant biological or hydrological function in relation to the portion of the buffer adjacent to the stream.

D. Structure Setbacks.

1. General.

The requirements of this section apply along with any other dimensional requirements of the Land Use Code (see LUC 20.20.010, 20.20.130, 20.20.190 and Parts 20.25A – 20.25G). The most restrictive dimension controls. Structure setbacks are required in order to:

a. Minimize long-term impacts of development adjacent to critical areas and critical area buffers; and

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b. Protect critical areas and critical area buffers from adverse impacts during construction.

2. Minimum Setback of Structures.

a. General -- Open Streams (Except West Tributary in Kelsey Basin).

i. Undeveloped site. An undeveloped site is a site that contains no primary structure. The following structure setbacks apply on undeveloped sites, measured from the edge of the critical area buffer:

Type S	20 feet
Type F	20 feet
Type N	15 feet
Type O	10 feet

ii. Developed site. A developed site is a site that contains a primary structure or any site where the stream and stream buffer have been included within an approved and recorded NGPE or NPGA prior to August 1, 2006. Lots created through subdivision, short subdivision, or the Planned Unit Development process from a developed site shall be considered undeveloped and subject to the requirements of subsection (i) above, except that the lot containing the existing primary structure shall be considered developed. The following structure setbacks apply on developed sites, measured from the edge of the critical area buffer or the boundary of the existing NGPE/NGPA, as applicable:

Type S	50 feet
Type F	50 feet
Type N	25 feet
Type O	None

b. General -- Closed Stream Segments. Closed stream segments, regardless of type, shall have a structure setback of 10 feet; provided that closed stream segments in the Kelsey Creek drainage basin shall have a structure setback of 50 feet or a structure setback representing the combined dimension of the critical area buffer and structure setback required for its stream type, whichever is less.

c. West Tributary – Open Stream Segments. Regardless of type, open stream segments of the West Tributary on developed and undeveloped sites shall have a structure setback of 20 feet, measured from the edge of the critical area buffer.

3. Structure Setback Modification – Open Streams on Undeveloped Sites. The director may waive or modify the structure setback on an undeveloped site as part of the permit or approval for the underlying proposal if the applicant demonstrates that:

a. Water quality, or slope stability as documented in a geotechnical report, will not be adversely affected;

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b. Encroachment into the structure setback will not disturb habitat of a species of local importance within a critical area or critical area buffer;

c. Vegetation in the critical area and critical area buffer will not be disturbed by construction, development or maintenance activities and will be maintained in a healthy condition for the anticipated life of the development; and

d. Enhancement planting on the boundary between the structure setback and the critical area buffer will reduce impacts of development within the structure setback.

4. **Structure Setback Modification – Open Streams on Developed Sites.** Structure setbacks on developed sites may be modified only through an approved critical areas report.

5. **Structure Setback Modification – Closed Stream Segments.** Structure setbacks associated with closed streams may be modified only through an approved critical areas report.

20.25H.080 Performance Standards.

A. General. Development on sites with a Type S or F stream or associated critical area buffer shall incorporate the following performance standards in design of the development, as applicable:

1. Lights shall be directed away from the stream.

2. Activity that generates noise such as parking lots, generators, and residential uses shall be located away from the stream or any noise shall be minimized through use of design and insulation techniques.
3. Toxic runoff from new impervious area shall be routed away from the stream.
4. Treated water may be allowed to enter the stream critical area buffer.

5. The outer edge of the stream critical area buffer shall be planted with dense vegetation to limit pet or human use.

6. Use of pesticides, insecticides and fertilizers within 150 feet of the edge of the stream critical area buffer shall be in accordance with the City of Bellevue's "Environmental Best Management Practices, now or as hereafter amended.

B. Modification of Stream Channel.

1. When allowed. A stream channel shall not be modified by relocating the open channel, or by closing the channel through pipes or culverts unless in connection with the following uses allowed under LUC 20.25H.055:

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a. a new or expanded utility facility or system;
b. a new or expanded essential public facility;
c. public flood control measures;
d. instream structures;
e. new or expanded public right of way, private roads, access easements or driveways;
f. habitat improvement project; or
g. reasonable use exception, provided that a modification may be allowed under this section for a reasonable use exception only where the applicant demonstrates that no other alternative exists to achieve the allowed development.

A critical areas report may not be used to modify the uses set forth in this subsection 1.

2. Critical areas report required. Any proposal to modify a stream channel under this section may be approved only through a critical areas report.

3. Relocation of closed stream channel. Any proposal to relocate an existing closed stream channel may be approved only through a critical areas report.

20.25H.085 Mitigation and Monitoring – Additional Provisions. In addition to the provisions of LUC 20.25H.210, mitigation plans designed to mitigate impacts to streams and stream critical area buffers shall meet the requirements of this section.

A. Mitigation Preference. Mitigation plans for streams and stream critical area buffers shall provide mitigation for impacts to critical area functions and values in the following order of preference:

1. On-site through replacement of lost critical area buffer;

2. On-site, through enhancement of the functions and values of remaining critical area buffer;

3. Off-site, through replacement or enhancement, in the same sub-drainage basin;

4. Off-site, through replacement or enhancement, out of the sub-drainage basin but in the same drainage basin.

Mitigation off-site and out of the drainage basin shall be permitted only through a critical areas report.

B. Buffer Mitigation Ratio. Critical area buffer disturbed or impacted under this Part 20.25H shall be replaced at a ratio of 1-to-1.

20.25H.090 Critical Areas Report – Additional Provisions.

A. Limitation on Modifications. A stream critical area buffer shall not be modified below the widths set forth in this section, measured from the top-of-bank:

Type S waters 25 feet

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Type F waters	25 feet
Type N waters	10 feet
Type O waters	10 feet

~~In addition to the provisions of LUC 20.25H.230, any proposal to modify a stream or stream critical area buffer shall comply with the requirements of this section.~~

B. Additional Content – Closed Stream Segments.

Any critical areas report proposing a modification to the structure setbacks required for closed stream segments shall be based on a consideration of the impact of the modification on the feasibility of reopening the closed stream segment in the future, when compared with the feasibility of reopening the closed stream segment without the proposed modification. Where the proposed modification significantly decreases the feasibility of a future reopening, such modification shall be denied, unless the proposal includes mitigation for the functions and values that could have been achieved by reopening the stream segment.

V. WETLANDS

20.25H.095 Designation of Critical Area and Buffers

A. Definition of Wetland. Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from non-wetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from non-wetland areas to mitigate the conversion of wetlands.

B. Designation of Critical Area. The following wetlands are hereby designated as critical areas subject to the requirements of this Part 20.25H. Wetlands are classified into category I, category II, category III and category IV wetlands based on the adopted Washington State Wetland Rating System for Western Washington, Washington State Department of Ecology publication number 04-06-025, published August, 2004.

1. **Category I wetlands.** Category I wetlands are those that 1) represent a unique or rare wetland type; or 2) are more sensitive to disturbance than most wetlands; or 3) are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime; or 4) provide a high level of functions.

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2. **Category II wetlands**. Category II wetlands are difficult, though not impossible, to replace, and provide high levels of some functions. These wetlands occur more commonly than Category I wetlands, but still need a relatively high level of protection. Category II wetlands in western Washington include: wetlands scoring between 51-69 points (out of 100) on the questions related to the functions present are Category II wetlands. Wetlands scoring 51-69 points were judged to perform most functions relatively well, or performed one group of functions very well and the other two moderately well.

3. **Category III wetlands.** Category III wetlands are wetlands with a moderate level of functions (scores between 30 -50 points). Wetlands scoring between 30 -50 points generally have been disturbed in some ways, and are often less diverse or more isolated from other natural resources in the landscape than Category II wetlands.

4. **Category IV wetlands over 2500 square feet.** Category IV wetlands have the lowest levels of functions (scores less than 30 points) and are often heavily disturbed. These are wetlands that we should be able to replace, and in some cases be able to improve. However, experience has shown that replacement cannot be guaranteed in any specific case. These wetlands may provide some important functions, and also need to be protected.

C. **Designation of Wetland Critical Area Buffer:** The following critical area buffers are hereby established.

1. **Wetland Critical Area Buffer**

a. General.

i. Undeveloped sites. An undeveloped site is any site where the wetland and wetland buffer have not previously been included within a Native Growth Protection Area (NGPA) or Native Growth Protection Easement (NGPE), regardless of whether the site contains a primary structure. Wetlands on undeveloped sites shall have the following critical area buffers, measured from the wetland boundary:

Category	Wetland Characteristic	Buffer
I	Natural Heritage wetlands	190 feet
	Bogs	190 feet
	Forested	Based on score for habitat or water quality functions
	Habitat score of 29 to 36	225 feet
	Habitat score of 20 to 28	110 feet
	Water quality score of 24 to 32 and habitat score of less than 20	75 feet
	Not meeting any of the above	75 feet

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Category	Wetland Characteristic	Buffer
II	Habitat score of 29 to 36	225 feet
	Habitat score of 20 to 28	110 feet
	Water quality score of 24 to 32 and habitat score of less than 20	75 feet
	Not meeting any of the above	75 feet
III	Habitat score of 20 to 28 points	110 feet
	Not meeting any of the above	60 feet
IV over 2500 square feet	Score for functions less than 30 points	40

ii. Developed site. A developed site is any site where the wetland and wetland buffer have ~~previously~~ been included within an ~~approved and recorded~~ NGPE or NPGA approved and recorded prior to August 1, 2006, or any site abutting an ~~approved and recorded~~ NGPA approved and recorded prior to August 1, 2006 containing the wetland and wetland buffer where such site does not also contain a wetland. Wetlands on developed sites shall be governed by the buffer established within the approved and recorded NGPA or NGPE, no additional wetland buffer shall apply.

b. Buffer and Setback on Sites with Existing Development. Where a primary structure legally established on a site prior to ~~[insert effective date]~~August 1, 2006 encroaches into the critical area buffer or structure setback established in this section, the critical area buffer and/or structure setback shall be modified to exclude the footprint of the existing primary structure. Expansion of any existing primary structure into the critical area buffer or critical area structure setback shall be allowed only pursuant to the provisions of LUC 20.25H.~~.~~055 (single family primary structures) or LUC 20.25H.230 (all other primary structures).

2. **Buffer Modification.** Modifications to the wetland critical area buffer may be approved pursuant to this section. Modifications to the wetland critical area buffer that do not meet the criteria of this subsection may be considered through a critical areas report, LUC 20.25H.230:

a. **Buffer averaging.** Buffer averaging may be allowed if all the following criteria are satisfied. Proposals to average the wetland critical area buffer under this subsection shall require a critical areas land use permit, provided that a mitigation or restoration plan is not required for buffer averaging.

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i. Buffer averaging may be approved only if the applicant demonstrates that a modification to non-protected area setbacks pursuant to LUC 20.25H.040 would not accommodate the proposed development in a manner consistent with its intended use and function.

ii. Through buffer averaging, the ecological structure and function of the resulting buffer is equivalent to or greater than the structure and function before averaging;

iii. The total buffer area is not reduced;

iv. The buffer area is contiguous;

v. Averaging does not result in any impact to slope stability and does not increase the likelihood erosion or landslide hazard;

vi. Averaging does not result in a significant adverse impact to habitat associated with species of local importance; and

vii. At no point is the critical area buffer width less than 75% of the required buffer dimension.

b. **Transportation or Utility infrastructure.** Where a legally established right of way, railroad right of way or other similar infrastructure of a linear nature crosses a wetland critical area buffer, the edge of the improved right of way shall be the extent of the buffer, if the part of the critical area buffer on the other side of the right of way provides insignificant biological or hydrological function in relation to the portion of the buffer adjacent to the wetland.

D. Structure Setbacks.

1. General.

The requirements of this section apply along with any other dimensional requirements of the Land Use Code (see LUC 20.20.010, 20.20.130, 20.20.190 and Parts 20.25A – 20.25G). The most restrictive dimension controls. Structure setbacks are required in order to:

a. Minimize long-term impacts of development adjacent to critical areas and critical area buffers; and

b. Protect critical areas and critical area buffers from adverse impacts during construction.

2. **Minimum Setback of Structures--** Undeveloped and developed sites. The following structure setbacks apply to both undeveloped and developed sites. Structure setbacks shall be measured from the edge of the critical area buffer on undeveloped sites, or from the edge of the approved and recorded NGPE or NGPA on developed sites:

Category I wetlands	20 feet

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Category II wetlands	20 feet
Category III wetlands	15 feet
Category IV wetlands	none required

3. **Structure Setback Modification – Undeveloped Sites**. The director may waive or modify the structure setback on an undeveloped site as part of the permit or approval for the underlying proposal if the applicant demonstrates that:

   a. Water quality, or slope stability as documented in a geotechnical report, will not be adversely affected;

   b. Encroachment into the structure setback will not disturb habitat of a species of local importance within a critical area or critical area buffer;

   c. Vegetation in the critical area and critical area buffer will not be disturbed by construction, development, or maintenance activities and will be maintained in a healthy condition for the anticipated life of the development; and

   d. Enhancement planting on the boundary between the structure setback and the critical area buffer will reduce impacts of development within the structure setback.

4. **Structure Setback Modification – Developed Sites.** Structure setbacks on developed sites may be modified only through an approved critical areas report.

20.25H.100 Performance Standards.
Development on sites with a wetland or wetland critical area buffer shall incorporate the following performance standards in design of the development, as applicable:

1. Lights shall be directed away from the wetland.

2. Activity that generates noise such as parking lots, generators, and residential uses, shall be located away from the wetland, or any noise shall be minimized through use of design and insulation techniques.
3. Toxic runoff from new impervious area shall be routed away from the wetlands.
4. Treated water may be allowed to enter the wetland critical area buffer.

5. The outer edge of the wetland critical area buffer shall be planted with dense vegetation to limit pet or human use.

6. Use of pesticides, insecticides and fertilizers within 150 feet of the edge of the stream buffer shall be in accordance with the City of Bellevue's "Environmental Best Management Practices, now or as hereafter amended.

20.25H.105 Mitigation and Monitoring – Additional Provisions. In addition to the provisions of LUC 20.25H.210, mitigation plans designed to mitigate impacts to wetlands and wetland critical area buffers shall meet the requirements of this section.

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A. Preference of Mitigation Actions.

1. Mitigation for impacted wetland critical area. Mitigation actions that require compensation of impacted wetland critical area shall occur in the following order of preference, subject to the location requirements of subsection B:

   a. Restoring wetlands on upland sites that were formerly wetlands.

   b. Creating wetlands on disturbed upland sites such as those with vegetative cover consisting primarily of non-native introduced species. This should only be attempted when there is a consistent source of hydrology and it can be shown that the surface and subsurface hydrologic regime is conducive for the wetland community that is being designed.

   c. Enhancing significantly degraded wetlands.

2. Mitigation for impacted wetland critical area buffer. Mitigation actions that require compensation of impacted critical area buffer shall occur in the following order of preference and in the following locations:

   a. On-site through replacement of lost critical area buffer;

   b. On-site, through enhancement of the functions and values of remaining critical area buffer;

   c. Off-site, through replacement or enhancement, in the same sub-drainage basin;

   d. Off-site, through replacement or enhancement, out of the sub-drainage basin but in the same drainage basin.

B. Type and Location of Mitigation for Wetland Critical Area. Compensatory mitigation for critical areas functions and values shall be either in-kind and on-site, or in-kind and within the same drainage sub-basin. Mitigation actions may be conducted off-site and outside of the drainage sub-basin when all of the following are demonstrated through a critical areas report:

1. There are no reasonable on-site or in-subdrainage basin opportunities or on-site and in-subdrainage basin opportunities do not have a high likelihood of success, after a determination of the natural capacity of the site to mitigate for the impacts. Consideration should include: anticipated wetland mitigation replacement ratios, buffer conditions and proposed widths, hydrogeomorphic classes of on-site wetlands when restored, proposed flood storage capacity, potential to mitigate stream fish and wildlife impacts (such as connectivity);

2. Off-site mitigation has a greater likelihood of providing equal or improved wetland functions than the impacted wetland; and

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3. Off-site locations shall be in the same sub-drainage basin unless established watershed goals for water quality, flood or conveyance, habitat, or other wetland functions have been established and strongly justify location of mitigation at another site.

C. Mitigation Ratios

1. **Wetland Acreage Replacement Ratios.** The following ratios shall apply to creation or restoration that is in-kind, is on-site, is the same category of wetland, is timed prior to or concurrent with alteration, and has a high probability of success. The first number specifies the acreage of replacement wetlands and the second specifies the acreage of wetlands altered.

Category I	6-to-1
Category II	3-to-1
Category III	2-to-1
Category IV	1.5-to-1

2. **Increased Replacement Ratio**. The director may increase the ratios where proposed mitigation will result in a lower category wetland or reduced functions relative to the wetland being impacted.

3. **Critical Area Buffer Mitigation Ratio.** Critical area buffer disturbed or impacted under this Part 20.25H shall be replaced at a ratio of 1-to-1.

E. Wetlands Enhancement as Mitigation. Impacts to wetland critical area functions may be mitigated by enhancement of existing significantly degraded wetlands. Applicants proposing to enhance wetlands must produce a critical areas report meeting the requirements of LUC 20.25H.110 and 20.25H.230 that identifies how enhancement will increase the functions of the degraded wetland and how this increase will adequately mitigate for the loss of wetland area and function at the impact site. An enhancement proposal must also show whether existing wetland functions will be reduced by the enhancement actions.

20.25H.110 Critical Area Report – Additional Provisions.

A. Limitation on Modification. A critical areas report may not be used to fill a wetland critical area, except where filling is required to allow a use set forth in LUC 20.25H.055.

B. Additional Content. In addition to the general requirements of LUC 20.25H.230, a critical areas report for wetlands shall include a written assessment and accompanying maps of the wetlands and buffers within three hundred (300) feet of the project area, including the following information at a minimum:

1. A discussion of measures, including avoidance, minimization, and mitigation, proposed to preserve existing wetlands and restore any wetlands that were degraded prior to the current proposed land use activity.

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1. Landslide Hazards. Areas of slopes of 15 percent or more with more than 10 feet of rise, which also display any of the following characteristics:

   a. Areas of historic failures, including those areas designated as Quaternary slumps, earthflows, mudflows, or landslides.
   b. Areas that have shown movement during the Holocene Epoch (past 13,500 years) or that are underlain by landslide deposits.
   c. Slopes that are parallel or subparallel to planes of weakness in subsurface materials.
   d. Slopes exhibiting geomorphological features indicative of past failures, such as hummocky ground and back-rotated benches on slopes.
   e. Areas with seeps indicating a shallow ground water table on or adjacent to the slope face.
   f. Areas of potential instability because of rapid stream incision, stream bank erosion, and undercutting by wave action.

2. Steep Slopes. Slopes of 40 percent or more that have a rise of at least 10 feet and exceed 1000 square feet in area.

3. Coal Mine Hazards. Areas designated on the Coal Mine Areas maps or in the City's Coal Mine Area Regulations, LUC 20.25H.130, as potentially affected by abandoned coal mines; provided, that compliance with the Coal Mine Area Regulations shall constitute compliance with the requirements of this chapter in regard to coal mines.

B. Geologic Hazard Area buffers. The following critical area buffers are established.

1. General Geologic Hazard Critical Area Buffers:

   a. Landslide Hazards — Top-of-slope buffer of 50 feet.

   b. Steep Slopes — Top-of-slope buffer of 50 feet

2. Existing Development. Where a primary structure legally established on a site prior to ~~[insert effective date]~~August 1, 2006 encroaches into the critical area buffer established in subsection 1, the critical area buffer and structure setback shall be modified to exclude the footprint of the existing structure. Expansion of an existing structure into the critical area buffer shall be allowed only pursuant to the provisions of LUC 20.25H.065.

3. Buffer Modification. Modifications to the geologic hazard critical area buffer may be considered through a critical areas report, LUC 20.25H.230.

C. Structure Setbacks.

1. General.

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The requirements of this section apply along with any other dimensional requirements of the Land Use Code (see LUC 20.20.010, 20.20.130, 20.20.190 and Parts 20.25A – 20.25G). The most restrictive dimension controls. Structure setbacks are required in order to:

a. Minimize long-term impacts of development adjacent to critical areas and critical area buffers; and

b. Protect critical areas and critical area buffers from adverse impacts during construction.

2. **Minimum Setback of Structures.**

   a. Landslide Hazards — Toe-of-slope setback of 75 feet.

   b. Steep Slopes — Toe-of-slope setback of 75 feet.

3. **Structure Setback Modification**. Structure setbacks may be modified only through an approved critical areas report.

20.25H.125. Performance Standards – Landslide Hazards and Steep Slopes. In addition to generally applicable performance standards set forth in LUC 20.25H.060 and 20.25H.070, development within a landslide hazard or steep slope critical area or the critical area buffers of such hazards shall incorporate the following additional performance standards in design of the development, as applicable. The requirement for long-term slope stability shall exclude designs that require regular and periodic maintenance to maintain their level of function.

A. Structures and improvements shall minimize alterations to the natural contour of the slope, and foundations shall be tiered where possible to conform to existing topography;

B. Structures and improvements shall be located to preserve the most critical portion of the site and its natural landforms and vegetation;

C. The proposed development shall not result in greater risk or a need for increased buffers on neighboring properties;

D. The use of retaining walls that allow the maintenance of existing natural slope area is preferred over graded artificial slopes where graded slopes would result in increased disturbance as compared to use of retaining wall; and

E. Development shall be designed to minimize impervious surfaces within the critical area and critical area buffer.

F. Where change in grade outside the building footprint is necessary, the site retention system should be stepped and regrading should be designed to minimize topographic modification.

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(3) The following stream buffers are established for streams:

Riparian Stream Corridor Classification	Stream Buffer Width (feet)
Class I	
▪ Sammamish River north of PSE powerline crossing	▪ 150' inner buffer + 50' outer buffer
▪ Sammamish River south of PSE powerline crossing	▪ 150'
▪ Bear Creek west of Avondale Road	▪ 150'
▪ Bear Creek east of Avondale Road	▪ 150' inner buffer + 50' outer buffer
▪ Evans Creek	▪ 150' inner buffer + 50' outer buffer
Class II	100' + 50' outer buffer
Class III	100'
Class IV	
▪ Perennial	▪ 36'
▪ Intermittent	▪ 25'

(4) Increased stream buffer widths. The recommended stream buffer widths may be increased as follows:

(a) When the Department determines that the recommended width is insufficient to prevent habitat degradation and to protect the structure and functions of the habitat areas;

(b) When the Frequently Flooded Area exceeds the recommended stream buffer width, the stream buffer shall extend to the outer edge of the Frequently Flooded Area;

(c) When the stream buffer is within a Landslide Hazard Area or its buffer, the stream buffer shall be the recommended distance, or the Landslide Hazard Area buffer, whichever is greater. Similarly if the stream buffer is within an Erosion Hazard Area, the stream buffer shall be the recommended distance or the extent of the Erosion Hazard Area.

(5) Reduced stream buffer widths. Stream buffer widths must meet the required width as described in the table above. This does not refer to stream buffer width averaging. See below provisions under which stream buffer width averaging is permitted.

(6) Stream buffer width averaging. The Director may allow the recommended stream buffer width to be reduced in accordance with best available science only if:

(a) The width reductions will not reduce stream or habitat functions, including those of nonfish habitat;

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(b) The width reduction will not degrade the habitat, including habitat for salmonid fisheries;

(c) The proposal will provide additional habitat protection;

(d) The total area contained in the stream buffer area after averaging is no less than that which would be contained within the standard stream buffer area; and

(e) The buffer width is not reduced to less than twenty-five percent (25%) of the standard stream buffer width or twenty-five (25) feet, whichever is greater.

(7) For Class I and II streams, buffer averaging may be applied to the inner buffer. The following provisions apply to the inner buffer:

(a) The width of the inner buffer shall not be reduced below 75% of the required inner buffer width at any point;

(b) Encroachment shall not occur into the buffer of an associated wetland;

(c) The area of the inner buffer after averaging shall be equivalent to the area of the inner buffer prior to averaging;

(d) There is a net improvement in overall buffer ecological functions; and

(e) Averaging shall not preclude the opportunity for future recovery of structure and function.

(8) For Class I and II streams, maximum clearing and grading within the outer 50-foot buffer is thirty-five percent (35%) of the outer buffer area. Nothing in this provision shall be construed to require remediation of existing situations where the current clearing and grading is in excess of thirty-five percent (35%). No net effective impervious surface may be created within this area.

(9) No structures or improvements shall be permitted within the stream buffer, including buildings, decks, docks, except as otherwise permitted or required under the City's adopted Shoreline Master Program, or under one of the following circumstances:

(a) When the improvements are part of an approved rehabilitation or mitigation plan; or

(b) For construction of new roads and utilities, and accessory structures, when no feasible alternative location exists; or

(c) Trails, according to the following criteria:

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(b) The width reduction will not degrade the habitat, including habitat for salmonid fisheries;

(c) The proposal will provide additional habitat protection;

(d) The total area contained in the stream buffer area after averaging is no less than that which would be contained within the standard stream buffer area; and

(e) The buffer width is not reduced to less than twenty-five percent (25%) of the standard stream buffer width or twenty-five (25) feet, whichever is greater.

(7) For Class I and II streams, buffer averaging may be applied to the inner buffer. The following provisions apply to the inner buffer:

(a) The width of the inner buffer shall not be reduced below 75% of the required inner buffer width at any point;

(b) Encroachment shall not occur into the buffer of an associated wetland;

(c) The area of the inner buffer after averaging shall be equivalent to the area of the inner buffer prior to averaging;

(d) There is a net improvement in overall buffer ecological functions; and

(e) Averaging shall not preclude the opportunity for future recovery of structure and function.

(8) For Class I and II streams, maximum clearing and grading within the outer 50-foot buffer is thirty-five percent (35%) of the outer buffer area. Nothing in this provision shall be construed to require remediation of existing situations where the current clearing and grading is in excess of thirty-five percent (35%). No net effective impervious surface may be created within this area.

(9) No structures or improvements shall be permitted within the stream buffer, including buildings, decks, docks, except as otherwise permitted or required under the City's adopted Shoreline Master Program, or under one of the following circumstances:

(a) When the improvements are part of an approved rehabilitation or mitigation plan; or

(b) For construction of new roads and utilities, and accessory structures, when no feasible alternative location exists; or

(c) Trails, according to the following criteria:

(g) Emphasize heterogeneity and structural diversity of vegetation in landscaping;

(h) Remove and/or control any noxious weeds or animals as defined by the City; and

(i) Preserve significant trees, preferably in groups, consistent with RCDG 20D.80.10-060 and with achieving the objectives of these standards.

(3) Landscape plan shall be submitted consistent with the requirements of RCDG 20D.80.10-040 and with the goals and standards of this chapter. The plan shall reflect the report prepared pursuant to RCDG 20D.140.10-060. (Ord. 1693. Formerly 20C.40.120(05)(b))

20D.140.30 Wetlands

20D.140.30-010 Classification and Rating of Wetlands.

To promote consistent application of the standards and requirements of this chapter, wetlands within the City of Redmond shall be classified according to their characteristics, function and value, and/or their sensitivity to disturbance. Wetlands shall be rated and regulated according to the categories defined by the Washington State Department of Ecology *Wetland Rating System for Western Washington* (Ecology Publication #04-06-025) as revised. This document contains the methods for determining the wetland category.

(1) Wetland Classification. Wetlands, as defined by this chapter, shall be designated Category I, Category II, Category III, and Category IV.

(a) Category I Wetlands are those wetlands that represent a unique or rare wetland type, are more sensitive to disturbance than most wetlands, are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime, or provide a high level of functions. All wetlands with one or more of the following criteria shall be considered a Category I wetland:

(i) Wetlands that are identified by scientists of the Washington Natural heritage Program/DNE as high quality, relatively undisturbed wetlands, or wetlands that support State listed threatened or endangered plants.; or

(ii) Bogs; or

(iii)Mature and old-growth forested wetlands over one acre in size; or

(iv) Wetlands that provide a very high level of functions as evidenced by a score of 70 points or more on the Western Washington Rating System form.

(b) Category II Wetlands are those wetlands that provide high levels of some functions which are difficult to replace. Category II wetlands meet the following criteria:

(i) Wetlands scoring between 51-69 points on the Western Washington Rating System form; or

(ii) Wetlands that do not meet the criteria of Category I.

(c) Category III Wetlands are those wetlands that provide a moderate level of functions. They are typically more disturbed and have less diversity or are more isolated from other natural resources in the landscape. Category III Wetlands meet the following criteria:

(i) Wetlands scoring between 30-50 points on the Western Washington Rating System form; or

(ii) Wetlands that do not meet the criteria of Category I.

(d) Category IV Wetlands are those wetlands that provide the lowest level of function. These wetlands score less than 30 points on the Western Washington Rating System form.

(2) Classification of wetlands shall be determined by the Committee based on consideration of the following factors:

(a) Maps adopted pursuant to this chapter, including the Wetland map, which identifies the approximate location and extent of wetlands. This map shall be used as a general guide only for the assistance of property owners and other interested parties; boundaries are generalized. The actual type, extent, and boundaries of wetlands shall be determined in the field by a qualified consultant according to the procedures, definition, and criteria established by this Chapter. In the event of any conflict between the critical area location and designation shown on the City's map and the criteria or standards of this section, the criteria and standards shall prevail;

(b) National Wetlands Inventory Maps prepared by the US Fish and Wildlife Service;

(c) Application of the criteria contained in these regulations; and

(d) Consideration of the technical reports submitted by qualified consultants in connection with applications subject to these regulations. (Ord. 2180; Ord. 1693. Formerly 20C.40.080)

20D.140.30-020 Wetland Buffers.

(1) Required buffer widths shall reflect the sensitivity of the particular wetland or the risks associated with development and, in those circumstances permitted by these regulations, the type and intensity of human activity and site design proposed to be conducted on or near the critical area.

(2) Wetland buffers shall be measured from the wetland edge as delineated and marked in the field using the DOE Wetland Manual. Wetland buffers shall be established as follows:

Wetland Category and Characteristics	**Buffer Width (feet) by Impact of Land Use* (see below)**	**Other Measures Recommended for Protection**
Category I		
Forested	Buffer size to be based on score for habitat functions or water quality functions	If forested wetland scores high for habitat, need to maintain connectivity to other natural areas. Restore degraded parts of buffer.
High level of function for habitat (score for habitat 29-36 pts.)	Low: 150 Moderate: 225 High: 300	Maintain connectivity to other natural areas. Restore degraded parts of buffer.
Moderate level of function for habitat (score for habitat 20-28 pts.)	Low: 75 Moderate: 110 High: 150	No recommendations at this time.
High level of function for water quality improvement (24-32 pts.) and low for habitat (less than 20 pts.)	Low: 50 Moderate: 75 High: 100	No additional discharges of untreated runoff.
Not meeting any of the above criteria	Low: 50 Moderate: 75 High: 100	No recommendations at this time.
Category II		
High level of function for habitat (score for habitat 29-36 pts.)	Low: 150 Moderate: 225 High: 300	Maintain connectivity to other natural areas.
Moderate level of function for habitat (score for habitat 20-28 pts.)	Low: 75 Moderate: 100 High: 150	No recommendations at this time.

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Wetland Category and Characteristics	Buffer Width (feet) by Impact of Land Use* (see below)	Other Measures Recommended for Protection
High level of function for water quality improvement and low for habitat (score for water quality 24-32 pts.; habitat less than 20 pts.)	Low: 50 Moderate: 75 High: 100	No additional discharges of untreated runoff.
Not meeting above criteria	Low: 50 Moderate: 75 High: 100	No recommendations at this time.
Category III		
Moderate level of function for habitat (score for habitat 20-28 pts.)	Low: 75 Moderate: 110 High: 150	No recommendations at this time.
Not meeting above criteria	Low: 40 Moderate: 60 High: 80	No recommendations at this time.
Category IV		
Score for functions less than 30 pts.	Low: 25 Moderate: 40 High: 50	No recommendations at this time.

* Consistent with the Department of Ecology classification system identified above, high, medium and low impact land uses are defined as follows:

(a) High impact land uses include: commercial, industrial, institutional, retail sales, high-intensity recreation (golf courses, ball fields), and residential uses with a density of more than one dwelling unit per acre.

(b) Medium impact land uses include residential uses with a density of one unit per acre or less, moderate-intensity open space (parks), and paved trails.

(c) Low impact land uses include: low-intensity open space (such as passive recreation and natural resources preservation) and unpaved trails.

(3) The buffer for a wetland created, restored, or enhanced as compensation for approved wetland alterations shall be that required for the category of the wetland.

(4) Increased buffer widths. The Department may extend the width of the buffer in accordance with the recommendations of a qualified wetland professional and the best available science on a case-by-case basis when a larger buffer is necessary to protect wetland functions and values based on site-specific characteristics.

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(5) Reduction of buffer widths. The Department may allow the standard wetland buffer width to be reduced in accordance with the best available science on a case-by-case basis when it is determined that a smaller area is adequate to protect the wetland functions and values based on site-specific characteristics.

(a) Reduction in buffer width based on reducing the intensity of impacts from proposed land uses. The buffer widths recommended for land uses with high-intensity impacts to wetlands can be reduced to those widths recommended for moderate-intensity impacts under the following conditions:

(i) For wetlands that score moderate or high for habitat (20 points or more), the width of the buffer around the wetland can be reduced if both the following criteria are met:

(A) A relatively undisturbed vegetated corridor at least 100 feet wide is protected between the wetlands and any other Priority Habitats as defined by the Washington State Department of Fish and Wildlife. The corridor must be protected for the entire distance between the wetland and the Priority Habitat via some type of legal protection such as a conservation easement; and

(B) Measures to minimize the impacts of different land uses on wetlands, such as those developed by the Department of Ecology under BAS, are applied.

(ii) For wetlands that score less than 20 points for habitat, the buffer width can be reduced to that required for moderate land use impacts if measures to minimize the impacts of different land uses on wetlands, such as those developed by the Department of Ecology under BAS, are applied.

(b) Reductions in buffer widths where existing roads or structures lie within the buffer. Where a legally established, non-conforming use of the buffer exists, proposed actions in the buffer may be permitted as long as they do not increase the degree of non-conformity. In terms of wetlands, this means no increase in the impacts to the wetland from activities in the buffer.

(6) Wetland buffer width averaging. Wetland buffer widths may be modified by averaging buffer widths as set forth herein. The Department may allow modification of the standard wetland buffer width in accordance with the best available science on a case-by-case basis by averaging buffer widths. Averaging buffer widths may only be allowed where a qualified wetland professional demonstrates that:

(a) It will not reduce the functions or values;

(b) The wetland contains variations in sensitivity due to existing physical characteristics or the character of the buffer varies in slope, soils, or vegetation, and the wetland would benefit from a wider buffer in places and would not be adversely impacted by a narrower buffer in other places.

(c) The total area contained in the buffer area after averaging is no less than that which would be contained within the standard buffer; and

(d) The buffer width is not reduced more than twenty-five (25) percent of the width or fifty (50) feet, whichever is less, except for buffers between Category IV wetlands and low or moderate intensity land uses.

(7) Buffer widths may be reduced by buffer width reduction or buffer width averaging as stated above. However, the use of either of these mechanisms or a combination of these mechanisms shall not result in a buffer width less than 75% of the standard buffer required as identified in 20D.140.30-020(2) above.

(8) Storm water management facilities, such as biofiltration swales and outfalls, may be located within the outer twenty-five (25) percent of the buffer, provided that no other location is feasible, and the location of such facilities will not degrade the functions or values of the wetland. Stormwater ponds must be located outside of the required buffer.

20D.140.30-030 Alteration of Wetlands.

(1) Wetland alteration shall result in no net loss of wetland area, except where the following criteria are met:

(a) The lost wetland area provides minimal functions and the mitigation action(s) results in a net gain in wetland functions as determined by a site-specific assessment; or

(b) The lost wetland area provided minimal functions as determined by a site-specific functional assessment and other replacement habitats provide greater benefits to the functioning of the watershed, such as riparian habitat restoration and enhancement.

(2) Category I Wetlands: Alterations of Category I wetlands shall be prohibited subject to the reasonable use provisions of this chapter.

(3) Category II, III, and IV Wetlands.

(a) Any proposed alteration and mitigation shall comply with the mitigation performance standards and requirements of these regulations; and

(b) No net loss of wetland function and value may occur.

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Bothell

. Stream Buffer Widths. Standard stream buffer widths are shown in the table below. A stream buffer shall have the width recommended, unless a greater width is required pursuant to subsection (D)(3) of this section, or a lesser width is allowed pursuant to subsection (D)(4) of this section. Widths shall be measured outward in each direction, on the horizontal plane, from the ordinary high water mark, or from the top of bank, if the ordinary high water mark cannot be identified. Stream buffers should be sufficiently wide to achieve the full range of riparian and aquatic ecosystem functions, which include but are not limited to protection of in stream fish habitat through control of temperature and sedimentation in streams; preservation of fish and wildlife habitat; and connection of riparian wildlife habitat to other habitats.[45]

Stream Buffers1

Stream Type	Standard Stream Buffer Widths
Type S; or shorelines of the state, or shorelines of statewide significance	100 feet*
Type F; or other salmonid bearing streams	100 feet
Type Np, or other, perennial, non-salmonid bearing streams	75 feet
Type Ns; or other intermittent, non-salmonid bearing streams	50 feet

1 While water typing is used here to classify riparian habitat areas, regulations regarding riparian habitat areas listed here are applicable to areas containing aquatic systems containing perennial or intermittent flowing water. See the definition for riparian habitat. Habitats associated with marine and standing water are by the general and other performance standards in this chapter.

* Except that the main stem of North Creek located between 240th Street SE and 228th Street SE shall have a stream buffer width of 150 feet.

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14.04.500 Designation, rating, and mapping wetlands.

A. Designating Wetlands. Wetlands are those areas, designated in accordance with the Washington State Wetland Identification and Delineation Manual (1997), that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation adapted for life in saturated soil conditions. All areas within the city meeting the wetland designation criteria in the Identification and Delineation Manual, regardless of any formal identification, are hereby designated critical areas and are subject to the provisions of this chapter.

B. Wetland Ratings.[15] Wetlands shall be rated according to the Washington State Department of Ecology wetland rating system found in the Washington State Wetland Rating System documents (Washington State Wetland Rating Manual for Western Washington (revised), Department of Ecology Document #04-06-025) or as revised by Ecology. These documents contain the definitions and methods for determining if the criteria below are met.

1. Wetland Rating Categories.

a. Category I. Category I wetlands are those wetlands that (i) represent a unique or rare wetland type; or (ii) are more sensitive to disturbance than most wetlands; or (iii) are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime; or (iv) provide a high level of functions. These include bogs, mature and old-growth forested wetlands, and wetlands that perform many functions very well (score 70 points or more (out of 100) on a completed rating form for the appropriate hydro-geomorphic class).

b. Category II. Category II wetlands are difficult, though not impossible, to replace, and provide high levels of some functions. These wetlands occur more commonly than Category I wetlands, but still need a relatively high level of protection. Because there are no estuarine or inter-dunal wetlands in Bothell, Category II wetlands are those that score between 51 and 69 (out of 100) points. Wetlands scoring 51 to 69 points were judged to perform most functions relatively well, or performed one group of functions very well and the other two moderately well.

c. Category III. Category III wetlands are wetlands with a moderate level of functions (scores between 30 to 50 points out of 100). Wetlands scoring between 30 to 50 points generally have been disturbed in some ways, and are often less diverse or more isolated from other natural resources in the landscape than Category II wetlands.

d. Category IV. Category IV wetlands have the lowest levels of functions (scores less than 30 points out of 100) and are often heavily disturbed. These are wetlands that should be able to be replaced, and in some cases be able to be improved. However, experience has shown that replacement cannot be guaranteed in any specific case. These wetlands may provide some important functions, and also need to be protected.

2. Date of Wetland Rating. Wetland rating categories shall be applied as the wetland exists on the date of adoption of the rating system by the local government, as the wetland naturally changes thereafter, or as the wetland changes in accordance with permitted activities. Wetland rating categories shall not change due to illegal modifications.

C. Mapping. The approximate location and extent of wetlands are shown on the adopted critical area maps. The following critical area maps, including locally adopted maps are hereby adopted. Additionally, soil maps produced by U.S. Department of Agriculture National Resources Conservation Service may be useful in helping to identify potential wetland areas.

These maps are to be used as a guide for the city, project applicants, and/or property owners, and may be continuously updated as new critical areas are identified. They are a reference and do not provide a final critical area designation.

The exact location of a wetland's boundary shall be determined through the performance of a field investigation by a qualified professional wetland scientist applying the Washington State Wetlands Identification and Delineation Manual as required by RCW 36.70A.175 (Ecology Publication #96-94, 1997). (Ord. 1946 § 3, 2005).

Allowed Activities

14.04.510 Activities allowed in wetlands.

The activities listed below are allowed in wetlands in addition to those activities listed in, and consistent with, the provisions established in BMC 14.04.150, Allowed activities, and do not require submission of a critical area report, except where such activities result in a loss to the functions and values of a wetland or wetland buffer. These activities include:

A. Conservation or preservation of soil, water, vegetation, fish, shellfish, and other wildlife that does not entail changing the structure or functions of the existing wetland.

B. The harvesting of wild crops in a manner that is not injurious to natural reproduction of such crops and provided the harvesting does not require tilling of soil, planting of crops, chemical applications, or alteration of the wetland by changing existing topography, water conditions, or water sources.

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C. Drilling for utilities under a wetland provided that the drilling does not interrupt the groundwater connection to the wetland or percolation of surface water down through the soil column. Specific studies by a hydrologist are necessary to determine whether the groundwater connection to the wetland or percolation of surface water down through the soil column is disturbed.

D. Enhancement of a wetland through the removal of non-native invasive species. Weeding shall be restricted to hand removal and weed material shall be removed from the site. Bare areas that remain after weed removal shall be revegetated with native shrubs and trees at natural densities. Some hand seeding may also be done over the bare areas with native herbs. (Ord. 1946 § 3, 2005).

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CITY OF WOODINVILLE

PLANNING COMMISSION SPECIAL MEETING PACKET

September 22, 2004

CITY HALL COUNCIL CHAMBERS
17301 133RD AVENUE NE
WOODINVILLE, WASHINGTON 98072

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WELCOME TO WOODINVILLE'S PLANNING COMMISSION MEETING

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Planning Commission Agenda Guidelines

Woodinville Planning Commission

Terry DePolo, Chair

Cherry Jarvis, Vice Chair

Hank Stecker

Michael Corning

Shirley Martin

Phil Relnick

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Public Comments provide an opportunity for the public to address the Planning Commission on any subject which is not of a quasi judicial nature or scheduled for a public hearing. Speakers are instructed to come to the podium and clearly state their name and address for the record. Comments should be limited to three minutes per individual, and five minutes if representing a group. Members of the public are also welcome to comment on specific agenda items as they are being discussed by the Planning Commission.

Agenda Approval. Commissioners may, at this time, move items on the agenda for additional consideration, or to accommodate attendees. The Planning Commission may also add and take action on other items not listed on the agenda.

Public Hearings are held to receive public comment on important matters before the Planning Commission. Please use the sign-up sheet at the agenda table if you wish to speak. You are welcome to offer your comments after being recognized by the Chair; please approach the podium and provide your name and address for the record. After all persons have spoken, the hearing is closed to public comment, and the Planning Commission proceeds with its deliberation and decision-making.

Planning Commission agenda material is available for public review at Woodinville City Hall or the Woodinville Library by the Monday preceding the meeting. Information regarding specific agenda topics may be obtained from the Planning Clerk's Office on the Friday preceding the Planning Commission meeting. You are encouraged to call the Planning Clerk if you have questions concerning Planning Commission meetings.

Planning Commission meetings are usually held twice a month (with occasional additional Special meetings) on the first and third Wednesdays of each month beginning at 7:00 p.m., in the City Council Chambers, 17301 133rd Avenue NE, Woodinville, WA 98072.

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CITY OF WOODINVILLE
PLANNING COMMISSION

The City of Woodinville Planning Commission consists of seven members, each of whom is appointed for a term of four years. The Planning Commission is advisory to the City Council and is responsible for reviewing and updating the Comprehensive Plan and reviewing land use management ordinances and regulations of the City, potential annexations, and holding public hearings as requested by the City Council. Planning Commissioners are guided by the general principles of : 1) land use planning as applied to Woodinville and its environs and the region; 2) the nature and elements of the Comprehensive Plan and the Washington State Growth Management Act; and 3) appropriate standards to be applied in arriving at findings of fact and formulating recommendations.

Planning Commissioners are residents of the City of Woodinville and all serve without compensation. The Planning Commission meets the first and third Wednesdays of each month beginning at 7:00 p.m. in the City Council Chambers.

The City of Woodinville Planning Commission invites citizens and interested parties to attend Planning Commission meetings, and welcomes comments, either in writing or offered during the time scheduled for public comments listed on the agenda. Planning Commissioners may be reached by leaving a message at City Hall at (425) 489-2757, extension 2222, or by calling Ray Sturtz, Community Development Director (425) 489-2757, extension 2281.

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Staff Report

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TO: PLANNING COMMISSION

FROM: DEBRA CRAWFORD, PLANNING TECHNICIAN DC

THRU: RAY STURTZ, COMMUNITY DEVELOPMENT DIRECTOR

SUBJECT: 2004 ANNUAL DOCKET - PUBLIC HEARING FOR CRITICAL AREAS REGULATIONS UPDATE CONSIDERING - BEST AVAILABLE SCIENCE (BAS)

FOR MEETING OF: SEPTEMBER 22, 2004

ISSUE:

Shall the Planning Commission hold a public hearing to consider including Best Available Science (BAS) in the review and update of the City of Woodinville Critical Areas Regulations?

STAFF RECOMMENDATIONS:

1. Staff recommends the Planning Commission hold a public hearing to consider including BAS as part of the Critical Areas Regulations Update.

2. Staff recommends that the Planning Commission review and consider the BAS information which includes the Science Technical Memos, Gap Analysis Report, and the recommended code amendments, as they relate to City of Woodinville's Environmentally Sensitive Areas Regulations (WMC 21.24), and take public comment at the public hearing on the BAS issues, to therefore be better prepared to make future recommendations to the City Council on the Critical Areas Regulations Update.

POLICY DECISION:

The Growth Management Act (GMA) requires that all jurisdictions consider BAS when updating their Critical Areas Ordinances (CAO). The CAO mandate is to be completed by December 1, 2004. BAS is defined as current scientific information used in the process to designate, protect, or restore critical areas that are derived from a valid scientific process as defined by WAC 365-195-900 through 925 (Exhibit 2). The Planning Commission has the responsibility to recommend to the City Council any changes to the City's Zoning Code.

GOALS and POLICIES:

The GMA has established goals that cities and counties are required to follow in their Comprehensive Plans. One of the GMA goals is to protect the environment and enhance the state's high quality of life, including air and water quality. In 1996, GMA required that counties and cities consider Best Available Science when updating their critical areas ordinances (CAOs). The Environmental Element of the Comprehensive Plan guides the

City in its goals, policies and implementation strategies as a continued effort to protect and enhance the environment for the future. Environmental goal ENV-3.8 states: *Consider and incorporate BAS, consistent with the GMA and applicable rules, in developing regulations for fish and wildlife habitat areas, wetlands, and other critical areas.* The Best Available Science CAO review and future CAO update will bring the City into compliance with GMA mandates.

REGULATIONS CRITERIA and STATE/CASE LAW:

GMA requires all cities and counties to consider Best Available Science when updating their Critical Areas Ordinances. The Environmental Sensitive Areas section (WMC 21.24) of the City's Zoning Code which implements the policies of the Comprehensive Plan needs to be brought into compliance with the GMA mandated BAS requirements.

BACKGROUND

The City of Woodinville on July 14, 2003 contracted with Adolfson and Associates, Inc. Consultant, to review and update the City's environmental sensitive areas regulations (*note*: to be consistent with GMA and state/local terminology the title, "environmental sensitive areas" should be replaced with the title "critical areas") to include the GMA BAS requirements. Adolfson was selected because of their familiarity with Woodinville and expertise in BAS research and regulation analysis/updates for other governmental agencies.

The following tasks describe the services that have been provided by the Consultant:

- Project Management & Meetings
- Research Existing Information / Prepare BAS Memorandums
- Review of Existing Codes – Gap Analysis
- Recommended Code Revision Update
- Public Involvement

A Citizen Advisory Panel (CAP) (Exhibit 3) was selected to promote public involvement in the updating of the City's sensitive areas regulations. The CAP members included two Planning Commissioners, one citizen from the business community, two owners of property which abut Little Bear Creek and Woodin Creek and two Woodinville citizens at large. The CAP met a total of nine times and was supported by City Staff.

Over the course of four meetings the Consultant provided the CAP with scientific technical memos for Geological Hazard areas (Exhibit 4), Critical Aquifer Recharge Areas (Exhibit 5), Wildlife Areas (Exhibit 6), Wetlands and Streams (Exhibit 7). The technical memos describe the general overview of the City's critical areas and the state of the science for these areas. Following the technical memos, a code gap analysis (Exhibit 9) of the City's existing code was completed by the Consultant. The code gap analysis identifies the difference between the City's current regulations and what the BAS is indicating needs to be included in the regulations in order to comply with GMA. It also includes general

recommended options for the City to consider when updating the City's critical areas code. The gaps identified in the City's existing code include:

For Wetlands and Streams

- The City should evaluate its wetland and stream rating system for consistency with state recommended rating systems.
- The City should evaluate the BAS for buffer widths to determine if larger buffers are warranted to protect salmonid habitat or wetland functions.
- Isolated wetlands need to be addressed.
- Wetland mitigation ratios are smaller than the recommended ratios from Department of Ecology (DOE).
- The City should address the mitigation sequencing approach recommended by DOE: Avoidance, minimizing, rectifying, and reducing impacts to wetlands. Also "no net loss" of wetland functions and value.
- Properly Functioning conditions (PFC) are not the goal of the CAO regulations; rather the regulations provide protection to streams, rivers, etc.
- The Variance and Reasonable use processes do not specifically consider affects to federally-listed species.
- There are no regulations that address retention of large woody debris (LWD) in streams.

For Fish and Wildlife Habitat Conservation Areas

- Areas of critical wildlife habitat have not been designed by the City. The Code lacks a section or process for protection of fish and wildlife conservation areas.
- The City needs separate regulations for fish and wildlife habitat WAC 365-190-080 which include:
  - Areas with threatened, endangered species have primary association.
  - Habitats and species of local importance
  - Ponds under twenty acres and their submerged beds
  - Waters of the State
  - Lakes, ponds, streams, and rivers planted with game fish by governmental or tribal entity
- The code lacks definitions for fish and wildlife habitat, PFC, channel migration zone, habitat linkages, and sensitive species.
- Buffers or other protection for fish & wildlife habitat (other than stream buffers for protection of fish) do not exist in code.

For Critical Aquifer Recharge Areas (CARA)

- Critical Aquifer Recharge Areas are not mapped in the City.
- The City's Critical Areas Regulations need to include:
  - A definition of CARA.
  - Provision to prohibit activities that are High Risk for contamination in CARA's.
  - Requirements for Best Management Practices (BMP's) in CARA areas
  - Guidance for appropriate mitigation types, and

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- Guidelines to indicate under what circumstances it would be appropriate to ban hazardous substances, pesticides, fertilizers or septic systems.

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Geological Hazards

- New geological hazard areas should be revised in view of BAS to incorporate new definitions and criteria from the Washington State Department of Community and Economic Development's Critical Areas Handbook (CTED).
- Code does not require the state licensing requirements for geologist, engineering geologist or hydrogeologist.

Other Policies and Plans

- Adaptive management plan
- Habitat restoration plan

The CAP received information provided by two privately funded consultants (Exhibit 10), Ecological Solutions and Chad Armour, LLC. The consultants critiqued the Cities BAS studies (i.e. the science technical memos and the gap analysis) and provided other BAS sources. The information was then discussed during the CAP sessions and some changes were made to the technical memos as requested by the consultants. The information was then forwarded to the Planning Commission for review.

The next step in the analysis of BAS was the recommended revision to the current Critical Areas Code. The recommended revisions were reviewed and discussed at the CAP meetings.

Following were the general recommended changes that needed to be made to the current code to bring it into compliance with the GMA BAS mandate.

New Definitions Section

- A list of new scientific words defining such words as anadromous fish, BAS, CARA, Erosion Hazard Areas, Engineering geologist and so on (see attachments).

Critical Aquifer Recharge Areas (CARA)

- It is recommended that the King County Critical Aquifer Recharge Areas map be adopted as the designation of critical aquifer recharge areas in the City of Woodinville.
- CARA designation and rating – Category I are critical aquifer recharge areas that are designated on the critical aquifer recharge area map as highly susceptible to groundwater contamination and that are located within a sole source aquifer or wellhead protection area, and Category II critical aquifer recharge areas include those mapped areas designated that have a medium susceptibility to groundwater contamination and relocated in a sole source aquifer or wellhead protection area or

are highly susceptible to groundwater contamination and are not located in a sole source aquifer or wellhead protection area.

- CARA development regulations – what activities are not allowed in Category I & II
- Standards that apply to any development proposal in a CARA.

Geological Hazards

- Geological hazard area designation – erosion hazard, landslide hazard, seismic hazard and other geological events such as mass wasting debris flow, rock falls, etc.
- New report requirements
- Development standards
- Performance standards – buffer requirements, alterations, design standards, seasonal restrictions, utilities, subdivisions, etc.

Fish and Wildlife Habitat Conservation Areas

- Designation for fish and wildlife conservation areas
- Report requirements – Habitat Management Plan
- Performance standards
- Performance standards for specific habitats – meaning endangered or threatened species, Chinook Salmon, Bald Eagles, Blue Heron rookeries
- Anadromous fish – special consideration

Wetlands

- Designation and ranking – similar to Department of Ecology wetland rating system – Class 1, 2, and 3.
- Recommended buffer widths
- Wetland mitigation requirements – for lost functions and values, type and location, timing, monitoring and maintenance.
- Mitigation ratios
- Mitigation banking
- Limited exemptions.

Streams

- Designation and rating – Type 1, Type 2, Type 3 and Type 4 and criteria
- Stream development standards and recommended buffer widths
- Streams permitted alterations include: special study, utilities, surface water management activities, trails, stream crossings, stream locations, channel stabilization, enhancement and restoration.
- Stream mitigation requirements

The recommended revisions were discussed at the CAP meetings. In general, the CAP Staff and Planning Commission concurred with the changes for the new and updated definition section of the code (Exhibit 11), Critical Aquifer Recharge Areas (Exhibit 12) Geological Hazard Areas (Exhibit 13), the designation of Fish and Wildlife Conservation Areas (Exhibit 14) and Wetlands (Exhibit 16). Streams became the more controversial

section of the code revision because of buffer width issues, and different alternatives were chosen for these sections.

Over the course of four months three options/alternatives (i.e. Science, Staff and the CAP recommendations) were developed on the BAS code revision for Streams and Wetlands. A benefit/risk analysis (when choosing the different alternatives, see the following) was prepared by Staff and presented to the Planning Commission for their consideration. Furthermore, Staff provided the Planning Commission with information on the GMA requirement of balancing growth/density and economics while protecting the natural resources. Information was also given to the Planning Commission on what our neighboring jurisdictions/counties were doing to address stream and wetland buffer issues, along with the state agencies recommendations (Exhibit 19). Following is the probable benefits/risks involved in choosing any of the three alternatives for the Best Available Science Code revisions.

Alternatives for BAS Code Amendments

Alternative 1

Science Recommended Code Amendment (i.e. large buffer widths to protect fish, wildlife, and habitat. These buffer widths can range on the order from 13 ft. to 984 ft. depending on function protection).

BENEFITS:

- Compliance with the City's Comprehensive Plan Environmental goals and policies
- Compliance with GMA Best Available Science requirements
- Approval from reviewing agencies: DOE, Fish and Wildlife, OCD, Tribes
- Larger area of habitat for fish and wildlife
- Better protection for critical areas
- Less risk of 3rd party law suits (environmental groups)
- May be more aligned with future Endangered Species Act (ESA) requirements

RISK FACTORS:

- Buffers may remain in degraded state (no incentive to restore them) (Exhibits 18 and 21)
- Property takings – leads to 3rd party law suits (property owners)
- Economic loss for property owner and the City of Woodinville

Alternative 2

Staff Recommended Code Amendment (Exhibit 17) (i.e. larger standard buffer widths on the order of 150 ft. for Type 1 streams, which are those streams that support significant anadromous fish to include the Sammamish River and Little Bear Creek (Exhibit 18) and wetlands, in combination with buffer reduction in exchange for enhancement.)

BENEFITS:

- Compliance with the City's Comprehensive Plan Environmental goals and policies
- Less threat for property takings – less 3rd party law suits (property owners)
- GMA balance – addressing urban growth and density and environmental issues
- Economic benefit for property owners and the City of Woodinville
- Tradeoff of reduced buffers for enhanced buffer creates improved buffers for certain functions and values of wetlands and stream corridors
- May be more aligned with future ESA requirements

RISKS FACTORS:

- Non approval by reviewing agencies
- May not be as beneficial to fish and wildlife
- More threat for third party law suits (environmental groups)
- Future ESA requirements may be more restrictive

Alternative 3

Citizen Advisory Panel (CAP) Recommended Code Amendment (i.e. more flexibility in stream and wetland buffer widths (instead of one standard buffer width), and includes the use of buffer width averaging and the designation of "urban stream" to allow for buffer width reduction.

BENEFITS:

- Economic benefit for property owners and the City of Woodinville
- Less threat for property takings – less 3rd party law suits (property owners)

RISKS FACTORS:

- Non approval by reviewing agencies
- May not be as beneficial to fish and wildlife
- More threat for third party law suits (environmental groups)
- Future ESA requirements may be more restrictive

Next, staff reiterated to the Planning Commission the goals and policies of the Environmental chapter of the City's Comprehensive Plan and the direction that staff has been given concerning environmental issues. This approach leads to protection and enhancement of Woodinville's natural environment which is of major importance for Woodinville's vision for the future.

The City of Woodinville has gone to great lengths to implement this vision. In 1999 the Federal government through the Endangered Species Act listed Puget Sound Chinook salmon as a threatened species. At that time, the leaders of this community decided to take a proactive approach and become involved in regional efforts to protect salmon and

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their habitat. Below is a list of activities and programs that the City has participated in recent years:

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- Participation in Water Resource Inventory Area (WRIA) 8 planning.
- Property acquisition with sensitive areas.
- Scientific assessment studies on major and minor streams.
- ESA regional road maintenance program.
- BAS study and code revision (in progress).
- Mapping of sensitive areas,
- Projects for fish habitat enhancement of Little Bear Creek (LBC) and Woodin Creek i.e. (this list is inclusive of the WRIA 8 Near Term Action Agenda)
  - creating pools as refuge places for fish on the Sammamish River,
  - culvert replacement at three different locations on LBC,
  - weir replacement on LBC,
  - bank restoration projects to include removal of invasive plants and replanting native vegetation on LBC, Sammamish River, and Woodin Creek.
- Public outreach programs i.e. Salmon Watchers, Sammamish Re-Leaf. chipping and recycling events, promotion of the Built Green Program.
- The designation of wildlife habitat areas (in progress).
- The urban forest program for preservation of our urban forest.
- Storm water inventory and Woodinville stormwater comprehensive plan, and implementation of the NPDES Phase 2 process (Ecology's comprehensive stormwater management program);
- Development of a monitoring system to maintain and assure successful restoration projects.

The Planning Commission has reviewed and concurred with the recommended code changes for the new and updated definition section, Critical Aquifer Recharge Areas, Geological Hazard Areas, Fish and Wildlife Conservation Areas and Wetlands (Exhibits 11, 12, 13, 14, and 16).

Staff and the Planning Commission differed in the recommended buffer widths for streams (Exhibit 15 & 17). Staff recommends standard buffer widths for Type 1 streams at 150 feet with a 35 foot reduction (when developed) in exchange for enhancement of the buffer. Staff recommended that Little Bear Creek, due to the significant anadromous fish runs (Exhibit 18) be designated as a Type 1 stream. This strategy was derived from BAS standard buffer width ranges (whereas, studies indicate that buffers 100 to150 foot wide provide most (on the order of 80 percent) of potential functions) (Exhibit 7).Type 2 streams require a standard buffer of 115 foot with a 15 foot reduction with enhancement. Provision for urban streams was also added to reduce buffer widths to 35 feet for small streams that have no fish presents (note: this is not derived from BAS but was a decision based upon economics). It was also recommended by staff that buffer averaging for streams be eliminated due to loss of buffer function that occurs when buffers are reduced. BAS does not support buffer width averaging for streams.

The Planning Commission concurred with the 150 standard stream buffer width for Type 1 streams, with a 50 foot reduction (when developed) in exchange for enhancement (Exhibit 15, Stream Section). Little Bear Creek was struck from a Type 1 stream, as recommended by the Staff, to a Type 2 classification. The Planning Commission recommends that Little

Bear Creek be exempted from the urban stream definition, which allows streams that are piped, degraded and channelized to have a buffer reduction of 50 feet for streams that have fish presence. The Planning Commission felt that due to the already existing land use constraints (economic for the City and landowner) that buffer width averaging should be allowed on all stream classifications.

The Planning Commission has reviewed and considered the BAS and other GMA goals and policies (i.e. growth/density in the UGB, economics, etc.) when recommending the CAO update (Exhibits 11 through 16).

FACTS & FINDINGS:

1. The Growth Management Act (GMA) requires that all jurisdictions consider BAS when updating their critical areas ordinances. The CAO mandate is to be completed by December 1, 2004.

2. The City of Woodinville on July 14, 2003 contracted with Adolfson and Associates, Inc. Consultant, to review and update the City's environmental sensitive areas regulations.

3. The following tasks have been completed by the Consultant:
   - Research Existing Information / Prepare BAS Memorandums
   - Review of Existing Codes – Gap Analysis
   - Public Involvement
   - BAS Recommendations
   - Recommended Code Revisions

4. A Citizen Advisory Panel (CAP) was selected to promote public involvement in the updating of the City's sensitive areas regulations.

5. Over the course of four meetings the Consultant provided the CAP with scientific technical memos for streams and wetlands, wildlife, aquifer recharge areas and geological hazard areas. The technical memos describe the general overview of the City's critical areas and the state of the science for these areas.

6. Following the technical memos, a gap analysis of the City's existing code was completed by the Consultant. The gap analysis identifies the difference between the City's current regulations and what the BAS is indicating needs to be included in the regulations in order to comply with GMA. It also includes general recommended options for the City to consider when updating the City's critical areas code.

7. The code gap findings as contained in Exhibit 1 (staff report), were reviewed and considered by the Planning Commission

8. The CAP received information provided by two privately funded consultants, Ecological Solutions and Chad Armour, LLC. The consultants critiqued the Cities BAS studies (i.e. the science technical memos and the gap analysis) and provided

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other BAS sources. The information was then discussed during the CAP sessions and some changes were made to the technical memos as requested by the consultants. The information was then forwarded to the Planning Commission for review.

9. The next step in the analysis of BAS was the recommended redline revision to the current Critical Areas Code. The recommended revisions prepared by the consultant and reviewed by staff, were discussed at the CAP meetings as contained in Exhibit 1 (staff report).

11. The CAP, Staff and Planning Commission concurred with the changes for the new and updated definition section of the code, the changes for Geological Hazard Areas, Critical Aquifer Areas and the designation of Fish and Wildlife Conservation Areas.

12. Streams and Wetlands became the more controversial sections of the code revision because of buffer width issues, and different alternatives were chosen for these sections.

13. Over the course of four months three options/alternatives (i.e. Science, Staff and the CAP recommendations) were developed on the BAS code revision for Streams and Wetlands.

14. A benefit/risk analysis (when choosing the different alternatives) was prepared by Staff and presented to the Planning Commission for their consideration.

15. Staff provided the Planning Commission with information on the GMA requirement of balancing growth/density and economics while protecting the natural resources.

16. Information was also given to the Planning Commission on what our neighboring jurisdictions are doing to address stream and wetland buffer issues.

17. A probable benefits/risks analysis (when choosing the three alternatives for the Best Available Science Code revisions) was prepared by staff and presented to the Planning Commission as contained in Exhibit 1 (staff report).

18. The goals and policies of the Environmental chapter of the City's Comprehensive Plan support the protection and enhancement of Woodinville's natural environment which is of major importance for Woodinville's vision for the future.

19. The City of Woodinville's leaders have gone to great lengths to implement this vision. In 1999 the Federal government through the Endangered Species Act listed Puget Sound Chinook salmon as a threatened species. At that time, the leaders of this community decided to take a proactive approach and become involved in regional efforts to protect salmon and their habitat. A list of activities and programs that the City has participated in recent years to protect salmon and wildlife is contained in Exhibit 1 (staff report).

20. The Planning Commission reviewed and considered the BAS and other GMA goals and policies (i.e. growth/density in the UGB, economics, etc.) when recommending the CAO update (Exhibits 11 through 16).

ALTERNATIVES:

1. Consider public comment at the September 1, 2004, public hearing. in regard to the City's update of the BAS Critical Areas Code, and develop a draft ordinance to include/consider Best Available Science requirements mandated by the GMA.

2. Do not consider public comment and delay review and update of the City's Critical Areas Regulations and the development of a draft ordinance to include/consider Best Available Science requirements mandated by the GMA.

ANALYSIS:

The Growth Management Act (GMA) requires counties and city's to review and consider Best Available Science (BAS) requirements when updating their Critical Areas Ordinances. BAS is defined as current scientific information used in the process to designate, protect, or restore critical areas that are derived from a valid scientific process as defined by WAC 375-195-900 through 925.

By choosing to update the City's Critical Areas Ordinance with the Best Available Science review, the City will comply with the state GMA mandate. Furthermore, the City will comply with the Comprehensive Plan Environmental Chapter goal ENV-3.8 which states: ***Consider and incorporate BAS, consistent with the GMA and applicable rules, in developing regulations for fish and wildlife habitat areas, wetlands, and other critical areas.***

In July of 2003, the City of Woodinville hired Adolfson and Associates to begin the background scientific research required by the GMA BAS mandate. A Citizen advisory panel (which included property owners, business persons and concerned citizens) was also established to promote public comment on the issues. After many months of public meetings and review of the research, specific recommendations for critical areas protection were defined. There were many views and comments, but the hard science indicated that critical areas need a high level of protection, especially those areas that contain endangered or threatened species (the law requires these areas to be given "special consideration").

During the study sessions one of the major considerations for urban areas was the issue of density and growth versus environmental protection. In other words, while the science shows that larger buffer widths are needed to protect wildlife habitat and water quality, urban areas are also required by the GMA to accommodate density and economic growth within their urban growth boundaries (UGB's). To analyze this issue appropriately, a balancing of these two criterions had to be taken into consideration.

To date, Woodinville has achieved the density goals established by the buildable lands criteria. The City has also been involved in joint partnership ventures to provide affordable housing for its citizens (such as the Green Brier project and the future Transit Oriented Housing Development (TOHD)). Presently, the City's Downtown Little Bear Creek Corridor Master Plan is being developed to accommodate for future growth and housing needs by implementing a mixed use commercial retail/ housing component.

The City, according to GMA, also has the responsibility to protect its natural resources. The City of Woodinville with its commendable leadership has gone to great lengths to implement protective measures for fish and wildlife. In 1999 the Federal government through the Endangered Species Act listed Puget Sound Chinook salmon as a threatened species. At that time, the leaders of this community decided to take a proactive approach and become involved in regional efforts to protect salmon and their habitat (see above list of activities and programs that the City has participated in recent years to protect salmon and other wildlife habitat). This approach helps to counter balance the impact of urban growth and development.

It became apparent during the study sessions for the code update, that the most controversial issues were buffer widths for streams and wetlands (due to the probability of constraining more property).

It was recommended that the Stream section be revised as a result of the Best Available Science review for streams and riparian areas. Note that higher preference was given to science and research conducted in the Pacific Northwest versus research from other areas in the United States (it should also be noted that there are limited number of published scientific studies in the Pacific Northwest which examine stream and riparian functions in urban environments).

It was also recommended that the stream classification be changed from *Class* to *Type* so that it is more aligned with the State classification system. Type 1 streams are identified as "Shorelines of the State" and include rivers and creeks that support significant anadromous salmonid use. Type 2 streams are those that have perennial or intermittent flow and are used by salmonids, and Type 3 and Type 4 are identified as streams that have other types of fish use or that are not used by fish.

The science reveals that riparian areas play a significant role in the protection of the functions of adjacent aquatic habitats. Elements necessary for healthy salmonid populations and for other aquatic organisms rely on processes sustained by the dynamic interaction between the stream and the adjacent riparian area. Furthermore, riparian buffers along stream banks help mitigate the impacts of urbanization and disturbance on adjacent lands. (One important point to remember is that effective buffer widths are variable, depending on their function. In other words, some science shows that smaller buffers are sufficient for protection of some functions, where larger buffers are required to protect other functions.) According to the Science Technical Memos (Exhibit 7), buffers of 100 to 150 feet wide provide most (on the order of 80 percent) of the potential functions.

It was recommended by Staff that the standard buffer width for a Type 1 stream have a 150 foot buffer with a reduction of 35 feet with enhancement (115 ft. buffer). A 115 ft. buffer provides woody debris recruitment for habitat, along with other valuable buffer

functions. This rational was derived from balancing science and economics in accordance with the State Growth Management Act (cities are required by GMA to accommodate growth and population densities in the Urban Growth Boundaries, and also protect their natural resources). These proposed changes are minimal when compared with the existing code. A larger standard buffer with the opportunity to reduce it, in exchange for enhancement is a win – win situation for the developer, land owner and environment. Standard buffer widths for Type 2 through Type 4 were also recommended with established criteria. A definition and criteria for "Urban streams" is a new recommendation that further establishes reduction of buffer widths (with enhancement), when dealing with urban streams that are piped, degraded, channelized and have a high degree of sedimentation.

The Planning Commission concurred with the new changes to the stream buffer widths with the exception of Type 1 streams. The standard buffer would be changed to 150 foot but reduced to 100 foot (when developed) with enhancement. Furthermore, Little Bear Creek was struck from a Type 1 stream to a Type 2 classification, which has a standard buffer width of 115 feet with a 15 foot reduction in exchange for enhancement. The Planning Commission derived at this conclusion given the economic and land constraints that are already imposed on the landowner/developer. On the other hand, this approach may be discerning to developers that may decide that an extra 15 feet of land use is not worth the cost of enhancement (therefore, no enhancement along LBC riparian corridor). Little Bear Creek was also exempted from the urban stream definition, which allows streams that are piped, degraded and channelized to have a buffer reduction of 50 feet. Buffer width averaging in riparian corridors was retained to allow more flexibility in land use development. It should be noted here that buffer averaging is not supported by BAS. Buffer averaging may result in function loss for some particular functions such as water quality, sedimentation, water temperature, wildlife and healthy benthic communities.

As for wetlands, staff proposes a similar approach which establishes standard buffer widths for Class 1 wetlands at 150 feet, with a buffer reduction of 50 feet with enhancement (100 ft. buffer). This strategy when applied, replaces the City's existing degraded buffers with healthier restored and enhanced habitat for both fish and wildlife. Class 2 and 3 wetland buffers are established with criteria and may also be reduced with enhancement. Buffer averaging is allowed as an alternative to this method, but only one method may be implemented. The new recommended code revision establishes new wetland mitigation requirements – for lost functions and values, type and location, timing, monitoring and maintenance. Mitigation replacement ratios have increased for a Class 1wetland from a 2:1 ratio to a 4:1 ratio. These replacement ratios are more aligned with the current State guidelines.

These recommendations are primarily based on the Best Available Science studies and the balancing of other GMA goals and policies. Comments on the Wetland section of the draft ordinance were received from the Department of Ecology (DOE) on September 10, 2004 (Exhibit 20). The overall view from DOE is that Woodinville's draft CAO does not adequately include BAS and will not protect wetland functions and values. Please note, that the DOE review is strictly scientific and does not take into consideration other GMA goals, such as density and economic requirements. Staff recommends that the Planning Commission carefully consider the DOE review.

CONCLUSION AND PREFERED ALTERNATIVE:

In conclusion, the Planning Commission has reviewed and concurred with the recommended code changes for the new and updated definition section, Critical Aquifer Recharge Areas, Geological Hazard Areas, Fish and Wildlife Conservation Areas and Wetlands.

Staff and the Planning Commission differ on the recommended buffer widths for streams. The staff recommendations are based primarily on the Best Available Science studies and the balancing of other GMA goals and policies. The preferred alternative for staff includes the recommendation of larger standard buffer widths of 150 feet with a reduction of 35 feet (when developed) in exchange for enhancement to the stream buffers. Staff also recommends that Little Bear Creek be classified as a Type 1 stream.

The Planning Commission concurred with the new standard buffer widths of 150 feet but recommends a reduction of 50 feet (when developed) with enhancement. Furthermore, Little Bear Creek was struck from a Type 1 stream to a Type 2 classification. Little Bear Creek was also exempted from the urban stream definition, which allows streams that are piped, degraded and channelized to have a buffer reduction of 50 feet.

RECOMMENDED ACTION:

THE PLANNING COMMISSION HOLD A PUBLIC HEARING TO RECEIVE/CONSIDER PUBLIC COMMENT FOR THE UPDATE OF THE CRITICAL AREAS CODE UPDATE BASED ON BAS.

RECOMMENDED MOTIONS:

- **I MOVE TO OPEN THE PUBLIC HEARING ON THE BEST AVAILABLE SCIENCE CRITICAL AREAS ORDINANCE UPDATE (ZCA-2004-079)**
- **I MOVE TO CLOSE THE PUBLIC HEARING ON THE BEST AVAILABLE SCIENCE CRITICAL AREAS ORDINANCE UPDATE (ZCA2004-079)**

[OR]

- **I MOVE TO CONTINUE THE PUBLIC HEARING ON THE BEST AVAILABLE SCIENCE CRITICAL AREAS UPDATE UNTIL 7 PM, SEPTEMBER 29, 2004 IN THE CITY COUNCIL CHAMBERS AT CITY HALL**

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EXHIBITS:

Exhibit 1	Staff Report
Exhibit 2	Best Available Science WAC 365-195900 through 925
Exhibit 3	Citizen Advisory Panel Applications and Credentials
Exhibit 4	Geological Hazard Areas Best Available Science Technical Memorandum
Exhibit 5	Critical Aquifer Recharge Areas Best Available Science Technical Memorandum
Exhibit 6	Wildlife Best Available Science Technical Memorandum
Exhibit 7	Wetlands and Streams Best Available Science Technical Memorandum
Exhibit 8	Woodinville Critical Areas Map
Exhibit 9	Code Gap Analysis
Exhibit 10	Best Available Science Review and Comments from CAP Consultants
Exhibit 11	Planning Commission Recommended Best Available Science New Definitions Section
Exhibit 12	Planning Commission Recommended Best Available Science Code Revision for Aquifer Recharge Areas
Exhibit 13	Planning Commission Recommended Best Available Science Code Revision for Geological Hazard Areas
Exhibit 14	Planning Commission Recommended Best Available Science Code Revision for Fish and Wildlife Conservation Areas
Exhibit 15	Planning Commission Recommended Best Available Science Code Revision for Streams
Exhibit 16	Planning Commission Recommended Best Available Science Code Revision for Wetlands
Exhibit 17	Staff's Recommended Critical Areas Code Revisions to the Planning Commission (Streams)
Exhibit 18	David Evans – Little Bear Creek Assessment July 2002 (Appendix Under separate cover)

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Exhibit 19	Table 1 & 2 – Comparison Table on Stream and Wetland Buffer Widths for Neighboring Jurisdictions and Science Recommended Buffer Widths
Exhibit 20	Department of Ecology Review of the revised CAO and Appendix 8-C Guidance on Widths of Buffers and Ratios for Compensatory Mitigation
Exhibit 21	Woodin Creek Basin Habitat Assessment Final Report, September 2004 (Under separate cover)

State of Washington's Growth Management Act
Procedural Criteria
For Adopting Comprehensive Plans and Development Regulations

PART NINE
BEST AVAILABLE SCIENCE

NEW SECTION

WAC 365-195-900 Background and purpose.

(1) Counties and cities planning under RCW 36.70A.040 are subject to continuing review and evaluation of their comprehensive land use plan and development regulations. Every five years they must take action to review and revise their plans and regulations, if needed, to ensure they comply with the requirements of the Growth Management Act. RCW 36.70A.~~245~~.130

(2) Counties and cities must include the "best available science" when developing policies and development regulations to protect the functions and values of critical areas and must give "special consideration" to conservation or protection measures necessary to preserve or enhance anadromous fisheries. RCW 36.70A.172(1). The rules in WAC 365-195-900 through 365-195-925 are intended to assist counties and cities in identifying and including the best available science in newly adopted polices and regulations and in this periodic review and evaluation and in demonstrating they have met their statutory obligations under RCW 36.70A.172 (1).

(3) The inclusion of the best available science in the development of critical areas policies and regulations is especially important to salmon recovery efforts, and to other decision-making affecting threatened or endangered species.

(4) These rules are adopted under the authority of RCW 36.70A.190 (4)(b) which requires the department of community, trade and economic development (department) to adopt rules to assist counties and cities to comply with the goals and requirements of the Growth Management Act.

NEW SECTION

WAC 365-195-905 Criteria for determining which information is the best available science.

(1) This section provides assessment criteria to assist counties and cities in determining whether information obtained during development of critical areas policies and regulations constitutes the "best available science."

(2) Counties and cities may use information that local, state or federal natural resource agencies have determined represents the best available science consistent with criteria set out in

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WAC 365-195-900 through WAC 365-195-925. The department will make available a list of resources that state agencies have identified as meeting the criteria for best available science pursuant to this chapter. Such information should be reviewed for local applicability.

(3) The responsibility for including the best available science in the development and implementation of critical areas policies or regulations rests with the legislative authority of the county or city. However, when feasible, counties and cities should consult with a qualified scientific expert or team of qualified scientific experts to identify scientific information, determine the best available science, and assess its applicability to the relevant critical areas. The scientific expert or experts may rely on their professional judgment based on experience and training, but they should use the criteria set out in WAC 365-195-900 through 365-195-925 and any technical guidance provided by the department. Use of these criteria also should guide counties and cities that lack the assistance of a qualified expert or experts, but these criteria are not intended to be a substitute for an assessment and recommendation by a qualified scientific expert or team of experts.

(4) Whether a person is a qualified scientific expert with expertise appropriate to the relevant critical areas is determined by the person's professional credentials and/or certification, any advanced degrees earned in the pertinent scientific discipline from a recognized university; the number of years of experience in the pertinent scientific discipline, recognized leadership in the discipline of interest, formal training in the specific area of expertise, and field and/or laboratory experience with evidence of the ability to produce peer-reviewed publications or other professional literature. No one factor is determinative in deciding whether a person is a qualified scientific expert. Where pertinent scientific information implicates multiple scientific disciplines, counties and cities are encouraged to consult a team of qualified scientific experts representing the various disciplines to ensure the identification and inclusion of the best available science.

(5) Scientific information can be produced only through a valid scientific process. To ensure that the best available science is being included, a county or city should consider the following:(a) *Characteristics of a valid scientific process.* In the context of critical areas protection, a valid scientific process is one that produces reliable information useful in understanding the consequences of a local government's regulatory decisions and in developing critical areas policies and development regulations that will be effective in protecting the functions and values of critical areas. To determine whether information received during the public participation process is reliable scientific information, a county or city should determine whether the source of the information displays the characteristics of a valid scientific process are as follows:

1. Peer review. The information has been critically reviewed by other persons who are qualified scientific experts in that scientific discipline. The criticism of the peer reviewers has been addressed by the proponents of the information. Publication in a refereed scientific journal usually indicates that the information has been appropriately peer-reviewed.

2. Methods. The methods that were used to obtain the information are clearly stated and able to be replicated. The methods are standardized in the pertinent scientific discipline or, if not, the methods have been appropriately peer-reviewed to assure their reliability and validity.

3. Logical conclusions and reasonable inferences. The conclusions presented are based on reasonable assumptions supported by other studies and consistent with the general theory underlying the assumptions. The conclusions are logically and reasonably derived from the assumptions and supported by the data presented. Any gaps in information and inconsistencies with other pertinent scientific information are adequately explained.

4. Quantitative analysis. The data have been analyzed using appropriate statistical or quantitative methods.

5. Context. The information is placed in proper context. The assumptions, analytical techniques, data, and conclusions are appropriately framed with respect to the prevailing body of pertinent scientific knowledge.

6. References. The assumptions, analytical techniques, and conclusions are well referenced with citations to relevant, credible literature and other pertinent existing information.

(b) *Common sources of scientific information.* Some sources of information routinely exhibit all or some of the characteristics listed in (a) of this subsection. Information derived from one of these sources may be considered scientific information if the source possesses the characteristics listed in Table 1. A county or city may consider information to be scientifically valid if the source possesses the characteristics listed in (a) of this subsection. The information found in Table 1 provides a general indication of the characteristics of a valid scientific process typically associated with common sources of scientific information.

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Table 1

SOURCES OF SCIENTIFIC INFORMATION	CHARACTERISTICS					
	Peer Review	Methods	Logical conclusions & reasonable inferences	Quantitative analysis	Context	References
A. Research. Research data collected and analyzed as part of a controlled experiment (or other appropriate methodology) to test a specific hypothesis.	x	x	x	x	x	x
B. Monitoring. Monitoring data collected periodically over time to determine a resource trend or evaluate a management program.		x	x	y	x	x
C. Inventory. Inventory data collected from an entire population or population segment (e.g., individuals in a plant or animal species) or an entire ecosystem or ecosystem segment (e.g., the species in a particular wetland).		x	x	y	x	x
D. Survey. Survey data collected from a statistical sample from a population or ecosystem.		x	x	y	x	x
E. Modeling. Mathematical or symbolic simulation or representation of a natural system. Models generally are used to understand and explain occurrences that cannot be directly observed.	x	x	x	x	x	x
F. Assessment. Inspection and evaluation of site-specific information by a qualified scientific expert. An assessment may or may not involve collection of new data.		x	x		x	x
G. Synthesis. A comprehensive review and explanation of pertinent literature and other relevant existing knowledge by a qualified scientific expert.	x	x	x		x	x
H. Expert Opinion. Statement of a qualified scientific expert based on his or her best professional judgment and experience in the pertinent scientific discipline. The opinion may or may not be based on site-specific information.			x		x	x

x = characteristic must be present for information derived to be considered scientifically valid and reliable

y = presence of characteristic strengthens scientific validity and reliability of information derived, but is not essential to ensure scientific validity and reliability

(c) *Common sources of nonscientific information.* Many sources of information usually do not produce scientific information because they do not exhibit the necessary characteristics for scientific validity and reliability. Nonscientific information may provide valuable information to supplement scientific information, but it is not an adequate substitute for scientific information. Nonscientific information should not be used as a substitute for valid and available scientific information. Common sources of nonscientific information include the following:

(i) Anecdotal information. One or more observations which are not part of an organized scientific effort (for example, "I saw a grizzly bear in that area while I was hiking").

(ii) Non-expert opinion. Opinion of a person who is not a qualified scientific expert in a pertinent scientific discipline (for example, "I do not believe there are grizzly bears in that area").

(iii) Hearsay. Information repeated from communication with others (for example, "At a lecture last week, Dr. Smith said their were no grizzly bears in that area").

(6) Counties and cities are encouraged to monitor and evaluate their efforts in critical areas protection and to update critical area ordinances, to include new scientific information as it becomes available.

NEW SECTION

WAC 365-195-910 Criteria for obtaining the best available science.

(1) Consultation with state and federal natural resource agencies and tribes can provide a quick and cost-effective way to develop scientific information and recommendations. State natural resource agencies provide numerous guidance documents and model ordinances that incorporate the agencies' assessments of the best available science. The department can provide technical assistance in obtaining such information from state natural resources agencies, developing model GMA-compliant critical areas policies and development regulations, and related subjects. The department will make available to interested parties a current list of the best available science determined to be consistent with criteria set out in WAC 365-195-905 as identified by state or federal natural resource agencies for critical areas.

(2) A county or city may compile scientific information through its own efforts, with or without the assistance of qualified experts, and through state agency review and the Growth Management Act's required public participation process. The county or city should assess whether the scientific information it compiles constitutes the best available science applicable to the critical areas to be protected, using the criteria set out in WAC 365-195-900 through 365-195-925 and any technical guidance provided by the department. If not, the county or city should identify and assemble additional scientific information to ensure it has included the best available science.

NEW SECTION

WAC 365-195-915 Criteria for including the best available science in developing policies and development regulations.

(1) To demonstrate that the best available science has been included in the development of critical areas policies and regulations, counties and cities should address each of the following on the record:

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(a) The specific policies and development regulations adopted to protect the functions and values of the critical areas at issue.

(b) The relevant sources of best available scientific information included in the decision-making.

(c) Any nonscientific information—including legal, social, cultural, economic, and political information—used as a basis for critical area policies and regulations that depart from recommendations derived from the best available science. A county or city departing from science-based recommendations should: (i) identify the information in the record that supports its decision to depart from science-based recommendations; (ii) explain its rationale for departing from science-based recommendations; and (iii) identify potential risks to the functions and values of the critical area or areas at issue and any additional measures chosen to limit such risks. State Environmental Policy Act (SEPA) review often provides an opportunity to establish and publish the record of this assessment.

(2) Counties and cities should include the best available science in determining whether to grant applications for administrative variances and exemptions from generally applicable provisions in policies and development regulations adopted to protect the functions and values of critical areas. Counties and cities should adopt procedures and criteria to ensure that the best available science is included in every review of an application for an administrative variance or exemption.

NEW SECTION

WAC 365-195-920 Criteria for addressing inadequate scientific information.

Where there is an absence of valid scientific information or incomplete scientific information relating to a county's or city's critical areas, leading to uncertainty about which development and land uses could lead to harm of critical areas or uncertainty about the risk to critical area function of permitting development, counties and cities should use the following approach:

(1) A "precautionary or a no risk approach," in which development and land use activities are strictly limited until the uncertainty is sufficiently resolved; and

(2) As an interim approach, an effective adaptive management program that relies on scientific methods to evaluate how well regulatory and non-regulatory actions achieve their objectives. Management, policy, and regulatory actions are treated as experiments that are purposefully monitored and evaluated to determine whether they are effective and, if not, how they should be improved to increase their effectiveness. An adaptive management program is a formal and deliberate scientific approach to taking action and obtaining information in the face of uncertainty. To effectively implement an adaptive management program, counties and cities should be willing to (i) address funding for the research component of the adaptive management

program (ii) change course based on the results and interpretation of new information that resolves uncertainties, and (iii) commit to the appropriate timeframe and scale necessary to reliably evaluate regulatory and non-regulatory actions affecting critical areas protection and anadromous fisheries.

NEW SECTION

WAC 365-195-925 Criteria for demonstrating "special consideration" has been given to conservation or protection measures necessary to preserve or enhance anadromous fisheries.

(1) RCW 36.70A.172(1) imposes two distinct but related requirements on counties and cities. Counties and cities must include the "best available science" when developing policies and development regulations to protect the functions and values of critical areas, and counties and cities must give "special consideration" to conservation or protection measures necessary to preserve or enhance anadromous fisheries. Local governments should address both requirements in RCW 36.70A.172(1) when developing their records to support their critical areas policies and development regulations.

(2) To demonstrate compliance with RCW 36.70A.172(1), a county or city adopting policies and development regulations to protect critical areas should include in the record evidence that it has given "special consideration" to conservation or protection measures necessary to preserve or enhance anadromous fisheries. The record should be developed using the criteria set out in WAC 365-195-900 through 365-195-925 to ensure that conservation or protection measures necessary to preserve or enhance anadromous fisheries are grounded in the best available science.

(3) Conservation or protection measures necessary to preserve or enhance anadromous fisheries include measures that protect habitat important for all life stages of anadromous fish, including, but not limited to spawning and incubation, juvenile rearing and adult residence, juvenile migration downstream to the sea, and adult migration upstream to spawning areas. Special consideration should be given to habitat protection measures based on the best available science relevant to stream flows, water quality and temperature, spawning substrates, instream structural diversity, migratory access, estuary and nearshore marine habitat quality, and the maintenance of salmon prey species. Conservation or protection measures can include the adoption of interim actions and long-term strategies to protect and enhance fisheries resources.

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AUG - 6 2003
City of Woodinville

WOODINVILLE

CITY OF WOODINVILLE
COMMUNITY SERVICE APPLICATION FOR MEMBERSHIP ON THE
Citizen Advisory Panel for Best Available Science

(Please type or print)

Name	DAVID J. THOMPSON
Home Address	17050-NORTHUP WY. #8 BELLEVUE WA 9800
Home Phone	425-747-3905
Home FAX	—
Home E-Mail	sthomp43@WORLDNET.ATT.NET
Work Address	715 LIND AVE. SO. RENTON WA. 98055
Work Phone	425 276 4508
Work E-Mail	dave.thompson@mclendons.com
Work FAX	425-276-4519

PLEASE NOTE: You may attach a resume to this application. Feel free to use the backside of this application if you need more room. Thank you!

Do you reside within the Woodinville City limits? NO Length of residence _____

1. List your educational background. (This position does not require you to have any special educational background.)
   1-12 GRADES & 1½ YRS COLLEGE

2. Please state your occupational background, beginning with your current occupation and employer, volunteer position or home occupation. (You do not have to be employed to be considered.)
   McLENDON HDWE 1970 - Present
   KALE RADIO / STERLING RECREATIONAL ORG 1969-70
   McLENDON HDWE 1963-1969
   BOEING 1961-1963

3. Describe your involvement in the Woodinville community.
FAMILY OWNS McLEAN HOME AND WAS MANAGER OF WOODINVILLE LOCATION FOR 10 YRS.

4. Describe your leadership roles and/or any special expertise you have which you would bring to the Citizen Advisory Panel.
- COMPANY BOARD MEMBER
- MANAGED A RETAIL OPERATION THAT WENT FROM $0 to 6.5 MILLION IN 10 YRS.
- PARTICIPATED AND LEAD VARIOUS COMMITTEES IN SCOUTING.

5. Describe why you are interested in serving in this position.
DUTY – COMMUNITY AND OUR BUSINESS

Appointment to the Citizen Advisory Panel will require your consistent attendance at regularly scheduled meetings.
Are you available for evening meetings? ✓ Daytime meetings? ✓

****

DUE DATE: FRIDAY, AUGUST 8TH, 2003, 5:00 PM
To be considered, please return this application to:
Debra Crawford, Planning Technician
Community Development Department
City of Woodinville
17301 – 133rd Avenue NE
Woodinville, WA 98072

For further information, please call Debra Crawford at 425-489-2757, extension 2221
Thank you for taking the time to fill out this application. Volunteers play a vital role in the Woodinville government. We appreciate your interest!

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AUG 2 7 2006
City of Woodinville

CITY OF WOODINVILLE
PLANNING DEPARTMENT

WOODINVILLE

CITY OF WOODINVILLE
COMMUNITY SERVICE APPLICATION
FOR MEMBERSHIP ON THE
Citizen Advisory Panel for Best Available Science

(Please type or print)

Name	Jeff Smith
Home Address	12820 130th Kirkland
Home Phone	206-979-7998
Home FAX	
Home E-Mail	
Work Address	13632 NE 177th Pl Woodinville
Work Phone	425-402-8200
Work E-Mail	jeffsmith@check-ride.com
Work FAX	425-481-3177

PLEASE NOTE: You may attach a resume to this application. Feel free to use the backside of this application if you need more room. Thank you!

Do you reside within the Woodinville City limits? no Length of residence _____

1. List your educational background. (This position does not require you to have any special educational background.)

   1-12 Grades, 3 Years college

2. Please state your occupational background, beginning with your current occupation and employer, volunteer position or home occupation. (You do not have to be employed to be considered.)

   Check Ride Driver Training Services
   1986 - Present

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3. Describe your involvement in the Woodinville community.

Business and property owner for 10 years

4. Describe your leadership roles and/or any special expertise you have which you would bring to the Citizen Advisory Panel.

Chair, for the Little Bear Creek Property owner's group.
Have attended C.P. and PC meeting in the past,
Am familiar with land use regulations, ESA, SEPA, SMA etc.

5. Describe why you are interested in serving in this position.

Its very important effected property owners have a "voice" in the process and understand the science behind of the LBC assessment etc.

Appointment to the Citizen Advisory Panel will require your consistent attendance at regularly scheduled meetings.
Are you available for evening meetings? Yes Daytime meetings? Yes

****

DUE DATE: FRIDAY, AUGUST 8TH, 2003, 5:00 PM

To be considered, please return this application to:

Debra Crawford, Planning Technician
Community Development Department
City of Woodinville
17301 – 133rd Avenue NE
Woodinville, WA 98072

For further information, please call Debra Crawford at 425-489-2757, extension 2221
Thank you for taking the time to fill out this application. Volunteers play a vital role in the Woodinville government. We appreciate your interest!

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CITY OF WOODINVILLE
COMMUNITY SERVICE APPLICATION
FOR MEMBERSHIP ON THE
Citizen Advisory Panel for Best Available Science

(Please type or print)

Name	Donna D. Scott
Home Address	17300 135 AVE NE #204
Home Phone	425.483.6012
Home FAX	—
Home E-Mail	LaContessa27 @hotmail.com
Work Address	—
Work Phone	—
Work E-Mail	—
Work FAX	—

PLEASE NOTE: You may attach a resume to this application. Feel free to use the backside of this application if you need more room. Thank you!

Do you reside within the Woodinville City limits? yes Length of residence 13 yrs

1. List your educational background. (This position does not require you to have any special educational background.)

   B.A. Education
   M.A. Reading

2. Please state your occupational background, beginning with your current occupation and employer, volunteer position or home occupation. (You do not have to be employed to be considered.)

   Teacher
   Travel Consultant
   Retired

3. Describe your involvement in the Woodinville community.

I am citizen concerned with the future development of Woodinville

4. Describe your leadership roles and/or any special expertise you have which you would bring to the Citizen Advisory Panel.

I am a member of the board of directors of Canterbury Square Criers Assoc.

5. Describe why you are interested in serving in this position.

I'm concerned about Wodin Creek and its future.

Appointment to the Citizen Advisory Panel will require your consistent attendance at regularly scheduled meetings.

Are you available for evening meetings? yes Daytime meetings? yes

****

DUE DATE: FRIDAY, AUGUST 8TH, 2003, 5:00 PM

To be considered, please return this application to:

Debra Crawford, Planning Technician
Community Development Department
City of Woodinville
17301 – 133rd Avenue NE
Woodinville, WA 98072

For further information, please call Debra Crawford at 425-489-2757, extension 2221
Thank you for taking the time to fill out this application. Volunteers play a vital role in the Woodinville government. We appreciate your interest!

due aug. 8, 200

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CITY OF WOODINVILLE
COMMUNITY SERVICE APPLICATION FOR MEMBERSHIP ON THE
Citizen Advisory Panel for Best Available Science

(Please type or print)

Name	Paulette Himmelspach-Bauman
Home Address	17022 NE 185th Street
Home Phone	425-483-2867
Home FAX	
Home E-Mail	baumanps@aol.com
Work Address	
Work Phone	
Work E-Mail	
Work FAX	

PLEASE NOTE: You may attach a resume to this application. Feel free to use the backside of this application if you need more room. Thank you!

Do you reside within the Woodinville City limits? Yes Length of residence 31 years

1. List your educational background. (This position does not require you to have any special educational background.)
   Bachelor of Arts Political Science, University of Wa
   HS graduate, Blanchet High School, Seattle Wa.

2. Please state your occupational background, beginning with your current occupation and employer, volunteer position or home occupation. (You do not have to be employed to be considered.)
   Currently at-home occupation, volunteer concierge at the City of Woodinville, Wellington Elementary PTA Secretary, vocalist and pianist at St. Jude in Redmond, Wa., Grants Chairperson for Wellington Elementary PTA.
   See resume' for occupational background.

3. Describe your involvement in the Woodinville community.

My children attend Wellington Elementary where I volunteer a great deal of my time with the PTA, as well as in the classroom. I am involved with the Woodinville Little League program and volunteer my time as a T-Ball coach.

4. Describe your leadership roles and/or any special expertise you have which you would bring to the Citizen Advisory Panel.

My background in sales, customer service, managerial roles and my political science education provide me with a blend of experience that allows me to serve the CAP. I am comfortable speaking publicly, as well as working with others. I am also very self-motivated and take the initiative often

5. Describe why you are interested in serving in this position.

I have lived in Woodinville for 3 yrs and my children attend school here. I want to be actively involved in my community. I believe in serving others. I want to be a representative and spokesperson for my community by representing their needs & concerns.

Appointment to the Citizen Advisory Panel will require your consistent attendance at regularly scheduled meetings.

Are you available for evening meetings? Yes Daytime meetings? Yes

****

DUE DATE: FRIDAY, AUGUST 8TH, 2003, 5:00 PM

To be considered, please return this application to:

Debra Crawford, Planning Technician
Community Development Department
City of Woodinville
17301 – 133rd Avenue NE
Woodinville, WA 98072

For further information, please call Debra Crawford at 425-489-2757, extension 2221
Thank you for taking the time to fill out this application. Volunteers play a vital role in the Woodinville government. We appreciate your interest!

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Paulette Himmelspach-Bauman
17022 Northeast 185th Street
Woodinville, WA 98072
Home 425-483-2867
Cellular 206-953-5498
baumanps@aol.com

OBJECTIVE

To serve and represent Woodinville

EDUCATION

B.A., Political Science, 1991
University of Washington, Seattle, Washington
Emphasis in American Government and International Relations
Internship: Washington State House of Representatives, Legislative Session 1990
Language Studies: Japanese

ACHIEVEMENTS

- Miss Washington Top Ten Finalist 1992
- Foundation Brunneria Stipend for International Political Study 1989-1990
- Researched and Co-author of "U.S.S.R.: Glasnost and Petro-Politik 1989
- Alpha Delta Pi National Sorority
- Miss Northshore Seafair Princess 1987
- High School Honor Student
- Exchange to Kobe, Japan 1983

VOLUNTEER WORK/COMMUNITY SERVICE

Woodinville City Hall, Woodinville, WA
Volunteer Concierge, 2003 - Present

Wellington Elementary PTA, Woodinville, WA
Secretary-Executive Board, 2003 - Present

Wellington Elementary, Woodinville, WA
Parent Volunteer , 1999 - Present

St. Jude's Gospel Choir, Redmond, WA
Music Ministry, 1999 - Present

St. Jude's Church, Redmond, WA
Nursery Care, 1999 - 2001

Northshore YMCA, Bothell, WA
Nursery Care, 1997 - 2000

EMPLOYMENT HISTORY

Evergreen Equine Veterinary Practice, Snohomish, WA
Office Manager, 2000 - 2002

Western Washington Beverage, Seattle, WA
Outside Sales Representative, 1996 - 1997

K & L Classic Wine Company, Bellevue, WA
Merchandiser/Sales Representative, 1996 - 1996

Nabisco Biscuit Company, Kent, WA
Outside Sales Representative, 1993 - 1996

Albertson's Retail Grocer, Woodinville, Monroe, Lake Forest Park, Everett, WA
Grocery Manager, Customer Service Supervisor, Cashier, Helper and Courtesy Clerk, 1983 - 1993

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AUG 08 2003

CITY OF WOODINVILLE
PLANNING DEPARTMENT

CITY OF WOODINVILLE
COMMUNITY SERVICE APPLICATION FOR MEMBERSHIP ON THE
Citizen Advisory Panel for Best Available Science

(Please type or print)

Name	PAUL SZEWCZYKOWSKI
Home Address	18826 144TH AVE. NE, WOODINVILLE 98072
Home Phone	425-481-7839
Home FAX	
Home E-Mail	
Work Address	12100 NE 195TH ST. SUITE 100 BOTHELL 98011
Work Phone	425-951-5324
Work E-Mail	pszewa@RH2.COM
Work FAX	425-951-5325

PLEASE NOTE: You may attach a resume to this application. Feel free to use the backside of this application if you need more room. Thank you!

Do you reside within the Woodinville City limits? YES Length of residence 1 YEAR

1. List your educational background. (This position does not require you to have any special educational background.)

   B.S. - BIOLOGY
   M.S. - NATURAL RESOURCES MGT.

2. Please state your occupational background, beginning with your current occupation and employer, volunteer position or home occupation. (You do not have to be employed to be considered.)

   CURRENT: SCIENTIST
   RH2 ENGINEERING
   (REFER TO RESUME)

3. Describe your involvement in the Woodinville community.

— ACTIVE WITH LITTLE BEAR CREEK RESTORATION
— ACTIVE WITH BRIGHTWATER ISSUES

4. Describe your leadership roles and/or any special expertise you have which you would bring to the Citizen Advisory Panel.

EXPERTISE IN FISHERIES SCIENCE, WETLANDS, WATER QUALITY, ESA, ENVIRONMENTAL REGULATIONS. PREVIOUS EXPERIENCE ON ADVISORY BOARDS, WATERSHED MGT. COMMITTEES, CITIZEN ADVISORY BOARDS. SEE RESUME

5. Describe why you are interested in serving in this position.

I LOVE WOODINVILLE, PLAN TO LIVE HERE ALONG TIME & WANT TO DO MY PART TO ASSIST THIS COMMUNITY TO MAINTAIN A HIGH QUALITY OF LIFE + ENVIRONMENT.

Appointment to the Citizen Advisory Panel will require your consistent attendance at regularly scheduled meetings.
Are you available for evening meetings? SOME Daytime meetings? YES

****

DUE DATE: FRIDAY, AUGUST 8TH, 2003, 5:00 PM
To be considered, please return this application to:

Debra Crawford, Planning Technician
Community Development Department
City of Woodinville
17301 – 133rd Avenue NE
Woodinville, WA 98072

For further information, please call Debra Crawford at 425-489-2757, extension 2221
Thank you for taking the time to fill out this application. Volunteers play a vital role in the Woodinville government. We appreciate your interest!

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PAUL SZEWCZYKOWSKI

WATERSHED SCIENTIST/REGULATORY FACILITATION

County. RH2 conducted stream and wetland assessments and prepared a Biological Assessment and Habitat Management Plan for the project. RH2 is facilitating permitting compliance with the Washington Department of Fish and Wildlife, the U.S. Army Corps of Engineers, NOAA Fisheries, the U.S. Fish and Wildlife Service and Snohomish County.

Temporary Erosion and Sediment Control Inspection and Compliance, 2002-2003

Client: City of Issaquah, Master Development Review Team. Extensive housing and commercial development is on-going in the Issaquah Highlands and Talus Master Developments. RH2 Engineering is providing continuous erosion control inspection and water quality monitoring to protect streams and salmonid resources in the Issaquah Creek and Tibbetts Creek watersheds.

Lake Chelan Wastewater System Improvements, Biological Assessment, 2002

Client: Lake Chelan Reclamation District. RH2 Engineering is assisting the Lake Chelan Reclamation District in designing upgrades to five sewage lift stations and nine miles of transmission main located directly adjacent to Lake Chelan. RH2 conducted a survey of wetlands, streams, regulated shorelines and steep slopes in the project area. RH2 prepared a Biological Assessment and facilitated permitting with the Washington Department of Fish and Wildlife, the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, the City of Chelan and U.S. Army Corps of Engineers.

Best Management Practices Framework/Environmental Protection, 2002-2003

Client: Northeast Sammamish Sewer and Water District. RH2 Engineering developed a Best Management Practices (BMP's) framework to avoid or reduce impacts to water quality, streams, wetlands and sensitive species from the operation and maintenance of municipal sewer and water facilities.

Municipal Water Supply, ESA Compliance and Grant Facilitation, 2002

Client: City of Stanwood. This project involved reconstruction of the City's primary well, which is located adjacent to Church Creek. RH2 prepared a Biological Assessment and facilitated SEPA, HPA, Community Development Block Grant and NEPA compliance.

Cottage Avenue Biological Assessment, 2001-2002

Client: City of Cashmere. This project involved reconstruction of 1,750 lineal feet of roadway in proximity to the Wenatchee River. RH2 prepared a Biological Assessment and facilitated ESA, SEPA and NEPA regulatory compliance with WSDOT, NMFS, USFWS and WDFW.

Peshastin Creek Irrigation Diversion Dam Fish Passage, 2000-2003

Client: Chelan County Planning Department. This project is addressing an irrigation diversion dam in Peshastin Creek, a tributary to the Wenatchee River. The dam is obstructing passage to ESA listed spring chinook salmon (endangered), summer steelhead (endangered) and bull trout (threatened). RH2 Engineering developed alternative fish passage concepts and facilitated a project approach, funding and permitting issues with adjacent land owners, the Salmon Recovery Funding Board, the Washington Department of Fish and Wildlife, the National Marine Fisheries Service, the U.S. Bureau of

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Watershed Scientist/Regulatory Facilitation

PAUL SZEWCZYKOWSKI

WATERSHED SCIENTIST/REGULATORY FACILITATION

Mr. Szewczykowski has over 16 years of diverse experience and manages scientific assessments and regulatory compliance for municipal engineering and watershed projects in western and central Washington State. Paul is highly effective at agency coordination, permitting facilitation and mitigation negotiation. His professional experience includes work with surface water and groundwater quality; municipal water supply; instream flow; fisheries biology; environmental chemistry; wetlands science; riverine ecology; water rights; flood control; hazardous materials; marine science; wellhead protection; lake diagnostics; treaty rights; and regulatory compliance. Previously, Paul represented the interests of the Muckleshoot Indian Tribe on watershed management and salmon restoration issues throughout the Puget Sound Region.

REPRESENTATIVE PROJECT EXPERIENCE

Bear/Evans Creek Basin, Watershed Management, 2002-2003

Client: Northeast Sammamish Sewer and Water District and Union Hill Water Association. This comprehensive program involves conducting water quality, instream flow, groundwater, wetlands and salmon habitat assessments throughout the Bear/Evans Creek Basin, a sub-basin to the Sammamish River. Working in cooperation with King County, data from these assessments are being used to develop an Ecosystem Diagnosis and Treatment (EDT) model for the Basin. The project goal is to develop a water resources management plan to balance municipal groundwater supply and salmon resources protection.

Columbia River, Biological and Essential Fish Habitat Assessments, 2002-2003

Client: City of East Wenatchee and Washington Department of Transportation. RH2 conducted all environmental permitting for this major roadway and stormwater conveyance improvement project. The project is directly adjacent to the Rock Island Reservoir of the Columbia River. RH2 assessed potential impacts to federally listed species including Upper Columbia River Spring Chinook, Upper Columbia River Steelhead, bull trout, bald eagle and Ute ladies'-tresses. To comply with the requirements of the Magnuson-Stevens Fishery Conservation and Management Act, an Essential Fish Habitat (EFH) analysis was conducted for the Pacific Salmon Fishery.

Municipal Water Transmission Main, Permitting Compliance, 2002-2003

Client: City of Marysville. RH2 Engineering designed a replacement 16-inch water main for the City of Marysville. The water main will be installed adjacent to wetlands and ESA regulated streams in Snohomish

Education

M.S. Natural Resources Mgmt.
University of Wisconsin, 1988

B.S. Aquatic Biology and Water Chemistry
University of Wisconsin, 1983

Affiliations

2001-2004 - Advisory Board, Regional Fisheries Enhancement Group Program, Appointment by Director of WDFW

2003 - Member, American Fisheries Society

2003 - Environmental and Land Use Section, Washington State Bar Association

1998-2000 - Board of Directors, Washington State Lake Protection Association

1995-1996 - Co-Chairman, Water Task Force, Covington Water District

1992-1995 - MIT Representative, Cedar River Watershed Management Committee

1992-1995 - MIT Representative, Issaquah Creek Watershed Management Committee

1993-1995 - MIT Representative, North and Swamp Creek Watershed Management Committees

1992-1994 - MIT Representative, East Lake Sammamish Basin Plan Watershed Management Committee

1994-1995 - MIT Representative, Lower Puyallup Watershed Management Committee

Specialized Training

Endangered Species Act Compliance and Biological Assessments

Wetlands Delineation Certification

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PAUL SZEWCZYKOWSKI

WATERSHED SCIENTIST/REGULATORY FACILITATION

Reclamation, the Washington Department of Ecology, the U.S. Army Corps of Engineers and Chelan County.

Groundwater Studies and Wellhead Protection Program, 1997-2003

Client: City of Bonney Lake. RH2 Engineering has assisted the City with developing and implementing a proactive and ongoing wellhead protection program. The program elements included contaminant source inventories; groundwater and springs water quality monitoring; water table mapping; public outreach; wellhead protection ordinance development; and GIS mapping. RH2 prepared CCWF and SRF loan applications and secured project funding.

Feasibility Study, Lake Washington Potable Water Supply Study, 1995-2002

Client: Shoreline Water District. RH2 Engineering conducted water quality testing, fisheries and environmental impacts assessments, and limnological studies of Lake Washington. RH2 coordinated with and solicited comments from local, state and federal agencies and the Muckleshoot Indian Tribe.

Flood Control Program and Habitat Mitigation, 1996-1999

Client: City of Issaquah. RH2 Engineering developed a flood control program and conducted salmonid habitat, wetlands and riparian vegetation inventories. RH2 facilitated habitat mitigation for the project and coordinated local, state and federal permitting. RH2 prepared FEMA grant applications and secured project funding.

Permitting and Mitigation, Cedar River Utility Crossing, 1997-1999

Client: City of Renton and King County. RH2 Engineering designed a joint sewer and water utility upgrade project. The utilities crossed under the Cedar River and required temporary damming and excavation of the river bed. RH2 conducted all environmental permitting including SEPA; Corps of Engineers Section 404 and 10; DNR Aquatic Bedlands; WDFW HPA; County Shoreline; County SAO; and the Department of Ecology's Water Quality Certification. RH2 facilitated mitigation elements with agencies and the Muckleshoot Indian Tribe. RH2 designed a salmon spawning channel and wetland enhancements as mitigation.

Hydraulic Continuity Assessment, Cedar River, 1996-2003

Client: City of Renton. RH2 Engineering is conducting a comprehensive wellfield and in-stream water quality and quantity monitoring program to evaluate hydraulic continuity and wellfield impacts on in-stream flows.

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WOODINVILLE CRITICAL AREAS UPDATE
GEOLOGICALLY HAZARDOUS AREAS

1.0 INTRODUCTION

This inventory of Woodinville's geologically hazardous areas has been prepared to support an update of policies and regulations for the management of critical areas in the City. Washington's Growth Management Act defines geologically hazardous areas as critical areas. Geologically hazardous areas include areas susceptible to erosion, landsliding, earthquake, or other geological events (WAC 365-190). Specifically, the code states that areas that are susceptible to one or more of the following types of hazards shall be classified as geologically hazardous areas:

- Steep slopes/landslide hazard areas, including areas potentially susceptible to landslides based on a combination of geologic, topographic, and hydrologic factors.
- Erosion hazard areas, including those areas identified by the U.S. Soil Conservation Service (SCS) (now Natural Resources Conservation Service) as having a "severe" or "very severe" rill and inter-rill erosion hazard.
- Seismic hazard areas, including areas subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement, soil liquefaction, or surface faulting.

Geologic hazards pose a threat to the health and safety of citizens when commercial, residential, or industrial development is inappropriately sited in areas of significant hazard. Some geologic hazards can be reduced or mitigated by engineering, design, or modified construction practices. When technology cannot reduce risks to acceptable levels, building in geologically hazardous areas is best avoided (WAC 365-190).

The City of Woodinville presently regulates development on and near steep and potentially unstable slopes, erosion hazard areas, and seismic hazard areas through Chapter 21.24 of the Municipal Code.

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2.0 METHODOLOGY

Two types of information were used as the basis for this report, a review of existing information and a three-day field reconnaissance. The landslide information presented in this assessment is based on a map review of geologic conditions, topography, and limited geologic field reconnaissance. It is not of sufficient detail to delineate the exact boundaries of landslide hazard areas, nor is it adequately detailed to evaluate relative degrees of risk of landslides. More detailed field reconnaissance and studies would be required to develop this additional level of information.

2.1 Existing Information.

To portray geologic information pertinent to the evaluation of critical areas in Woodinville, existing information was reviewed to assess the type and location of steep slope, erosion-prone, seismic hazard, and landslide hazard areas. Areas with such potential were identified from maps prepared by the U.S. Geological Survey (USGS), the Washington Department of Natural Resources (DNR), and the former U.S. Soil Conservation Service (SCS), as cited below (Section 3.0) and as presented in the reference section.

2.2 Field Reconnaissance.

Based on the review of existing information, several areas within the City of Woodinville were targeted for a field reconnaissance. The main focus of the field reconnaissance was to field check and re-evaluate those areas previously mapped as steep slopes and landslide prone areas, and delineate new landslide hazard areas based on an updated set of criteria. Each of the targeted areas were walked and mapped according to the following definitions of a landslide hazard area (WAC 365-190):

- Areas with a combination of: 1) slopes steeper than fifteen percent, 2) pervious geologic units overlying soil units of lower permeability, and 3) the presence of springs or groundwater seepage.
- Areas that have shown movement during the Holocene Epoch (the past 13,500 years) or are underlain by landslide deposits.
- Slopes parallel or sub-parallel to planes of weakness in subsurface materials.
- Areas of potential instability because of rapid stream incision or stream bank erosion

- Slopes having gradients steeper than eighty percent (80%) subject to rock/earth fall during seismic shaking.
- Areas located on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding.
- Areas with a slope of forty percent (40%) or steeper with a vertical relief of ten (10) or more feet, except those areas composed of consolidated rock. (This was not used in the field, as it is a separate map that can be generated by an analyst with appropriate digital topographic information.) (City of Woodinville GIS, 2003).

Areas with potential for instability were identified from slope, geologic hazard, and geology maps. Within the limited time provided in this study, a geologist visited on foot as many of these areas as possible. Coverage of all of the areas was not possible in the three days scoped for this task; given the dense vegetation and the dissected nature of the topography locally, it would be impossible to discern all of the nuances of the landscape without weeks of field effort. Additionally, some private properties were posted. The field reconnaissance for this study improves the accuracy and reliability of the outline of landslide-prone areas, but does not make it precise. Applications for development in or adjacent to the landslide-prone ground will still need to be screened on a site-specific basis by a qualified geo-professional.

Delineating erosion and seismic areas was not part of the field reconnaissance because those areas are based purely on existing or forthcoming information, including maps from the USGS, SCS and DNR.

3.0 RESULTS

The information in the following section is based upon the information gathered during a review of existing information and the subsequent field reconnaissance. Three maps are included in this report.

- Figure 1 depicts surface geology in Woodinville as derived from the geologic maps of the Kirkland (Minard, 1983), Bothell (Minard, 1985a), and Maltby (Minard, 1985b) Quadrangles; geologic units shown on the map are discussed under General Geology below and referenced in parentheses.
- Figure 2 shows steep slopes and erosion-prone areas, as delineated by the City of Woodinville.
- Figure 3 indicates the areas that are landslide-prone.

4.0 TOPOGRAPHY AND GEOLOGIC CONDITIONS

The City of Woodinville is situated in the east central portion of the Puget Lowland, an elongated topographic and structural depression bordered by the Cascade Mountains on the east and the Olympic Mountains on the west. Glacial drift plains of low rolling relief separated by deeply cut ravine valleys and marine embayments characterize this lowland. The area occupied by the City of Woodinville has a maximum relief of about 510 feet from the Sammamish River valley at approximate elevation 40 feet to the topographic high located near the intersection of N.E. 175th Street and 159th Avenue N.E. at about elevation 550 feet. Ravines and valleys within the City of Woodinville range from roughly 80 to 300 feet deep, including the dissected slope located west of the Woodinville-Redmond Road and in the vicinity of N.E. Woodinville-Duvall Road. The Sammamish River valley trough has been infilled with sediment since the melting of glacial ice about 13,500 years ago.

Surficially exposed bedrock comprised of Tertiary sedimentary rocks is exposed approximately five miles north of the study area, but exposures do not exist within the City of Woodinville.

The Woodinville area is underlain by a thick sequence of unconsolidated glacial and nonglacial deposits of Pleistocene age. Based on geologic maps published for the area (Minard, 1983, 1985a and b), the Pleistocene deposits exposed at the ground surface within the City of Woodinville, from oldest to youngest, are pre-Fraser undivided glacial till (Qtu), pre-Fraser Olympia gravel (Qog), Olympia/Vashon transitional lacustrine beds (Qtb), Vashon advance outwash (Qva), Vashon till (Qvt), Vashon recessional outwash (Qvr), older Holocene alluvium (Qoal), and younger Holocene alluvium (Qyal/Qal).

Pre-Fraser glacial till (Qtu) and Olympia gravel (Qog) were deposited prior to the advance of the most recent glaciation (Fraser Glaciation), before or during the interglacial period from about 18,000 to 80,000 years ago. They are exposed at the ground surface near the toe of the east-facing slope located west of the Woodinville-Redmond Road. The pre-Fraser glacial till is comprised of very dense, nonsorted clay, silt, sand, gravel and cobbles. The Olympia gravel unit (Qog) consists of very dense, locally oxidized, stratified fluvial sand and gravel.

Overlying the Olympia interglacial sand and gravel deposit (Qog) is glacial sediment deposited during the Vashon Stade (12,000 to 18,000 years ago) of the Fraser Glaciation. As the glacial ice advanced southward from British Columbia to the northern part of Puget sound, a large lake formed to the south of the ice into which fine-grained soils (silt and clay) were deposited. These

fine-grained deposits are termed transitional beds (Qtb) and consist of nonglacial and glacial deposits of massive to thinly bedded, hard/very dense, clay, silt and fine sand. The transitional beds were eventually overlain by a relatively thick deposit of glacial outwash sand and gravel (Qva) as the ice advanced southward, displacing the lake. In the Woodinville area, the uppermost portion of the transitional beds (Qtb) represents the Vashon glaciolacustrine unit, commonly termed the Lawton Clay. The transitional beds (Qtb) are exposed at the ground surface along the lower portion of the steep, east-facing slope to the west of Woodinville-Redmond Road and in the downtown Woodinville core area.

Vashon advance outwash (Qva) overlies the transitional beds (Qtb) in the Woodinville area. The advance outwash is typically a thick section of very dense, clean to slightly silty, sand and gravel that generally coarsens to gravelly sand near the top of the unit. The Vashon advance outwash soils (Qva) are currently found along the steep slopes and ravines located west of Woodinville-Redmond Road, north and west of SR 522, and in the upland area near Lake Leota and N.E. Woodinville-Duvall Road.

As the southward encroaching glacial ice overrode the land, lodgment till (Qvt) was deposited beneath the ice. Vashon till (Qvt) is composed of cobbles and gravel in a matrix of fine sand, silt, and clay. Vashon till presently blankets much of the Woodinville uplands. Furthermore, based on geologic maps of the area, thin, discontinuous Vashon till exists along the steep, east-facing slope located west of Woodinville-Redmond Road.

During the recession and melting of the Vashon ice, recessional glacial deposits were laid down in front of, or underneath the ice. Recessional outwash (Qvr), consisting of sand and gravel with some silt and clay was deposited in the lower portions of the Bear Creek valley west of SR 522, near the northern Woodinville City limit.

Since the melting of the ice from the Woodinville area about 13,500 years ago, stream erosion and deposition and mass wasting have further modified the landscape. Holocene alluvium in the Woodinville area consists of older alluvium (Qoal) that is comprised of stratified sand and gravel with sandy organic silt layers. The older alluvium (Qoal) forms terraces along the Sammamish River Valley margins and may be intermixed with colluvium at the bases of the slopes. Younger alluvium(Qal) is comprised of sand and organic-rich silt with some peat deposits and is located within the Sammamish River floodplain, at the lowest elevations.

Other unconsolidated deposits that are not differentiated on geologic maps of the Woodinville area include fill placed by humans in an engineered or non-engineered manner. Fill is composed of various materials, including debris and may be dense, stiff, and unyielding if engineered, and very loose to dense or very soft to stiff, if not engineered. Fills may have been placed in abandoned Sammamish River channels.

4.1 Steep Slopes/Landslide Hazard Areas

4.1.1 Location and Description

Slope instability in the Woodinville area occurs mainly in areas where the inclinations of the slopes exceed 40 percent. Geologic factors, particularly those in which pervious geologic units overlie soil units of lower permeability, are responsible for much of the slope instability in the Woodinville area. The underlying impervious soils are likely to be glaciolacustrine silt and clay or nonglacial silt and fine sand (i.e. Qtb and Qtu) (Minard, 1983, 1985a and 1985b).

A combination of geologic maps and topographic maps was used to approximate potential landslide-prone areas. Geologic mapping was taken from a compilation of geologic maps produced by the USGS (Minard, 1983,1985a and 1985b). Topographic information used to identify slopes steeper than 40 percent was taken from USGS topographic maps. Based on discussions with the City of Woodinville (Debra Crawford), it is understood that the City maintains no historical landslide information.

Based on this information, primary areas of potential instability or with geologic factors (as discussed above) that may make them susceptible to landsliding within the Woodinville were identified for further field review:

- The slopes located west of SR 522 between N.E. 185th Street and N.E. 195th Street
- The slopes located north and south of N.E. 190th Street/N.E. Woodinville-Duvall Road
- The slope located east of Woodinville-Snohomish Road between N.E. 185th Street and N.E. 195th Street.
- The approximately 200-foot-high slope located in the north-central portion of the City between 144th Avenue N.E. and 148th Avenue N.E.

Based on physical characteristics or existing publications, other areas of potential landslide hazards should include:

- Areas designated as Quaternary slumps, earthflows, mudflows, or landslides on maps by the USGS, the DNR, and/or the King County Department of Natural Resources.
- Areas that have shown movement during the Holocene Epoch (the past 13,500 years) or are underlain by landslide deposits.
- Slopes that are parallel or sub-parallel to planes of weakness in subsurface materials.
- Areas of potential instability because of rapid stream incision or stream bank erosion.

After field reconnaissance, the following areas were shown to contain the characteristics that are typical of landslide-prone ground:

- Portions of the dissected slope located along the west side of the Sammamish River Valley. They are characterized by old landslide scars, landslide debris deposits, incised streams, springs at the clay/sand contact on slopes steeper that 15 percent.
- A deep east/west-oriented ravine between NE 202nd Street and the north city limit and east of 144th Avenue NE. It is characterized by old landslide scars, seepage, and incised streams.

Erosion Hazard Areas

The City of Woodinville currently uses existing maps specifically prepared for King County by the King County Department of Natural Resources that indicate zones of soils that are susceptible to erosion (King County, 1990). Other jurisdictions, such as Bainbridge Island and Burien, have also used similar maps showing characteristics and distribution of soils, as described in the soil surveys completed by the former SCS, to identify erosion hazard areas. Based on a survey of government agencies and senior geologists working in the Puget Sound region and a recommendation by the DNR, the use of SCS soil units is a reasonable approach to creating a map that portrays erosion-susceptible zones. The following list contains a compilation of the soil units that have a "severe" or "very severe" erosion hazard classification, according to King County Area Soil Survey (Snyder, et al., 1973). The hazard is "severe" or "very severe" if steep slopes, rapid or very rapid runoff, and past ground incision make the soil highly susceptible to erosion.

The Soil Survey of King County, Washington, was used to determine the soil series present in Woodinville with severe to very severe erosion potential based on slopes and runoff potential (Snyder, et al., 1973). The soil series identified in the project area that may be used to create an erosion-susceptible hazard area map are:

- Alderwood gravelly sandy loam, 15 to 30 percent slopes ("AgD")
- Kitsap silt loam, 15 to 30 percent slopes ("KpD")

Best Management Practices (BMPs) for development on erosion-prone soils, such as seeding, mulching, and use of silt-retaining fences, help to control erosion and fine sediment migration from cleared sites, particularly those areas close to streams and wetlands where sediment delivery can result in increased turbidity and sedimentation of wetlands and stream habitat. Use of BMPs in these areas can also result in reduced costs to the City in the maintenance of stormwater conveyance and detention systems by limiting the delivery of sediments to these natural systems.

4.2 Liquefaction Hazard Areas

Liquefaction occurs in saturated, loose, granular soil (e.g., sand below the water table where the spaces between sand particles – pores – are filled with water). During an earthquake, loose soils (with water-filled pores) will tend to densify. If pore water is present in the soil, the water pressure will increase as the soil particles attempt to arrange themselves in a denser or more compact configuration. A "quicksand" or liquefied soil will result. Liquefaction can cause a drastic reduction in the soil's shear strength. As a result of this shear strength reduction, ground displacements of several feet can occur on even relatively flat ground. The soil may lose much of its capacity to support foundations, which can cause a structure to settle differentially, laterally displace, and in some cases topple over.

Soils that are susceptible to liquefaction are geologically recent deposits and non-engineered fills. Liquefaction hazard mapping studies for other areas in the region have generally found that the non-engineered fills and Holocene alluvium (Qal) typically have a high susceptibility to liquefaction (Palmer et al., 2002). Older glacial sediments that have not been overridden by glacial ice (e.g., Vashon Recessional Outwash, Qvr) may have a moderate susceptibility to liquefaction (Palmer et al., 2002). The susceptibility of glacially overridden sediment (i.e., Vashon till, Qvt, and older geologic units) to liquefaction is very low, while bedrock has no susceptibility to liquefaction (Palmer et al., 2002). Liquefaction mapping has been completed

by the DNR for the Kirkland Quadrangle, which encompasses the Sammamish River valley in the southeastern corner of Woodinville (Palmer et al., 2002). The alluvial geologic units (Qoal and Qyal) in the Sammamish River valley have been mapped as a low to moderate liquefaction hazard, and the chief investigator for that map indicates that it is likely that the same designation may apply to the same geologic units in the Bothell and Maltby Quadrangles, which contain the remainder of Woodinville. Liquefaction mapping for those two quadrangles is anticipated to be complete by the end of 2004 (Palmer, 2003).

Management of development activities on soils susceptible to liquefaction is important to protect public health and safety and to minimize potential property damage during an earthquake. Such management also limits the risk of liability for the City and for private property owners. Risk management can include requiring site-specific liquefaction assessments for projects located on soils with a low to moderate liquefaction hazard. A liquefaction assessment would generally include an assessment of the risk of occurrence and severity, and also should consider potential associated effects, such as lateral spreading, differential settlement, and potential loss of soil/foundation capacity. For the Sammamish River valley, the risk of seismically-induced settlement is likely, but some of the more onerous manifestations, such as lateral spreading and loss of foundation support are less likely.

5.0 DATA GAPS

- The City of Woodinville has not maintained files documenting the locations of and conditions associated with previous landslides and erosion incidents in the City. Such files would aid in establishing a record of the locations of landslides and erosion hazards, the associated geologic conditions, and factors contributing to initiation of the landslide or erosion event. This information could be recorded in a geographic information system (GIS) related database, so all data is spatially referenced. If such a system is initiated and maintained, then in future years, sufficient information will be available to delineate landslide-prone and erosion-susceptible zones in the City.

- The landslide information presented in this assessment is based on a map review of geologic conditions, topography, and limited geologic field reconnaissance. It is not of sufficient detail to delineate the exact boundaries of landslide hazard areas, nor is it adequately detailed to evaluate relative degrees of risk of landslides. More detailed field reconnaissance and studies would be required to develop this additional level of information.

- The City of Seattle and south Snohomish County have benefited from recent geologic mapping using sophisticated mapping and testing techniques (Troost et al.,in press). The

City of Woodinville, its residents, and developers should be able to more accurately identify and address geologic hazards on a site-specific level using the results of the geologic mapping project that is presently in progress. Such new information may include improved soil unit delineation for hydrologic studies, better demarcation of landslide areas, and a database of subsurface explorations.

- Although liquefaction potential mapping has been completed for the Kirkland Quadrangle (southeastern part of Woodinville), the Bothell and Maltby quadrangles will not be completed until the end of 2004. When it is available, this information should be incorporated by the City.

6.0 WOODINVILLE CODE GAP ANALYSIS

In many jurisdictions in western Washington, setback or buffer distances are established between a structure and the top and toe of a steep or unstable slope. Although not universally used and not based on findings of specific studies, 50 feet is a common and reasonable distance based on records of land use practices in the region. The Washington State Office of Community Development (OCD) has adopted it in the draft Model Critical Areas Code (OCD, 2002). The setback requirements may be decreased, based on recommendations from a geotechnical engineer and engineering geologist, but in no case should be less than 10 feet. Where warranted, setbacks can also be increased based on site-specific conditions.

6.1 Landslide Hazard Areas/Steep Slope Hazard Areas

- In areas of steep slopes (steeper than 40 percent), Woodinville presently requires geotechnical review and reporting for development in those areas. However, for areas inclined at 15 to 40 percent and/or with unfavorable geologic conditions, the City does not have a tool to determine the appropriate level of geologic review. A map of geologic conditions could be used for this purpose by overlaying the geologic map on a map indicating 15 to 40 percent slopes to identify the risk associated with various geologic units in the City.

- Other criteria that could be added to the list of considerations for potentially unstable slopes are:

- Areas designated as Quaternary slumps, earthflows, debris flows (including alluvial fan deposits), or landslides on maps by the USGS and the DNR.

- Slopes that are parallel or sub-parallel to planes of weakness in subsurface materials.

- Slopes having gradients steeper than eighty percent (80%) subject to rock/earth fall during seismic shaking.

- With the advent of licensing of geologists, engineering geologists, and hydrogeologists in Washington (effective July 1, 2002), Woodinville's code (Chapter 21.06.283) could recognize the acceptance of licensed geo-professionals to evaluate geologic processes. For evaluations of faulting, erosion, and slope stability, a licensed engineering geologist could be allowed to perform the duties previously only given to a geotechnical engineer. As provided for under state law, engineering design issues are still the responsibility of the geotechnical engineer.

- All drainage pipes that are not buried into the original, undisturbed ground (below the zone of creeping soil) could be fuse-welded, high-density polyethylene (HDPE) on the ground surface on slopes 40 percent or steeper. Breakage, pulling-apart of the joints, and crushing of other types of pipes are common (and inevitable), and contribute to slope instability.

- GIS files containing information about landslide, erosion, and liquefaction incidents could be started by the City of Woodinville, so that all information is collected in one location and can be used in the future to further refine land use and geologic hazard maps.

6.2 Erosion Prone Areas

- The City should continue to require erosion control measures in erosion-prone areas, particularly near stream and wetland systems. These measures include minimizing areas of grading and vegetation removal where feasible, limiting clearing during wetter times of the year, use of erosion control BMPs, and requiring revegetation immediately following development. Recording of site-specific erosion-prone areas in the City's GIS files, as discussed above, would be useful in further refining erosion hazard maps.

6.3 Seismic Hazard Areas/ Liquefaction Hazard Areas

- The City of Woodinville currently defines seismic hazard areas as those areas "subject to severe risk of earthquake damage as a result of soil liquefaction in areas underlain by cohesionless soils of low density and usually in association with shallow groundwater table or of other seismically induced settlement." The City could modify the definition to conform to the DNR designation of low to moderate risk, so there is a warning of the potential for damage, but not the connotation of severe risk, as is more appropriate for looser and thicker liquefaction-prone deposits elsewhere.
- The City could consider developing public education and outreach materials to provide information to residents and business owners about seismic risks. This information could include building techniques, disaster preparedness, and other general information about ways to minimize safety risks and property damage during seismic events.
- When the liquefaction hazard maps are published by the DNR for the Bothell and Maltby quadrangles, the City of Woodinville could incorporate these into the inventory. These maps could be used to further delineate soils with a low to moderate susceptibility to liquefaction, and to determine whether a project developer may be required to submit

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site-specific liquefaction assessment and incorporate mitigation measures.

Development approval could be contingent on the successful demonstration of how the potential effects of liquefaction (if present) will be mitigated. Potential mitigation measures could include:

- Improving the soil structure to densify/cement the soils.
- Utilizing pile foundations to provide support for the structure in soils below the potential liquefiable soil.
- Reducing allowable soil bearing pressures to limit the potential for bearing capacity failures and differential foundation settlements.

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REPORT REQUIREMENTS FOR GEOLOGICALLY HAZARDOUS AREAS

(1) **Prepared by a qualified professional.** A critical areas report for a geologically hazardous area shall be prepared by a geotechnical engineer or geologist, licensed in the state of Washington, with experience analyzing geologic, hydrologic, and ground water flow systems.

(2) **Area addressed in critical area report.** The following areas shall be addressed in a critical area report for geologically hazardous areas:

(a). The project area of the proposed activity; and

(b) All geologically hazardous areas within two hundred (200) feet of the project area or that have potential to be affected by the proposal;

(3) **Geotechnical assessment.** A critical area report for a geologically hazardous area shall contain an assessment of geological hazards including the following site- and proposal-related information at a minimum:

(a) **Site and construction plans.** The report shall include a copy of the site plans for the proposal showing:

i. The type and extent of geologic hazard areas, and any other critical areas, and buffers on, adjacent to, within two hundred (200) feet of, or that are likely to impact the proposal;

ii. Proposed development, including the location of existing and proposed structures, fill, storage of materials, and drainage facilities, with dimensions indicating distances to the floodplain;

iii. The topography, in two-foot contours, of the project area and all hazard areas addressed in the report; and

iv. Clearing limits;

(b) **Assessment of geological characteristics.** The report shall include an assessment of the geologic characteristics and engineering properties of the soils, sediments, and/or rock of the project area and potentially affected adjacent properties, and a review of the site history regarding landslides, erosion, and prior grading. Soils analysis shall be accomplished in accordance with accepted taxonomic classification systems in use in the region. The assessment shall include, but not be limited to:

i. A description of the surface and subsurface geology, hydrology, soils, and vegetation found in the project area and in all hazard areas addressed in the report;

ii. A detailed overview of the field investigations, published data and references; data and conclusions from past assessments of the site; and site specific measurements, test, investigations, or studies that support the identification of geologically hazardous areas; and

iii. A description of the vulnerability of the site to seismic and other geologic events;

(c) **Analysis of proposal.** The report shall contain a geotechnical analysis including a detailed description of the project, its relationship to the geologic hazard(s), and its potential impact upon the hazard area, the subject property and affected adjacent properties; and

(d) **Minimum buffer and building setback.** The report shall make a recommendation for the minimum no-disturbance buffer and minimum building setback from any geologic hazard based upon the geotechnical analysis.

(4) **Incorporation of previous study.** Where a valid geotechnical report has been prepared within the last five (5) years for a specific site, and where the proposed land use activity and surrounding site conditions are unchanged, said report may be incorporated into the required critical area report. The applicant shall submit a geotechnical assessment detailing any changed environmental conditions associated with the site.

(5) **Mitigation of long-term impacts.** When hazard mitigation is required, the mitigation plan shall specifically address how the activity maintains or reduces the pre-existing level of risk to the site and adjacent properties on a long-term basis (equal to or exceeding the projected lifespan of the activity or occupation). Proposed mitigation techniques shall be considered to provide long-term hazard reduction only if they do not require regular maintenance or other actions to maintain their function. Mitigation may also be required to avoid any increase in risk above the pre-existing conditions following abandonment of the activity.

(6) **Additional requirements for specific hazards.** In addition to the general critical area report requirements, critical area reports for geologically hazardous areas must meet the requirements of this Section. Critical area reports for two or more types of critical areas must meet the report requirements for each relevant type of critical area.

(a) **Erosion and landslide hazard areas.** In addition to the basic critical area report requirements, a critical area report for an erosion hazard or landslide hazard area shall include the following information at a minimum:

i. **Site plan.** The report shall include a copy of the site plan for the proposal showing:

1. The height of slope, slope gradient, and cross section of the project area;
2. The location of springs, seeps, or other surface expressions of ground water on or within two hundred (200) feet of the project area or that have potential to be affected by the proposal; and

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3. The location and description of surface water runoff;

ii. **Geotechnical analysis.** The geotechnical analysis shall specifically include:

1. A description of the extent and type of vegetative cover;
2. An estimate of load capacity including surface and ground water conditions, public and private sewage disposal systems, fills and excavations and all structural development;
3. An estimate of slope stability and the effect construction and placement of structures will have on the slope over the estimated life of the structure;
4. An estimate of the bluff retreat rate that recognizes and reflects potential catastrophic events such as seismic activity or a one hundred year storm event;
5. Consideration of the run-out hazard of landslide debris and/or the impacts of landslide run-out on down slope properties.
6. A study of slope stability including an analysis of proposed angles of cut and fill and site grading;
7. Recommendations for building limitations, structural foundations, and an estimate of foundation settlement;
8. An analysis of proposed surface and subsurface drainage, and the vulnerability of the site to erosion;

iii. **Erosion and sediment control plan.** For any development proposal on a site containing an erosion hazard area, an erosion and sediment control plan shall be required. The erosion and sediment control plan shall be prepared in compliance with requirements set forth in the City of Woodinville stormwater management regulations;

iv. **Drainage plan.** The report shall include a drainage plan for the collection, transport, treatment, discharge and/or recycle of water prepared in accordance with the City of Woodinville surface water management plan. The drainage plan should consider on-site septic system disposal volumes where the additional volume will affect the erosion or landslide hazard area.

v. **Mitigation plans.** Hazard and environmental mitigation plans for erosion and landslide hazard areas shall include the location and methods of drainage, surface water management, locations and methods of erosion control, a vegetation management and/or replanting plan and/or other means for maintaining long term soil stability.

vi. **Monitoring surface waters.** If the City determines that there is a significant risk of damage to downstream receiving waters due to potential erosion from the site,

based on the size of the project, the proximity to the receiving waters, or the sensitivity of the receiving waters, the critical area report shall include a plan to monitor the surface water discharge from the site. The monitoring plan shall include a recommended schedule for submitting monitoring reports to the City.

(b) **Seismic hazard areas.** In addition to the basic report requirements, a critical area report for a seismic hazard area shall also meet the following requirements:

i. The site map shall show all known and mapped faults within two hundred (200) feet of the project area or that have potential to be affected by the proposal.

ii. The geotechnical analysis shall include a complete discussion of the potential impacts of seismic activity on the site.

c **Other geologically hazardous areas.** In addition to the basic report requirements, the City may require additional information to be included in the critical area report when determined to be necessary to the review the proposed activity and the subject hazard. Additional information that may be required, includes, but is not limited to:

i. **Site plan.** The site plan shall show all hazard areas located within two hundred (200) feet of the project area or that have potential to be affected by the proposal; and

ii. **Geotechnical analysis.** The geotechnical analysis shall include a complete discussion of the potential impacts of the hazard on the project area and of the proposal on the hazard.

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MEMORANDUM

ADOLFSON

Environmental Solutions

DATE: November 26, 2003

TO: Debra Crawford
City of Woodinville
Planning and Community Development Department

FROM: Cathie Conolly

CC: Teresa Vanderburg

RE: Critical Aquifer Recharge Areas Best Available Science Technical Memorandum

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1.0 INTRODUCTION

1.1 Project Authorization

At the request of the City of Woodinville, Adolfson Associates, Inc. (Adolfson) has prepared this technical memo to provide an overview of the "best available science" pertaining to critical aquifer recharge areas in the City of Woodinville (the City). This memo will provide guidance to the City in development and revision of its Environmentally Sensitive Areas Code (Woodinville Municipal Code (WMC) Chapter 21.24)

This technical memorandum discusses the results of the best available science review for critical aquifer recharge areas and evaluates the applicability of the science to critical aquifer recharge area regulations in the City. Adolfson has based our review on existing literature and preliminary information from the City. This technical memorandum is the first step in Adolfson's review of the City's Critical Areas Ordinance. Future documents will evaluate the gaps between the City's existing regulations and best available science guidelines. Adolfson will also be proposing revisions to the City's Critical Areas Ordinance.

The Washington Administrative Code (WAC) directs counties and cities as follows (the full text of WAC 365-195-900 through 365-195-925 is included in Appendix A):

> Counties and cities must include the "best available science" when developing policies and development regulations to protect the functions and values of critical areas and must give "special consideration" to conservation or protection measures necessary to preserve or enhance anadromous fisheries. RCW 36.70A.172(1). The rules in WAC 365-195-900 through 365-195-925 are intended to assist counties and cities in identifying and including the best available science in newly adopted polices and regulations and in this

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periodic review and evaluation and in demonstrating they have met their statutory obligations under RCW 36.70A.172 (1).

1.2 State Growth Management Act Requirements

Rules promulgated under the 1990 Washington State's Growth Management Act (GMA) (RCW 360.70A.060) required counties and cities to adopt development regulations that protect the functions and values of critical areas, including streams, wetlands, wildlife habitat, and critical aquifer recharge areas. In 1995, the Washington State legislature added a new section to the GMA to ensure that counties and cities consider reliable scientific information when adopting policies and development regulations to designate and protect critical areas. As a result of this legislation, in 2000 the Growth Management Division of Washington's Office of Community Development (OCD) adopted procedural criteria to guide cities and counties in identifying and including the best available science in their critical area policies and regulations. In accordance with RCW 36.70A.172(1), communities "shall include the best available science in developing policies and development regulations to protect the functions and values of critical areas."

Critical aquifer recharge areas are defined by Washington's GMA as areas that significantly contribute to the recharge of aquifers used for potable water (WAC 365-190-030(2)). Prevailing geologic conditions in these areas cause high infiltration rates that allow water to move relatively quickly from the surface to groundwater aquifers. Because of these conditions, these areas contribute significantly to the replenishment of groundwater, but are also areas with a high potential for contamination of groundwater resources.

1.3 Overview of City Environment

The City of Woodinville is an urbanizing city located in the Sammamish River Valley in King County, Washington (see Figure 1). It is approximately 5.66 square miles in size and has an estimated population of 9,809 (as of April 2003). The Sammamish River flows through the City and west toward Lake Washington. Little Bear Creek also flows through Woodinville and into the Sammamish River. Woodinville's commercial, industrial and agricultural areas are generally confined to the valley floor, while residential neighborhoods occupy the surrounding plateaus and slopes, many of which are heavily forested.

The Sammamish River Valley was historically a wide area filled with wetlands and meandering and braided channels (U.S. Army Corps of Engineers and King County Department of Natural Resources and Parks, 2003). The river channel and valley have been drastically altered by development—forests have been cleared, wetlands have been drained, the river has been confined to one channel, the Lake Washington lake level has been lowered altering the flow pattern of the river, and the river has been constrained for flood control.

The city limits are generally described as the lands bounded on the north by the Snohomish/King County line, on the east by 170th Ave NE north of NE Woodinville-Duvall Road and the Sammamish River, on the south by NE 145th Street (State Route 202), and on the west by 124th Avenue NE.

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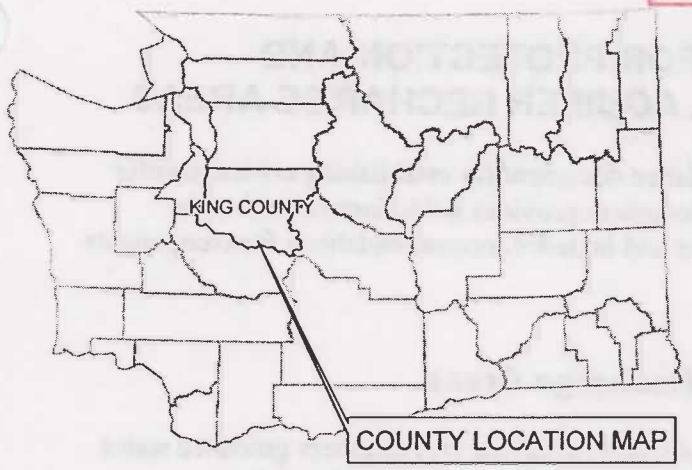
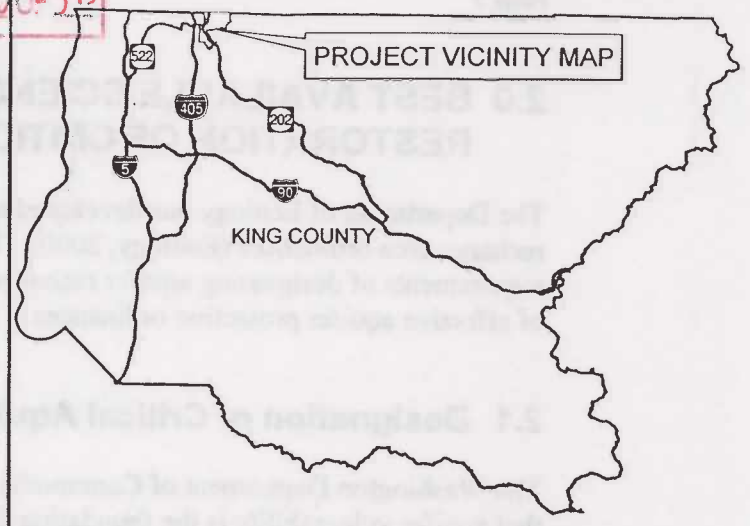
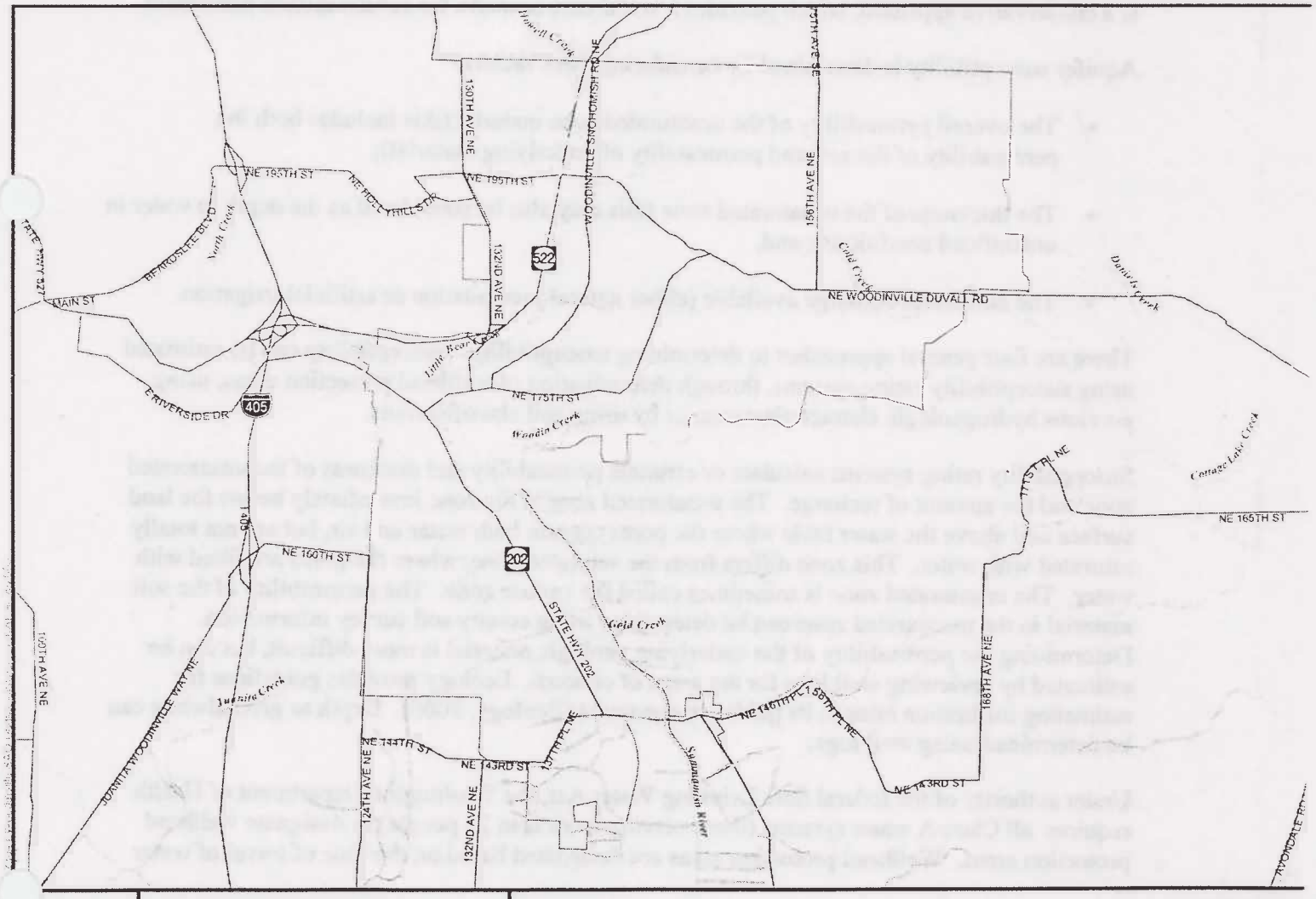


COUNTY LOCATION MAP





Map data shown are the property of the sources listed below. Inaccuracies may exist, and Adolfson Associates, Inc. implies no warranties or guarantees regarding any aspect of data depiction.

Source: Woodinville GIS 2002; King County GIS 2002; ESRI 2000

NO SCALE

FIGURE 1

VICINITY MAP

WOODINVILLE SAO UPDATE AND BAS

WOODINVILLE, WASHINGTON

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2.0 BEST AVAILABLE SCIENCE FOR PROTECTION AND RESTORATION OF CRITICAL AQUIFER RECHARGE AREAS

The Department of Ecology has developed a guidance document for establishing critical aquifer recharge area ordinances (Ecology, 2000). The document provides guidelines related to the requirements of designating aquifer recharge areas and includes recommendations for components of effective aquifer protection ordinances.

2.1 Designation of Critical Aquifer Recharge Areas

The Washington Department of Community, Trade, and Economic Development guidance states that aquifer vulnerability is the foundation for determination of a critical aquifer recharge area. However, in most cases, there is not adequate information about the groundwater to determine an aquifer's vulnerability. The Ecology guidelines suggest that a susceptibility determination can be used by jurisdictions to designate critical aquifer recharge areas. The susceptibility determination is a conservative approach, which provides a worst-case scenario for contamination movement

Aquifer susceptibility is determined by considering three factors:

- The overall permeability of the unsaturated zone material (this includes both the permeability of the soil and permeability of underlying material);
- The thickness of the unsaturated zone (this may also be considered as the depth to water in unconfined conditions); and,
- The amount of recharge available (either natural precipitation or artificial irrigation.

There are four general approaches to determining susceptibility. Susceptibility can be estimated using susceptibility rating systems, through determination of wellhead protection areas, using previous hydrogeologic characterizations, or by using soil classifications.

Susceptibility rating systems calculate or estimate permeability and thickness of the unsaturated zone and the amount of recharge. The unsaturated zone is the zone immediately below the land surface and above the water table where the pores contain both water and air, but are not totally saturated with water. This zone differs from the saturated zone, where the pores are filled with water. The unsaturated zone is sometimes called the vadose zone. The permeability of the soil material in the unsaturated zone can be determined using county soil survey information. Determining the permeability of the underlying geologic material is more difficult, but can be estimated by reviewing well logs for the areas of concern. Ecology provides guidelines for estimating infiltration rates in its guidance document (Ecology, 2000). Depth to groundwater can be determined using well logs.

Under authority of the federal Safe Drinking Water Act, the Washington Department of Health requires all Class A water systems (those serving more than 25 people) to designate wellhead protection areas. Wellhead protection areas are designated based on the time of travel of water

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from its source to the well. Wellhead protection areas are delineated using analytical or numerical modeling techniques.

Previously conducted hydrogeologic studies can be used to determine susceptibility. Possible sources of such studies are Ecology, the U.S. Geological Survey, the U.S. Department of Energy, or the Washington State Department of Health.

Soil classification studies conducted by the Natural Resource Conservation Service (formerly Soil Conservation Service) often contain information on the permeability of the upper portions of the unsaturated zone. Use of this information is especially valid when the depth to groundwater is shallow (0 to 10 feet below ground surface). However, using Soil Survey information exclusively to determine susceptibility does not meet requirements for best available science (Ecology, 2000).

2.2 Protection of Critical Aquifer Recharge Areas

The guidelines for methods to protect critical aquifer recharge areas are relatively simple. To protect the recharge potential, the amount of impervious surface in recharge areas should be minimized. To minimize the potential for contamination of the aquifer, certain activities that have a high potential for contamination should be prohibited from the critical aquifer recharge areas and/or best management practices can be required to reduce the potential for contamination from high risk activities. Activities that are considered high risk include landfills, underground injection wells, mining, and wood treatment facilities. Other activities could be considered high risk depending on the amount and type of materials used and the location of the facility. Best management practices that could be required of high risk activities include storage and handling requirements, secondary containment to confine any spills, and design requirements for stormwater facilities.

Another method to protect critical aquifer recharge areas is to require that any facility proposing to locate in a susceptible area be required to conduct specific site evaluations to assess the hydrogeologic conditions of the site and to characterize the proposed facility's potential to degrade the environment. Site evaluation studies can provide additional information on the critical aquifer recharge area boundaries and can be the basis for determining appropriate mitigation for the proposed activity. Ecology provides recommendations for the requirements of the site evaluation studies (Ecology, 2000).

3.0 CRITICAL AQUIFER RECHARGE AREAS IN THE CITY

The primary source of information on aquifers in the Sammamish River Valley is the Redmond-Bear Creek Valley Ground Water Management Plan (Redmond-Bear Creek Ground Water Advisory Committee, 1999). According to this Plan, there are four aquifer zones underlying the Sammamish River Valley—Alluvial, Local Upland, Sea Level, and Regional. The Alluvial Aquifers are apparently restricted to alluvial deposits along Cottage Lake Creek, Bear Creek, and Evans Creek. The Local Upland Aquifers occur beneath the ridge of the Redmond-Bear Creek Ground Water Management Area. The Sea Level Aquifers underlie the entire Redmond-Bear Creek Ground Water Management area and are apparently independent of topography. The

Regional Aquifers also underlie the entire Redmond-Bear Creek Ground Water Management Area and are also independent of topography. There is a high degree of connectivity between the surface water of the Sammamish River and its tributaries and the Alluvial Aquifer. The direction of flow between the river and the aquifers is the subject of on-going research (Carey, 2003).

There is limited information on groundwater within the City of Woodinville. The easternmost portion of the City is located in the Redmond-Bear Creek Valley Groundwater Area (See Figure 2). King County is currently developing a Sammamish River Groundwater Study, which is expected to be released at the end of 2003 (Johnson, 2003). This study will cover an additional portion of southern Woodinville (See Figure 3).

Studies conducted for the Environmental Impact Statement on the proposed new King County Wastewater Treatment Plant describe the groundwater conditions for the areas under consideration for plant locations—the Unocal Site in Edmonds and the SR 9 Site north of Woodinville—and the associated conveyance routes (King County Department of Natural Resources and Parks, 2003). The SR-9 site is located within the Woodinville Urban Growth Area and is approximately 0.5 miles north of the City limits. The area surrounding the SR 9 site and bordering Woodinville's northern boundary has a shallow, unconfined aquifer that varies from 0 to 10 feet below ground surface (King County Department of Natural Resources and Parks, 2003). The aquifer is fed by infiltration of precipitation from the surface and from upslope areas. The aquifer discharges to Little Bear Creek or flows in the same direction of Little Bear Creek. There are no known water supply wells in this shallow aquifer. A deeper aquifer with depths in excess of 100 feet below ground surface is also located in the area. Sediments in the area are relatively low in permeability.

The area north of Woodinville, including the SR 9 site, is located within the Cross Valley Water District. The Cross Valley Aquifer was designated as a sole-source aquifer by the U.S. Environmental Protection Agency (EPA) in 1987. A sole-source aquifer is one that supplies 50 Percent or more of the drinking water for an area and therefore contamination of the aquifer could pose a threat to public health. The designation means that any federally funded projects overlying the aquifer are required to undergo EPA evaluation to determine the potential for contamination. Neither the water district or the sole-source aquifer boundary is located within the Woodinville city limits; however, both areas lie within the northern urban growth area for the City.

The Cross Valley Water District has developed a wellhead protection plan (Golder, 2000 in King County Natural Resources and Parks, 2003) that includes designation of the 10-year time of travel zone to the district's water supply wells. The time of travel zone delineates the area within which a crop of water would reach a well. All of the City of Woodinville lies outside the 10-year time of travel zone and maps indicate that groundwater flow is away from the water supply wells and toward the City.

None of the existing studies indicate that there are any critical aquifer recharge areas in the City. There are areas north of the City and within the City's northern urban growth area that are critical aquifer recharge areas. These areas would warrant protection from contamination.

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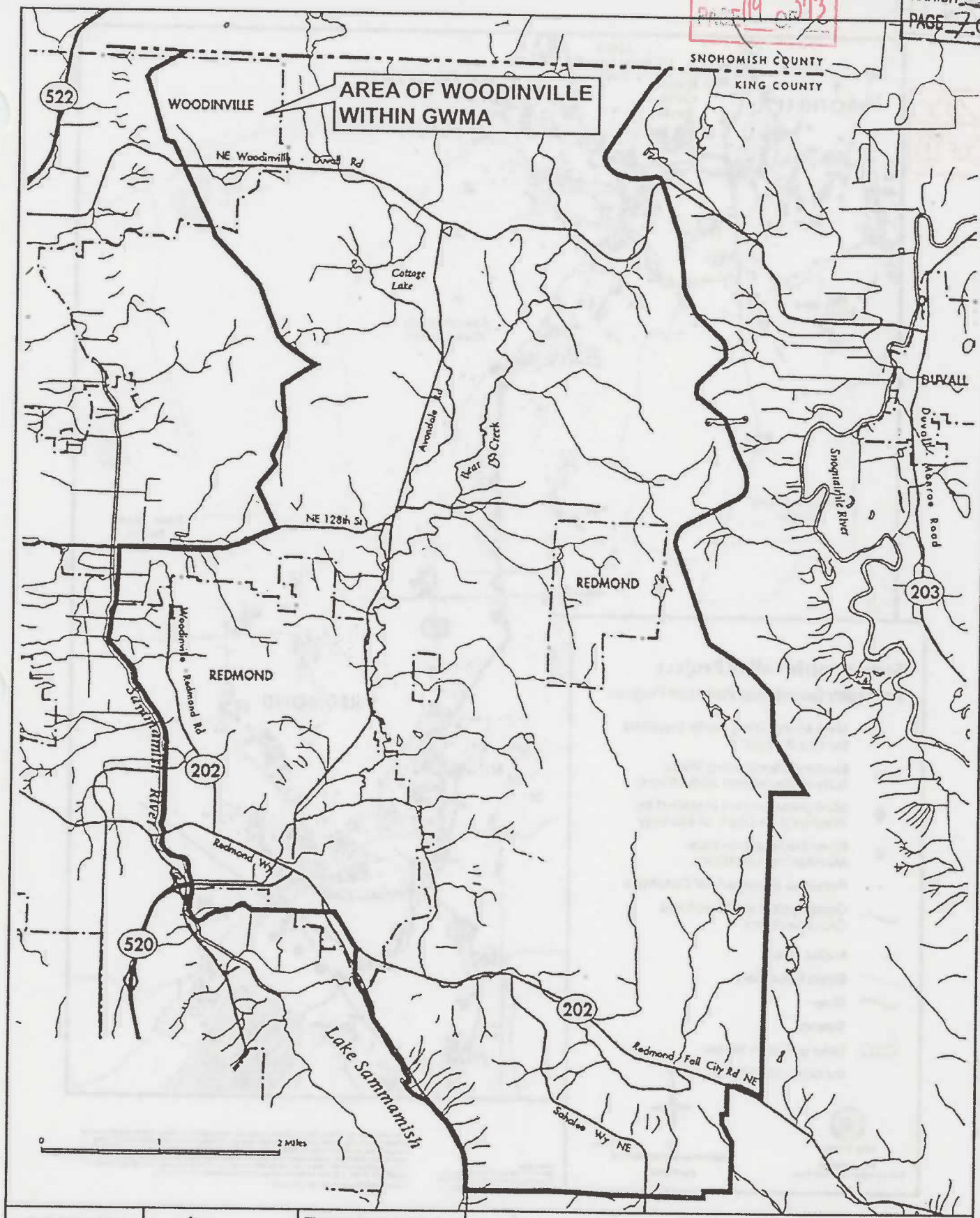

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File name: 23041_GWMA.ai
Original AAI graphic by: ACT
Edits by:
Date: 09/29/03

Source: Remond-Bear Creek Valley Ground Water Management Plan.

ADOLFSON

FIGURE 2.
REDMOND-BEAR CREEK
GROUND WATER MANAGEMENT AREA
WOODINVILLE SAO UPDATE
KING COUNTY, WASHINGTON

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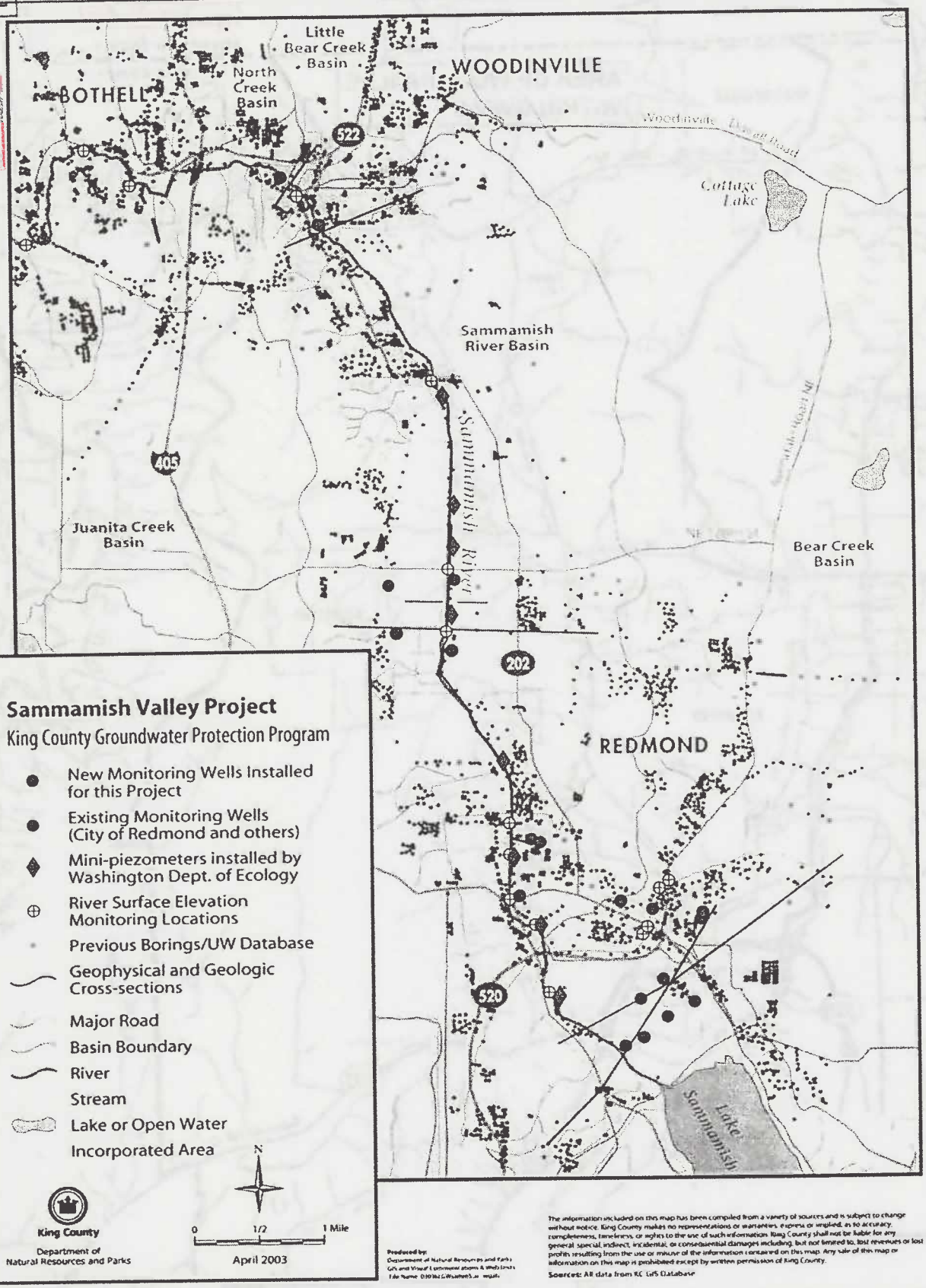

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Date: 09/29/03

Source: King County Department of Natural Resources and Parks.

FIGURE 3.
SAMMAMISH VALLEY PROJECT
WOODINVILLE SAO UPDATE
KING COUNTY, WASHINGTON

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4.0 DATA GAPS

As indicated in Section 3, information on critical aquifer recharge areas in the City is limited. A portion of eastern Woodinville lies within the Redmond-Bear Creek Ground Water Management Area. Forthcoming studies on the Sammamish Valley Project and on the proposed King County wastewater treatment plant may provide additional information on aquifers and groundwater movement in the Woodinville area. The City should monitor the results of those studies, which may help to identify aquifer recharge areas in, or near, the City..

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U.S. Army Corps of Engineers and King County Department of Natural Resources and Parks. 2002. Sammamish River Corridor Action Plan. Seattle, Washington.

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Attachment A

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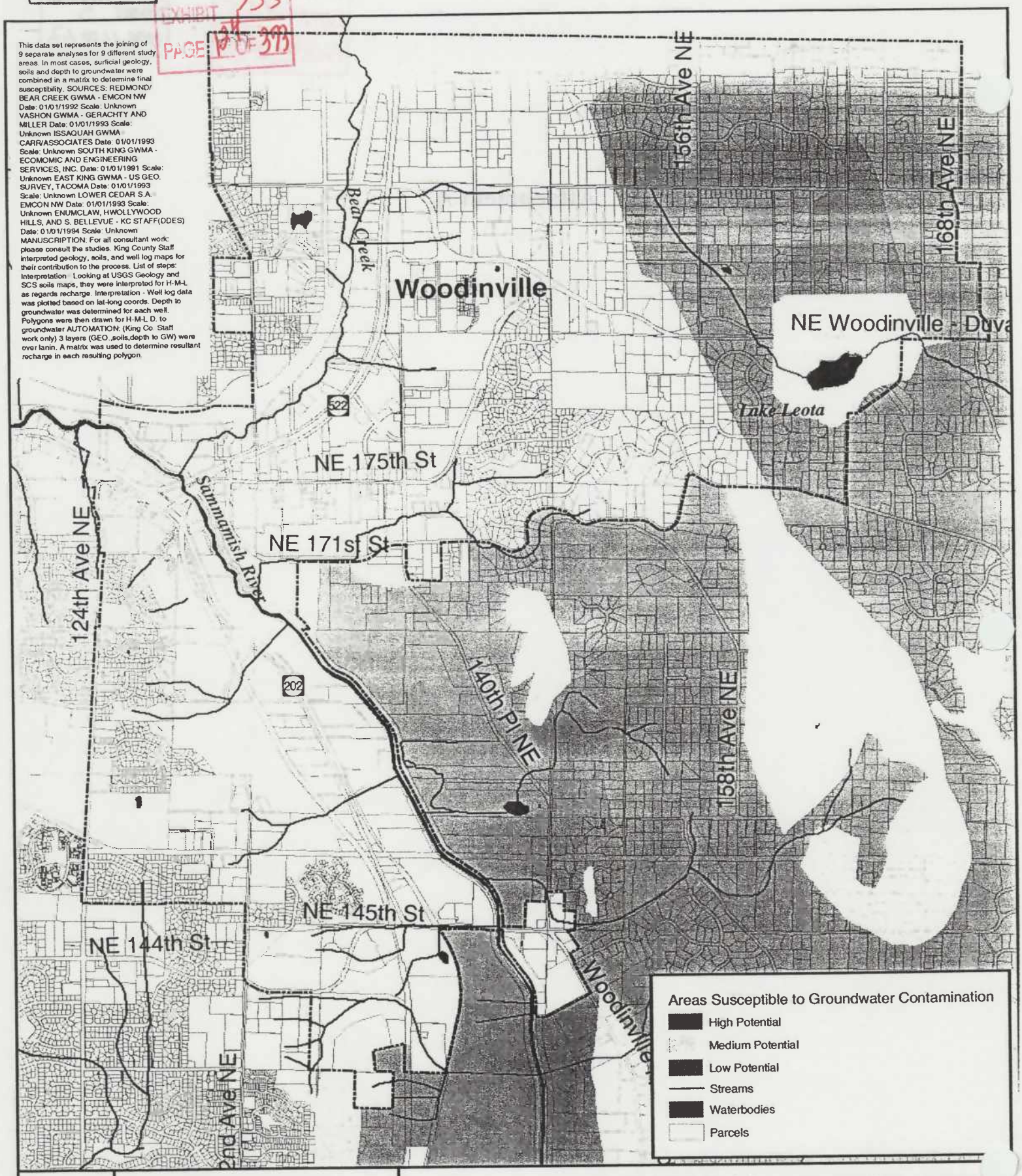
This data set represents the joining of 9 separate analyses for 9 different study areas. In most cases, surficial geology, soils and depth to groundwater were combined in a matrix to determine final susceptibility. SOURCES: REDMOND/ BEAR CREEK GWMA - EMCON NW Date: 01/01/1992 Scale: Unknown VASHON GWMA - GERACHTY AND MILLER Date: 01/01/1993 Scale: Unknown ISSAQUAH GWMA CARR/ASSOCIATES Date: 01/01/1993 Scale: Unknown SOUTH KING GWMA - ECOMOMIC AND ENGINEERING SERVICES, INC. Date: 01/01/1991 Scale: Unknown EAST KING GWMA - US GEO. SURVEY, TACOMA Date: 01/01/1993 Scale: Unknown LOWER CEDAR S.A. EMCON NW Date: 01/01/1993 Scale: Unknown ENUMCLAW, HWOLLYWOOD HILLS, AND S. BELLEVUE - KC STAFF(DDES) Date: 01/01/1994 Scale: Unknown MANUSCRIPTION: For all consultant work: please consult the studies. King County Staff interpreted geology, soils, and well log maps for their contribution to the process. List of steps: Interpretation - Looking at USGS Geology and SCS soils maps, they were interpreted for H-M-L as regards recharge. Interpretation - Well log data was plotted based on lat-long coords. Depth to groundwater was determined for each well. Polygons were then drawn for H-M-L D. to groundwater AUTOMATION: (King Co. Staff work only) 3 layers (GEO.,soils,depth to GW) were over lanin. A matrix was used to determine resultant recharge in each resulting polygon.



Map data shown are the property of the sources listed below. Inaccuracies may exist, and Adolfson Associates, Inc. implies no warranties or guarantees regarding any aspect of data depiction.

Sources: King County GIS

WOODINVILLE - CRITICAL AREAS
AREAS SUSCEPTIBLE TO GROUNDWATER CONTAMINATION

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MEMORANDUM

ADOLFSON

Environmental Solutions

DATE: February 27, 2004

TO: Debra Crawford
City of Woodinville
Planning and Community Development Department

FROM: Cathie Conolly

CC: Teresa Vanderburg

RE: Final Wildlife Best Available Science Technical Memorandum

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1.0 INTRODUCTION

1.1 Project Authorization

At the request of the City of Woodinville, Adolfson Associates, Inc. (Adolfson) has prepared this technical memorandum to provide an overview of the "best available science" pertaining to management of wildlife and its application to urban environments such as those found in the City of Woodinville (the City). This paper will provide guidance to the City in development of the City's code regarding wildlife.

The Washington Administrative Code (WAC) directs counties and cities as follows (the full text of WAC 365-195-900 through 365-195-925 is included in Appendix A):

> Counties and cities must include the "best available science" when developing policies and development regulations to protect the functions and values of critical areas and must give "special consideration" to conservation or protection measures necessary to preserve or enhance anadromous fisheries (RCW 36.70A.172(1)). The rules in WAC 365-195-900 through 365-195-925 are intended to assist counties and cities in identifying and including the best available science in newly adopted polices and regulations and in this periodic review and evaluation and in demonstrating they have met their statutory obligations under RCW 36.70A.172 (1).

This technical memorandum discusses the results of the best available science review for wildlife and evaluates the applicability of the science to wildlife habitat protection in the City. Adolfson has based our review of the City environment on two days of field reconnaissance, existing literature, state database searches, and preliminary information from the City.

State Growth Management Act Requirements Rules promulgated under the 1990 Washington State Growth Management Act (GMA) (RCW 360.70A.060) require counties and cities to adopt

development regulations that protect the functions and values of critical areas, including streams, wetlands, wildlife habitat, and critical aquifer recharge areas. In 1995, the Washington State legislature added a new section to the GMA to ensure that counties and cities consider reliable scientific information when adopting policies and development regulations to designate and protect critical areas. As a result of this legislation, in 2000 the Growth Management Division of Washington's Office of Community Development (OCD) adopted procedural criteria to guide cities and counties in identifying and including the best available science in their critical area policies and regulations. In accordance with RCW 36.70A.172(1), communities "shall include the best available science in developing policies and development regulations to protect the functions and values of critical areas, including wetlands."

Wildlife habitat areas are one component of "fish and wildlife habitat conservation areas," a critical area defined by Washington's GMA. Fish and wildlife habitat conservation areas are defined as critical areas in Washington Administrative Code (WAC) 365-190-080 and include the following components:

- Areas that have a primary association with endangered, threatened, and sensitive species;
- Habitats for species of local importance;
- Naturally occurring ponds under 20 acres and their submerged aquatic beds that provide fish or wildlife habitat;
- Waters of the state; and
- Lakes, ponds, streams, and rivers planted with game fish by a governmental or tribal entity.

Fish and wildlife conservation areas are lands that are designated to maintain target species within their natural geographic distribution so that isolated subpopulations are not created. These areas are considered to be critical for long-term viability and proliferation of certain native fish and wildlife species.

1.2 Overview of City Environment

The City of Woodinville is an urbanizing city located in the Sammamish River Valley in King County, Washington (see Figure 1). It is approximately 5.66 square miles in size and has an estimated population of 9,809 (as of April 2003). The Sammamish River flows through the City and to the west toward Lake Washington. Little Bear Creek also flows through Woodinville and into the Sammamish River. Woodinville's commercial, industrial, and agricultural areas are generally confined to the valley floor, while residential neighborhoods occupy the surrounding plateaus and slopes, many of which are heavily forested.

The Sammamish River Valley was historically a wide area filled with wetlands and meandering and braided channels (U.S. Army Corps of Engineers and King County Department of Natural Resources and Parks, 2003). The river channel and valley have been drastically altered by development—forests have been cleared, wetlands have been drained, the river has been confined to one channel, the Lake Washington lake level has been lowered altering the flow pattern of the river, and the river has been constrained for flood control.

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The city limits are generally described as the lands bounded on the north by the Snohomish/King County line, on the east by 170th Ave NE north of NE Woodinville-Duvall Road and the Sammamish River, on the south by NE 145th Street (State Route 202), and on the west by 124th Avenue NE.

Wildlife and wildlife habitat in the City of Woodinville is scattered throughout the city in and around the main watercourses, lowland forest patches, riparian areas, wetlands, and urban environments. The largest contiguous areas of priority habitat include wetlands along Little Bear Creek, the forested slopes above the Sammamish River and its remaining riparian areas (WDFW 2003). Priority habitats are areas that support diverse, unique, and/or abundant communities of fish and wildlife (WDFW 1998). There is a lack of detailed inventory information for wildlife use and wildlife habitat in the City. Knowledge of wildlife habitat in the City is based on Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species mapping, aerial photographs, and limited August field reconnaissance.

2.0 STATE OF THE SCIENCE FOR WILDLIFE AND WILDLIFE HABITAT CONSERVATION AREAS

This section summarizes the state of the science, or "best available science" for wildlife and wildlife habitat conservation areas. Habitat for fish and special consideration for anadromous fish are addressed in a separate memorandum addressing streams (Adolfson, in preparation, 2004). This information is a summary of existing literature and is not intended to be an exclusive list of all best available science currently published on wildlife and wildlife habitat, but is intended to provide a brief overview of published information useful for local planning. Adolfson has referenced findings from selected scientific literature where applicable, including relevant studies from the Washington State Office of Community Development's (OCD) "Citations of Recommended Sources for Designating and Protecting Critical Areas" (OCD 2002). In addition, Adolfson reviewed the DRAFT *Freshwater Wetlands in Washington State – Volume 1: A Synthesis of the Science* (Ecology, 2003). Higher preference has been given to science and research conducted in the Pacific Northwest versus research from other areas of the United States.

3.0 WILDLIFE HABITAT TYPES AND SPECIES REQUIREMENTS

Wildlife habitats for western Washington are described and categorized in *Wildlife–Habitat Relationships in Oregon and Washington* (Johnson and O'Neil, 2001). The WDFW and the Northwest Habitat Institute developed this habitat typing methodology with input from a panel of regional wildlife experts and with information collected from more than 12,000 pertinent publications. Using this methodology, habitats were assessed at three levels of detail: wildlife habitat types, structural conditions, and habitat elements. The term "wildlife habitat type" as referred to in Johnson and O'Neil (2001) generally describes vegetation cover types or land use/land cover types. Geographic distribution and physical setting (including climate, elevation, soils, hydrology, geology, and topography) and human activities (such as agriculture and urban development) influence vegetation cover and land use patterns. Wildlife species abundance and distribution are directly related to wildlife habitat types.

Structural condition refers to vegetation structure and is based on the characteristics of trees and shrubs including tree size, number of canopy layers, and canopy closure. Upland and wetland habitat types in this report are broken down by vegetation structure: forest, shrub, and grassland/emergent. Structural conditions in urban areas are shaped by land use cover type as indicated by variables such as the percent impervious surface in a watershed.

Habitat elements are described on a site-specific basis and include biological, physical, and anthropogenic features that influence wildlife species distribution, abundance, fitness, and viability. Common habitat elements in Woodinville include downed wood, tree snags, moss, leaf litter, trails, hedgerows, street trees, ornamental landscaping, and roads. Habitat elements can have positive or negative effects on wildlife species.

As per the habitat types in Johnson and O'Neil (2001), wildlife habitats in Woodinville include the following general categories:

- Westside riparian wetlands;
- Westside lowland conifer/hardwood forest;
- Herbaceous wetlands and open water; and
- Agriculture and urban environs (agriculture, pasture, and mixed environs; and urban and mixed environs).

Outside of vegetated habitat patches and linkages, Woodinville's current landscape matrix is urban in character, comprised primarily of residential development, both single-family and multi-family, and secondarily of commercial development. Within this matrix, a few large blocks of westside lowland forest remain in the northern and southern portions of the City. Habitat linkages between these blocks, where they exist, are predominantly comprised of westside riparian-wetland habitat or lowland forested slopes. Open water and herbaceous wetland habitats in the City are scattered throughout and are mostly associated with ponds or lakes. Agricultural habitats consist of scattered pastures near the Sammamish River. The percentages of each habitat within the City are unknown at this time.

In general, wildlife species require adequate forage, water, structure, and space for breeding/nesting, roosting, and for cover (Johnson and O'Neil, 2001; Link, 1999). Urban development can affect these basic requirements through:

- Habitat loss and fragmentation;
- Loss of habitat connectivity necessary for dispersal;
- A substantial increase in impervious surface, which affects surface water runoff; and
- Increased human activity.

Similar to other urban areas in the Puget Sound region, roads are a significant feature of Woodinville's landscape matrix. Road systems are important features that influence wildlife species distribution on the landscape (Ferguson et al., 2001). Roads can create barriers to wildlife movement, fragmenting habitat, and facilitating the spread of non-native plant and animal species

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(Ferguson et al., 2001). In the City of Woodinville, Highway 522, the Woodinville-Duvall Road, and the Woodinville-Redmond Road are the prominent roads that fragment habitat and interrupt the movement of large and small mammals, amphibians, and reptiles.

4.0 SPECIES COMMONLY PRESENT IN WOODINVILLE

The City of Woodinville provides habitat for many common wildlife species found in the Pacific Northwest. A habitat assessment of Little Bear Creek conducted by David Evans and Associates, Inc. (DEA 2002) included wildlife surveys along Little Bear Creek that are likely representative of other riparian and wetland habitats in the City. DEA (2002) observed several mammal species including beaver, river otter, black-tailed deer, and myotis bat. Amphibians and reptiles observed included Pacific tree frog, northwestern salamander, northwestern garter snake, and bull frog. Other amphibian species possible in the City include red-legged frog, long-toed salamander, and rough-skinned newt.

Resident songbirds such as song sparrows, spotted towhee, winter and Bewick's wren, dark-eyed junco, and black-capped and chestnut-backed chickadees are common in forested patches and shrubs and trees of urban neighborhoods. Neotropical migrant birds are also likely found in the City's riparian and wetland habitats during spring and summer, including swallows, Wilson's and yellow warblers, and Swainson's thrush. DEA (2002) noted that the City could potentially provide breeding habitat for several migratory species whose populations are declining. Raptors, such as Cooper's and sharp-shinned hawks, likely inhabit forested areas and urban areas with mature trees.

Urban areas like Woodinville tend to support more "generalist" species and are more prone to invasion by non-native, invasive plant and animal species due to the high level of disturbance to soil and vegetation in agricultural and urban habitats (Ferguson et al., 2001). Generalist species can use a variety of vegetation cover types for breeding and foraging and include both native and non-native species tolerant of human disturbance. In contrast, many "specialist" species require specific habitat characteristics that are either limited or no longer present in developed landscapes. Examples of generalist species found in Woodinville include: American crow, Steller's jay, European starling, American robin, spotted towhee, song sparrow, house finch, raccoon, Virginia opossum, and eastern gray squirrel.

While Woodinville's urban character limits habitat for a number of specialist species, the City does provide habitat for several "special status" species. The potential effects of urban development on these "special status" species in Woodinville and management considerations for these species are discussed below.

5.0 SPECIAL STATUS SPECIES

5.1 Overview

Special status species include species designated by federal government agencies (USFWS and NMFS) as endangered, threatened, proposed, and candidate, and species designated by WDFW as

endangered or threatened. Appendix B includes a table of special status species that may exist in the City of Woodinville and where they may be found.

5.2 Habitat Elements/Values Supporting Special Status Species

Like all wildlife species, each of the special status wildlife species identified in the City of Woodinville requires adequate forage, water, structure, and space for breeding/nesting, roosting, and cover. Their ability to survive in the remaining fragmented habitat areas in Woodinville depends on the presence of and their specific requirements for forage, water, and structure. The regular nesting and roosting sites of special status species are considered priority habitat by the Washington Department of Fish and Wildlife (WDFW), and the agency has published recommendations for managing breeding and foraging habitats for these species (Watson and Rodrick, 2002; Rodrick and Milner, 1991).

6.0 FUNCTIONS AND VALUES OF HABITAT TYPES IN WOODINVILLE

6.1 Wildlife Habitat Function of Agricultural and Urban Environs

Urban environs are characterized by low (10-29%), medium (30-59%), and high-intensity (60-100%) areas of impervious surface. Medium-density, single-family lots (lot sizes less than 1 acre) cover most of Woodinville and are the dominant habitat type in the City. Large conifer trees provide structure and a scattered urban forest canopy in many medium-density neighborhoods. Native and ornamental shrubs and trees provide food for several bird and mammal species in these neighborhoods as noted in Section 4.0 above. Medium-density areas are interspersed with other habitat types and can function as upland forest or riparian wetlands if enough habitat elements are provided in undeveloped lots or as part of site landscaping. Common wildlife species observed in urban mixed environs included Steller's jay, American crow, seagulls, house sparrow, European starling, and Eastern gray squirrel. High-density commercial and residential areas are concentrated in the downtown core and adjacent to major highways. Even in high-density areas, wildlife species are attracted to landscaping islands for food and cover. Wildlife species using these areas include those listed for medium-density areas above.

Agricultural areas are located near the Sammamish River on small parcels of private land and include cultivated croplands and grazed pastures. Relatively few acres in the City are considered agricultural. These areas are grouped with urban environs because they provide similar habitat elements for wildlife and are considered developed. Habitat elements in agricultural areas include, but are not limited to, seeds from herbaceous plants, berries from shrubs, scattered trees, farm buildings, and adjacent lakes, ponds, and streams. Common wildlife species include Canada goose, barn owl, American crow, European starling, mallard, swallow species, bat, mole, vole, mouse, rat, and other species adapted to human modified landscapes.

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Both agricultural and urban habitats are largely occupied by generalist species that are adapted to use a variety of habitats for foraging and breeding (Ferguson et al., 2001). In general, these habitats types do not contain the required structure, forage, and space needed for specialist species (e.g., Swainson's thrush, winter wren, mink, northwest salamander), including special status species, that are adapted to native habitats (Ferguson et al., 2001).

6.2 Wildlife Habitat Function of Westside Lowland Hardwood/Conifer Forest

Prior to agriculture and urban development, westside lowland conifer-hardwood forest was likely the most common habitat type in the Woodinville area. Today, some of the largest tracts of lowland forest are located on the steep slopes in the southern portion of the City and/or in riparian areas. Several large patches of lowland forest are also present at the northern end of the City, near the Snohomish County border, which are fragmented by medium-density residential development. Dominant trees in forest areas include Douglas fir, western hemlock, western red cedar, big leaf maple, red alder, and vine maple. Common understory shrubs, herbs, and forbs include salmonberry, Indian plum, sword fern, salal, and Oregon grape. The understory of younger (sapling and small tree) forests is dominated by red alder, salmonberry, and Himalayan blackberry. Invasive, non-native plants that are common in forest areas include Himalayan blackberry, English ivy, and English holly.

Forest structural elements defined by Johnson and O'Neil (2001) include tree size, number of canopy layers, and canopy closure. Most forested areas observed during the habitat reconnaissance are characterized by medium-sized trees (15-19 inches diameter at breast height [dbh]), one to two canopy layers, and moderate canopy closure (40-69%). Habitat elements or features include snags, downed logs, stumps, moss and lichens, leaf litter, and dense shrub thickets. Adjacent streams, wetlands, and lakes are also considered habitat elements.

Native forest in the Puget Sound lowlands provides habitat for more than 130 other non-special status bird, mammal, amphibian, and reptile species (Johnson and O'Neil, 2001). Several key features in forests are important for wildlife, including large trees, structure, the species composition of trees and shrubs, dead wood, and forest litter layers. These key components can be managed to provide vertical structure and cavities, food resources, and substrates for cover and for burrowing species (McComb, 2001). Common bird species likely in forest areas with medium-aged trees, one to two canopy layers, and moderate canopy closure included black-capped chickadee, dark-eyed junco, song sparrow, golden-crowned kinglet, American robin, northern flicker, red-breasted nuthatch, spotted towhee, and bushtit. Mammals may include eastern gray squirrel, raccoon, Virginia opossum, black-tailed deer, coyote, mole, vole, rat, and mouse. Amphibians use upland forest for cover and dispersal. Forest-dwelling species include Pacific tree frog, red-legged frog, northwestern salamander, long-toed salamander, and western red-backed salamander. Reptiles expected to use upland forest include rubber boa and northwestern and common garter snakes.

When there is a presence of large trees and dead tree snags, lowland forests provide important foraging and breeding habitat for several special status species, most notably bald eagle and pileated woodpecker.

6.3 Wildlife Habitat Function of Westside Riparian/Wetlands

Westside riparian/wetland habitat in Woodinville includes forested and shrub upland riparian areas and wetlands, most of which are associated with streams. Dominant plants in wetland/riparian areas include black cottonwood, red alder, willow species, Douglas spiraea, salmonberry, red osier dogwood, Himalayan blackberry, and reed canarygrass. Riparian areas perform multiple functions by attenuating floodwaters, improving water quality, moderating stream water temperature, contributing to channel complexity, supplying large woody debris, and providing wildlife habitat (Spence et al., 1996; Knutson and Naef, 1997; Castelle and Johnson, 2000; Brazier and Brown, 1973; Ecology, 2001; Naiman et al., 1992; Swales and Levings, 1989). In addition, these wetlands provide habitat for most wildlife species that reside in or migrate through the City. Wildlife species abundance and diversity is higher in wetland/riparian areas than in other habitat types because these areas generally provide:

- Structural and plant diversity;
- Edge habitat where two or more habitat types adjoin;
- Varied forage; and
- A predictable water source (Kauffman et al., 2001).

Common wildlife species found in riparian areas are similar to those of lowland forest, with the addition of some amphibians that require standing water and birds that prefer snags for forage and/or nesting. In addition to salmonids, other special status species also depend on high quality riparian areas for nesting and roosting. Special status species in Woodinville also generally forage on riparian-dependent species such as insects, stream dwelling invertebrates, and juvenile fish. High quality riparian areas generally include native vegetation with multi-canopy structure, snags, and down logs (McMillian, 2000). These areas provide habitat for the greatest range of wildlife species. All of the special status species in the City are closely or generally associated with westside riparian-wetland habitats (Johnson and O'Neil, 2001).

6.4 Wildlife Habitat Function of Herbaceous Wetlands/Open Water Habitat

Herbaceous wetlands in Woodinville contain emergent vegetation such as reed canarygrass, common cattail, creeping buttercup, soft rush, small fruited bulrush, and slough sedge. Large snags are sometimes present, providing nesting and roosting opportunities for birds and bats, and foraging opportunities for birds. Herbaceous wetland and open water habitats in Woodinville are concentrated in the drainages of Little Bear Creek, Woodin Creek, and Cold Creek, and in the vicinity of the Sammamish River.

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The characteristics and presence of open water and herbaceous wetland habitats depend upon hydrology, chemical reactions in wetland soils, vegetation community composition, and other factors influenced by human and other animal inputs (Mitsch and Gosselink, 1993). Herbaceous wetlands have decreased in size in the Puget Sound region and therefore are highly susceptible to invasion by non-native invasive species (Johnson and O'Neil, 2001). Presence of surface water, including seasonal flooding and drying, and the presence of relatively undisturbed native plant communities are important for wildlife in open water and herbaceous wetland habitats (Weller, 1994).

More than 130 non-status wildlife species forage or breed in herbaceous wetland habitats, while over 70 forage or breed in open water habitats (Johnson and O'Neil, 2001). Closely associated wildlife species include red-winged blackbird, common yellowthroat, marsh wren, amphibian species, beaver, muskrat, river otter, mink, and weasel. Herbaceous wetlands also provide important breeding and foraging opportunities for all of the special status species, some of which are known to occur in Woodinville and others which are rare or may be extirpated (Rodrick and Milner, 1991; Smith et al., 1997; Leonard et al., 1993).

7.0 HABITAT LINKAGES, ISOLATION, AND FRAGMENTATION

Wildlife habitat linkages are typically linear strips of habitat that connect larger habitats, such as lowland forest or riparian areas. These bands of habitat provide enough food, structure, and water for some wildlife species to live in the linkage area, while others use these areas to move from one habitat area to another. Linkages that connect larger tracts of more diverse habitat are especially important in urban areas where habitats are fragmented and isolated by development and roads (Adams, 1994). Habitat linkages in urbanizing areas generally consist of riparian areas and forested steep slopes that provide habitat for species moving between foraging areas, breeding areas, and seasonal ranges, and which can provide habitat for the dispersal of young animals (Knutson and Naef, 1997). The potential and existing habitat linkages also encompass public lands, such as parks, open space, and trail corridors. Major roads and urban development, however, interrupt even the most substantial (widest) habitat linkages in Woodinville. Roads can be partial or complete barriers to terrestrial wildlife movement, especially to slow moving species such as turtles and salamanders (Ferguson et al., 2001).

Primary habitat linkages in Woodinville include Woodin Creek Park combined with the Wilmot Gateway Park, and the Rotary Community Park. Additional linkage areas connecting smaller habitat tracts include the scattered vegetated riparian areas and steep slopes throughout the City.

8.0 WILDLIFE HABITAT PROTECTION AND RESTORATION STRATEGIES

Protecting the highest quality habitats in Woodinville, for example the well-established forest habitat on the slopes above the Sammamish River, may be an effective strategy for protecting wildlife habitat. In addition, protection of the remaining patches of lowland conifer forest in the northern part of the city, such as the rectangular parcels near the Snohomish/King County border,

would preserve some of the remaining upland habitat and existing habitat linkages. Protection efforts can be focused on protecting intact, native forest habitats because these habitats are not easily replaced.

Changes to forest structure drive the composition of wildlife communities that live in Western Washington habitats (Brown, ed. 1985). In upland and riparian habitats, the goal of enhancement could be to improve forest structure. To achieve long-term habitat improvement or enhancement this means planting native trees, providing regular monitoring and maintenance, followed by planting shade tolerant ground cover to complete the forest vegetation community. Measures that provide almost immediate habitat improvement include installation of upright snags, downed logs, brush piles, and other structural habitat elements.

9.0 WILDLIFE CONSERVATION

Several strategies for conserving wildlife and wildlife habitat are available for cities to adopt. For example, the City of Redmond has drafted several comprehensive plan policies and regulations contained in the Redmond Community Development Guide (RCDG) designed to protect wildlife and wildlife habitat with a focus on "critical habitat". The City proposes to protect critical habitat and habitat linkages using a combination of regulatory and non-regulatory tools. In their sensitive areas regulations, Redmond defines critical habitat as habitat for species that are proposed or listed by the federal government or Washington State as endangered, threatened, sensitive, or priority species. Critical habitat also includes areas with heron rookeries or raptor nesting trees; Type I wetlands; and Class I streams. Although other sensitive areas such as wetlands, streams, and steep slopes were identified on Redmond maps in the early 1990s, critical habitat had not been identified. This led to uncertainties in the development review process as to how to protect fish and wildlife conservation areas when they were unmapped.

Another example of an approach to wildlife conservation is the City of Bellevue's wildlife habitat inventory. The City has completed an inventory based upon a review of existing information and four days of field reconnaissance to support an update of policies and regulations for the management of critical areas in Bellevue. The inventory describes Bellevue's landscape and major habitat types, identifies "special status" species that are known to inhabit or may inhabit Bellevue, and describes habitat conditions in the City's major drainage basins.

10.0 DATA GAPS

Several data gaps were identified during preparation of this memorandum. First, a complete inventory of wildlife and habitats occurring within the City of Woodinville is lacking. The City must rely at this time on Priority Habitat and Species mapping for the area, which may or may not be complete or current. GIS mapping of wildlife habitat in the City can be a useful tool in determining where linkages between habitats or corridors may be present. Secondly, a list of special status species with documented occurrence in the City of Woodinville does not exist. This could be generated after the wildlife inventory is complete using the information compiled from City staff and others.

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APPENDIX A

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APPENDIX B

Special Status Species Likely to Occur as Residents or Breeders in the City of Woodinville

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APPENDIX B

Table 1 - Special Status Species Likely to Occur as Residents or Breeders in the City of Woodinville

Common Name	Scientific Name	Federal Status	State Status	Habitat Types					
				Westside Lowlands Conifer-Hardwood Forest	Westside Riparian-Wetlands	Herbaceous Wetlands	Open Water	Agricultural, Pasture, and Mixed Environs	Urban and Mixed Environs
Birds									
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Threatened	Generally associated	Generally associated	Generally associated	Closely associated	Generally associated	Generally associated
Peregrine falcon	*Falco peregrinus*	Species of Concern	Endangered	Generally associated	Generally associated	Generally associated	Generally associated	Present	Generally associated
Amphibians									
Oregon spotted frog	*Rana pretiosa*	Candidate	Endangered	Present	Closely associated	Closely associated	Closely associated	Present	NA
Reptiles									
Western pond turtle	*Clemmys marmorata*	Species of Concern	Endangered	Present	Closely associated	Closely associated	Closely associated	Present	Present
Fish[2]									
Chinook salmon (Puget Sound)	*Oncorhynchus tshawytscha*	Threatened	Candidate	NA	Closely associated	NA	Closely associated	NA	NA

Common Name	Scientific Name	Federal Status	State Status	Habitat Types					
				Westside Lowlands Conifer-Hardwood Forest	Westside Riparian-Wetlands	Herbaceous Wetlands	Open Water	Agricultural, Pasture, and Mixed Environs	Urban and Mixed Environs
Bull trout	*Salvelinus confluentus*	Threatened	Candidate	NA	Closely associated	NA	Closely associated	NA	NA

1. Habitat association information from O'Neil, T A., et. al., *Matrixes for Wildlife-Habitat Relationships in Oregon and Washington*. Northwest Habitat Institute. 2001. In D.H. Johnson and T.A. O'Neil *Wildlife-Habitat Relationships in Oregon and Washington*. Oregon State University Press. Corvallis. Oregon. 2001.

2. Information obtained from National Marine Fisheries Service and United States Fish and Wildlife Service, not from Johnson and O'Neil (2001).

Closely Associated - A species is widely known to depend on a habitat for part of all of its life history requirements.
Generally Associated - A species exhibits a high degree of adaptability and may be supported by a number of habitats.
Present – A species demonstrates occasional use of the habitat.
NA – Not associated or present in this habitat type.

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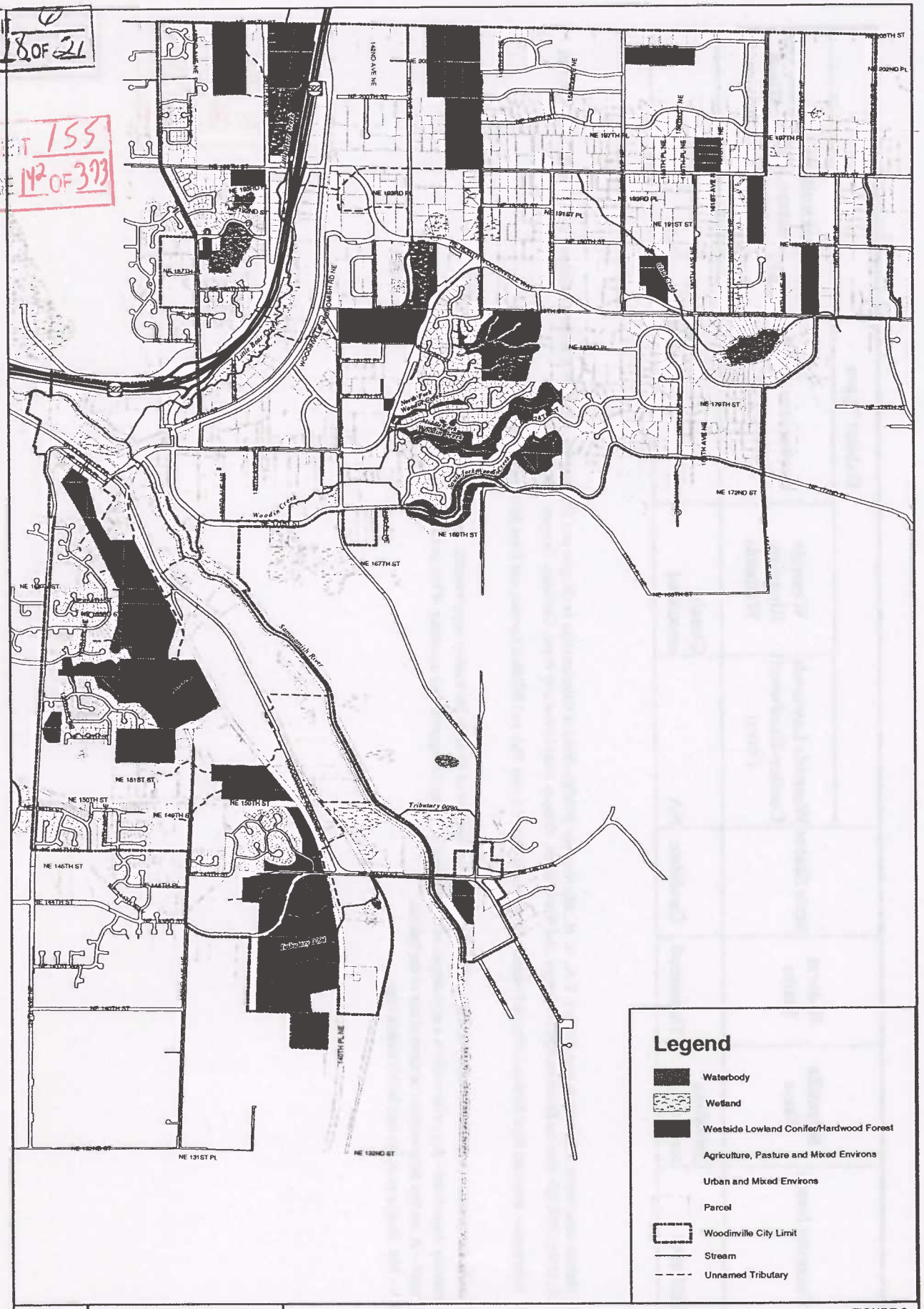

Map data shown are the property of the sources listed below. Inaccuracies may exist, and Adolfson Associates, Inc. implies no warranties or guarantees regarding any aspect of data depiction.

Source: Woodinville GIS 2003; King County GIS 2003; NWI 1987

0 0.25 0.5 Miles

FIGURE 2.
HABITAT TYPES
WOODINVILLE SAO UPDATE AND BAS
WOODINVILLE, WASHINGTON

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REPORT REQUIREMENTS FOR HABITAT CONSERVATION AREAS

Critical area report – Requirements for habitat conservation areas.
Critical area reports for habitat conservation areas must meet the requirements of this section. Critical area reports for two or more types of critical areas must meet the report requirements for each relevant type of critical area.

A. **Prepared by a qualified professional.** A critical areas report for a habitat conservation area shall be prepared by a qualified professional who is a biologist with experience preparing reports for the relevant type of habitat.

B. **Area addressed in critical area report**. The following areas shall be addressed in a critical area report for habitat conservation areas:[1]

1. The project area of the proposed activity;
2. All habitat conservation areas and recommended buffers within three hundred (300) feet of the project area; and
3. All shoreline areas, floodplains, and other critical areas, and related buffers within three hundred (300) feet of the project area.

C. **Habitat assessment.** A habitat assessment is an investigation of the project area to evaluate the presence or absence of a potential critical fish or wildlife species or habitat. A critical area report for a habitat conservation area shall contain an assessment of habitats including the following site- and proposal-related information at a minimum:

1. A map drawn to scale or survey showing the following information:
   a. All lakes, ponds, streams, wetlands and tidal waters on, or adjacent to the subject property, including the name (if named), and ordinary high water mark of each, and the stream type or wetland category consistent with WMC _____
   b. The location and description of the fish and wildlife habitat conservation area on the subject property, as well as any potential fish and wildlife habitat conservation area within 200 feet of the subject property as shown on maps maintained by the department,
2. Detailed description of vegetation on and adjacent to the project area;
3. Identification of any species of local importance, priority species, or endangered, threatened, sensitive or candidate species that have a primary association with habitat

[1] Critical area reports for habitat areas should consider protected habitats and species and their buffers located within three hundred (300) feet. Three hundred feet is a suggested distance so that habitat areas that might be affected by the proposal are included in the critical area report. Three hundred feet allows for the potential riparian habitat area widths and for buffers/zones that may not be accurately mapped at the time of application.

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on or adjacent to the project area, and assessment of potential project impacts to the use of the site by the species;

4. A discussion of any federal, state, or local special management recommendations, including Department of Fish and Wildlife habitat management recommendations, that have been developed for species or habitats located on or adjacent to the project area;

5. A detailed discussion of the potential impacts on habitat by the project, including potential impacts to water quality;

6. A discussion of measures, including avoidance, minimization and mitigation, proposed to preserve existing habitats and restore any habitat that was degraded prior to the current proposed land use activity and to be conducted in accordance with *Mitigation sequencing* [Section X.10.230]; and

7. A discussion of ongoing management practices that will protect habitat after the project site has been developed, including proposed monitoring and maintenance programs.

8. Prohibition or limitation of development activities within the fish and wildlife habitat conservation area,

9. Establishment of a buffer around the fish and wildlife habitat conservation area,

10. Retention of certain vegetation or areas of vegetation critically important to the critical species,

11. Limitation of access to the fish and wildlife habitat conservation area and buffer,

12. Seasonal restrictions on construction activities on the subject property,

13. Clustering of development on the subject property, and

14. The preservation or creation of a habitat area for the critical species.

D. **Additional information may be required.** When appropriate due to the type of habitat or species present or the project area conditions, the [director] may also require the habitat management plan to include:

1. An evaluation by an independent qualified professional regarding the applicant's analysis and the effectiveness of any proposed mitigating measures or programs, to include any recommendations as appropriate;

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2. A request for consultation with the Department of Fish and Wildlife or the local Native American Indian Tribe; and

3. Detailed surface and subsurface hydrologic features both on and adjacent to the site.

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MEMORANDUM

ADOLFSON

Environmental Solutions

DATE: February 26, 2004

TO: Debra Crawford
City of Woodinville
Planning and Community Development Department

FROM: Cathie Conolly

CC: Teresa Vanderburg

RE: Final Wetlands and Streams Best Available Science Technical Memorandum

---

1.0 INTRODUCTION

1.1 Project Authorization

At the request of the City of Woodinville, Adolfson Associates, Inc. (Adolfson) has prepared this technical memo to provide an overview of the "best available science" pertaining to management of wetlands and streams and its application to urban environments such as those found in the City of Woodinville (the City). This paper will provide guidance to the City in development and revision of the City's code regarding wetlands and streams –Woodinville Municipal Code (WMC) Chapter 21.24 Sensitive Areas Ordinance.

The Washington Administrative Code (WAC) directs counties and cities as follows (the full text of WAC 365-195-900 through 365-195-925 is included in Appendix A):

> Counties and cities must include the "best available science" when developing policies and development regulations to protect the functions and values of critical areas and must give "special consideration" to conservation or protection measures necessary to preserve or enhance anadromous fisheries. RCW 36.70A.172(1). The rules in WAC 365-195-900 through 365-195-925 are intended to assist counties and cities in identifying and including the best available science in newly adopted polices and regulations and in this periodic review and evaluation and in demonstrating they have met their statutory obligations under RCW 36.70A.172 (1).

This paper discusses the results of the best available science review for wetlands and streams and evaluates the applicability of the science to stream and wetland habitat protection in the City. Adolfson has based our review of the city environment on two days of field investigation (August 1st and 21st), existing literature, and preliminary information from the City. This

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technical memorandum is the first step in Adolfson's review of the City's Critical Areas Ordinance. Future documents will evaluate the gaps between the City's existing regulations and best available science guidelines. Adolfson will also be proposing revisions to the City's Critical Areas Ordinance.

1.2 Overview of Growth Management Act Requirements

Rules promulgated under the 1990 Washington State's Growth Management Act (GMA) (RCW 360.70A.060) required counties and cities to adopt development regulations that protect the functions and values of critical areas, including streams, wetlands, wildlife habitat, and critical aquifer recharge areas. In 1995, the Washington State legislature added a new section to the GMA to ensure that counties and cities consider reliable scientific information when adopting policies and development regulations to designate and protect critical areas. As a result of this legislation, in 2000 the Growth Management Division of Washington's Office of Community Development (OCD) adopted procedural criteria to guide cities and counties in identifying and including the best available science in their critical area policies and regulations. In accordance with RCW 36.70A.172(1), communities "shall include the best available science in developing policies and development regulations to protect the functions and values of critical areas, including wetlands."

1.3 Overview of the City Environment

The City of Woodinville is an urbanizing city located in the Sammamish River Valley in King County, Washington (see Figure 1). It is approximately 5.66 square miles in size and has an estimated population of 9,809 (as of April 2003). The Sammamish River flows through the City and to the west toward Lake Washington. Little Bear Creek also flows through Woodinville and into the Sammamish River. Woodinville's commercial, industrial and agricultural areas are generally confined to the valley floor, while residential neighborhoods occupy the surrounding plateaus and slopes, many of which are heavily forested.

The Sammamish River Valley was historically a wide area filled with wetlands and meandering and braided channels (U.S. Army Corps of Engineers and King County Department of Natural Resources and Parks, 2003). The river channel and valley have been drastically altered by development-forests have been cleared, wetlands have been drained, the river has been confined to one channel, the Lake Washington lake level has been lowered altering the flow pattern of the river, and the river has been constrained for flood control.

The city limits are generally described as the lands bounded on the north by the Snohomish/King County line, on the east by 170th Ave NE north of NE Woodinville-Duvall Road and the Sammamish River, on the south by NE 145th Street (State Route 202), and on the west by 124th Avenue NE.

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The Sammamish River is the main water feature in the City. Along with the Sammamish River, there are five tributary streams that have documented salmonid use: Little Bear Creek, Woodin Creek, Cold Creek, and Tributary 0090, and Tributary 0091, and several minor tributaries that drain into the Sammamish River within Woodinville. Many of the minor streams have undocumented fish usage . The City is currently in the process of performing detailed stream inventories for many of the tributaries.

2.0 STATE OF THE SCIENCE FOR STREAMS AND RIPARIAN AREAS

This section summarizes the state of the science, or "best available science" for streams and riparian areas. Higher preference has been given to science and research conducted in the Pacific Northwest versus research from other areas of the United States[1]. The information in this report is a summary of existing literature and is not intended to be an exclusive list of all best available science currently published on streams, but is intended to provide a brief overview of published information useful for local planning and regulatory review. Adolfson has referenced findings from selected scientific literature where applicable, including relevant studies from the Office of Community Development's "Citations of Recommended Sources for Designating and Protecting Critical Areas." In addition, Adolfson reviewed the DRAFT *Freshwater Wetlands in Washington State – Volume 1: A Synthesis of the Science* (Ecology, 2003)

2.1 Importance of Streams and Riparian Areas

Stream systems are one of the most productive natural ecosystems. Riparian areas play a significant role in the protection of the functions of adjacent aquatic habitats. Both provide important habitats for aquatic species and other wildlife as well as contribute to recreation, water supply, economic, cultural and historic values. Specific stream functions are discussed in the following section.

2.2 Functions and Values of Streams

Elements necessary for healthy salmonid populations and for other aquatic organisms rely on processes sustained by the dynamic interaction between the stream and the adjacent riparian area (Naiman et al., 1992).

- Maintaining stream baseflows;
- Maintaining water quality;

[1] It should be noted that there are a limited number of published scientific studies in the Pacific Northwest that examine stream and riparian functions in urban environments.

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- Providing in-stream structural diversity; and
- Providing biotic input of insects and organic matter.

2.2.1 Stream Flow

Stream flow is the amount and velocity of water flowing in a stream. In undisturbed stream basins, flows are variable depending upon site-specific conditions, but are generally more stable and not subject to the peak/base flow regimes of urbanized streams. Stream degradation has been associated with the quantity of impervious surface in a basin (Booth, 2000; May et al., 1997a; May et al. 1997b; Horner and May, 2000). Urbanization changes the volume, rate, and timing of water flowing through stream systems, which can impact the physical characteristics of the stream channel (Booth, 1991). Studies in Puget Sound lowland streams show that alteration can occur in basins with as little as 10 percent total impervious surface. However, dramatic effects can be seen relative to discharge in basins where impervious surface exceeds 40 percent (May et al., 1997). In addition, medium-sized flood events in moderately urbanized watersheds are found to have peak-flow increases of two to three times the amount of runoff than non-urbanized watersheds (Booth et al., 2000). Increases in peak flow are more apparent as smaller, more frequent floods relative to larger floods (Booth et al., 2001).

Stream flow or discharge has a significant influence on salmonids during their various life stages. The quantity of stream water available for use by fish and other aquatic species will determine how habitats will be effectively used in a particular basin. Adult chinook and steelhead, for example, require greater water depths to spawn as compared to other salmonids, and thus, commonly spawn in larger streams (Wydoski and Whitney, 1979). Reaches of streams that are dry or have low flows in summer may limit summer rearing habitat for these species. While low flows may limit access to some streams or reaches, excessively high flows can also affect both stream habitat and reproductive success. Surface water that flows into riparian areas during floods or as direct precipitation can infiltrate into groundwater in riparian areas and be stored for later discharge to the stream (Ecology, 2001; City of Portland, 2001) particularly during the region's typically dry season (City of Portland, 2001; Booth, 2000; May et al., 1997; Schueler, 2001). *Most of the City's tributary streams overflow into riparian areas (Crawford, personal communication, 2003). Again maybe *note this at the bottom of the page

2.2.2 Water Quality

Low stream temperature and high water quality are critical elements of essential habitat for all native salmonid fish. Good water quality is also important to other aquatic species adapted to living in Pacific Northwest streams as well. Parameters for salmonids in particular are discussed below.

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2.2.2.1 Water Temperature

The general range of temperatures required to support healthy salmonid populations is generally considered to be between about 39° and 63° F (NMFS, 1996; USFWS, 1998). Cutthroat trout have the highest range of temperature tolerances of native salmonids (Pauley et al., 1989 in City of Portland, 2001). Above 63° F, however, salmonids begin to exhibit stress that may cause sublethal effects including reduced growth and overall survival. Lethal limits vary widely by species and development stage; constant temperatures in excess of 78° F, as one example, are within the lethal range for coho salmon (Thomas et al., 1986), which are less tolerant of high stream temperature because they usually spend a full year in freshwater Riparian vegetation, particularly forested riparian areas, can affect water temperature by providing shade to reduce solar exposure and regulate high ambient air temperatures, ameliorating water temperature increases (Brazier and Brown, 1973; Corbett and Lynch, 1985).

2.2.2.2 Dissolved Oxygen

Dissolved oxygen is one of the most influential water quality parameters for stream biota, including salmonid fish (Lamb, 1985). The most significant factor affecting dissolved oxygen levels in most streams is temperature, with cooler waters maintaining higher levels of oxygen than warmer waters (Lamb, 1985). Other factors that can contribute to oxygen levels includes water turbulence (the amount of aeration) and biochemical oxygen demand created by organic decomposition from natural organic materials, organic pollution (pet waste, sewage, etc.), and aquatic algae respiration. Nutrients may originate from human-induced sources such as fertilizers (both chemical and natural), pet waste, and leaking sewers, or from natural processes such as decomposing algae or dead plant materials that fall into streams (Lamb, 1985). Septic systems and agricultural waste can also contribute nutrients to surface waters.

2.2.2.3 Metals and Pollutants

Common pollutants in urban areas include nutrients such as phosphorus and nitrogen, pesticides, bacteria, and miscellaneous contaminants such as PCBs and heavy metals. Impervious surfaces collect and concentrate pollutants from different sources and deliver these materials to streams during rainstorms. In general, concentrations of pollutants increase in direct proportion to total impervious area (May, et al., 1997). Undisturbed riparian areas can retain sediments, nutrients, pesticides, pathogens, and other pollutants that may be present in runoff, protecting water quality in streams (Ecology, 2001; City of Portland 2001). Stormwater systems can be designed to reduce the amount of pollutants entering streams.

Elevated nitrogen and phosphorus levels in runoff are a typical problem in urban watersheds. They can lead to increased in-stream plant growth, which results in excess decaying plant material that consumes oxygen in streams and reduces aquatic habitat quality (Kerwin, 2001). Metals and hydrocarbons are often transported with sediments. Heavy metals, Polychlorinated Biphenyls (PCBs), and other contaminants may be toxic to fish and wildlife (Kerwin, 2001).

The extent to which salmonids are exposed to toxic substances such as pesticides is largely unknown (Washington Department of Agriculture et al., 2001). Toxic substances can have an acute and/or chronic effect on salmonids and other aquatic organisms, and the toxicity of many elements depends on independent factors (Kerwin, 2001).

2.2.3 In-stream Structural Diversity

There are several general habitat elements that support many species of salmonid fish. The National Marine Fisheries Service (NMFS, 1996) and U.S. Fish and Wildlife Service (USFWS, 1998) have developed guidelines to address physical habitat elements necessary to support healthy salmonid populations under variable conditions. Most of the research has been done in rural environments; however, these represent the BAS for urban environments at this time. These physical habitat elements are discussed below.

2.2.3.1 Substrate

Under natural conditions, the redistribution of substrate through bank erosion and channel movement is a natural occurrence and is necessary to maintain clean, sediment-free gravels. In urban basins, increases in stormflow quantities and velocities can cause scouring that can displace stream substrates, which in turn reduces the quality and quantity of spawning areas (May et al., 1997). Scouring can result from increased runoff from impervious surfaces and from increases in velocities as a result of channelization (straightening) and the removal of streamside vegetation. Increased runoff rates from impervious surfaces can also flush spawning gravel from streams (Bledsoe and Watson, 2001).

To balance the displacement of gravel resulting from natural redistribution or scour, streams must have a constant source of new material. In general, armoring of stream banks with riprap or revetments reduces the supply of gravel and large woody debris (LWD) (May et al., 1997).

Large woody debris creates habitat diversity in the stream environment (for example pool habitat for rearing and cover for refuge). Woody debris adds roughness to the stream channel, which slows water velocities and traps sediment (Shirvell, 1990). Because coniferous logs are slower to decompose, they generally provide more benefit as large woody debris than deciduous species (May et al., 1997).

Movement of the stream channel, undercutting of banks, windthrow, and flood events are all methods of recruitment of woody debris to the stream[2]. However, when riparian areas have been cleared and developed, and the stream bank stabilized for development, there is little large woody debris available for recruitment (May et al., 1997). Man-made features such as culverts or bridges, which restrict the ability of the stream to pass large and small woody debris

[2] LWD is sometimes added to streams by people to counteract lack of natural recruitment.

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downstream, also hinder recruitment. Increased runoff rates from impervious surfaces can also flush large woody debris from streams (Bledsoe and Watson, 2001).

Many authors have found that more than half of all large woody debris recruitment is from within 15 feet of streams, and about 90 percent comes from trees growing within about 50 feet of streams (Murphy and Koski, 1989; McDade et al., 1990; Van Sickle and Gregory, 1990).

2.2.3.2 Pool Quality and Quantity

Large, deep pools with cover provided by woody debris, overhanging vegetation, or other features such as boulders, typically provide more habitat value than smaller, shallow pools (May et al., 1997). Adult salmonids of all species require pools with sufficient depth and cover to protect them from predators during their spawning migration (Kerwin, 2001). Adult salmon often hold in pools during daylight, moving upstream from pool to pool at night.

Studies have shown, however, that stream habitat in urban and urbanizing streams typically includes reduced pool frequency and reduced overall habitat quality (May, et al., 1997). As one example, May, et al. (1997) found a dramatic decline in habitat functions as total basin impervious area increased above the 5 to 10 percent range. Two significant factors limiting stream habitat structure in urban areas include the lack of pool-forming large woody debris recruitment from riparian areas and increased frequency and magnitude of peak discharge rates, which may scour pools and woody debris from the channel.

Pools, although important for most species of salmonid fish, are just one type of habitat that salmonid fish require. Multiple habitats allow niche separation to occur so multiple populations of fish with similar habitat needs can be maintained. Riffles provide habitat for many of the aquatic insects that rearing salmonids utilize as food and create turbulence that contributes to increase stream dissolved oxygen levels. One study of urbanizing basins found that, for multiple reasons including competition, physiology, and food preferences, cutthroat trout densities may actually increase in streams that have lower pool frequencies compared to more diverse pristine systems (May et al., 1997).

2.2.3.3 Floodplain Connectivity and Off-Channel Refugia

Off-channel wetlands and side channels in riparian areas provide foraging habitat, over-wintering habitat, and refuges for rearing fish (Swales and Levings, 1989; City of Portland, 2001). These areas, which includes wetlands connected to the stream channel and side channel habitats, also have high levels of productivity and provides areas for juvenile fish to forage and grow before outmigrating to salt water. Studies in urban and urbanizing areas indicate that off-channel habitat and refugia may be reduced by urban development (Kerwin, 2001). Causes of this loss include channel straightening and disconnection from adjacent wetland areas.

2.2.4 Biotic Input

Riparian areas provide food for salmonids, both directly and indirectly (Meehan et al., 1977). Insects falling from overhanging vegetation provide food for fish. Many species of aquatic invertebrates have become adapted to feed on dead and decomposing organic material that has fallen or washed into the stream from adjacent uplands (Benfield and Webster, 1985).

Most juvenile salmonids that rear in streams prey on aquatic invertebrates and terrestrial insects that fall into streams from overhanging vegetation (Horner and May, 1999; May et al., 1997). In some streams during the summer, an estimated 50 percent of the diet of juvenile salmonids is comprised of terrestrial insects (City of Portland, 2001).

2.3 Function and Values of Riparian Buffers

Riparian buffers along stream banks help mitigate the impacts of urbanization and disturbance on adjacent lands (Finkenbine et al., 2000 in Bolton and Shellberg, 2001). Knutson and Naef (1997) summarize many of the functions of riparian buffers for Washington. Recommendations for effective buffer widths are variable, depending on their function. The Washington Department of Fish and Wildlife's (WDFW) recommended standard buffer widths for the state's five-tier stream typing system (Table 1) are based on this latter research (OCD, 2002). Table 2 identifies the ranges for recommended buffer widths from two of the papers used in the development of the WDFW recommended buffers. The WDFW stream typing system is included in Appendix B.

Table 1. Riparian Habitat Area Buffer Recommendations: Washington Department of Fish and Wildlife

Stream Type	Recommended Riparian Width
Type 1 & 2, shorelines of statewide significance	250 feet
Type 3 or other perennial or fish bearing streams, 5-20 feet wide	200 feet
Type 3 or other perennial or fish bearing streams, less than 5 feet wide	150 feet
Type 4 and 5 (low mass wasting potential)	150 feet
Type 4 and 5 (high mass wasting potential)	225 feet

Source: OCD, 2002; For definitions of the stream types see the Washington Administrative Code Sections 222-16-030 and 031 in Appendix B.

Buffer widths reported to be effective for riparian functions vary considerably; the literature is not definitive in identifying one buffer width for each function studied (Williams and Lavey, 1986; Johnson and Ryba, 1992). The wide range of reported effective buffer widths indicates that site-specific factors are important in determining the outcome of each study.

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Table 2. Range of Effective Buffer Widths

Function	Riparian Buffer Functions and Appropriate Widths Identified by May (2000)	Riparian Buffer Functions and Appropriate Widths Identified by Knudson and Naef (1997)
Sediment Removal/Erosion Control	26 - 600 feet	N/A
Sediment Removal	N/A	26 - 300 feet
Erosion Control	N/A	100 - 125 feet
Pollutant Removal	13 - 860 feet	13 - 600 feet
Large Woody Debris	33 - 328 feet	100 - 200 feet
Water Temperature	36 - 141 feet	35 - 151 feet
Wildlife Habitat	33 - 656 feet	25 - 984 feet

A general relationship between buffer width and buffer effectiveness is apparent in the research findings. Studies indicate that buffers 100-to 150-feet (30 to 45 meters) wide provide most (on the order of 80 percent) of the potential functions (Horner and May, 2000; Knutson and Naef, 1997; and Leavitt, 1998). However, there is little research on effectiveness of riparian buffers in urban environments (Herson-Jones et al., 1995). Buffer distances should be viewed mainly as guidelines, as the literature shows that site-specific factors may impact buffer effectiveness just as much as buffer width (Naiman et al., 1992; Castelle et al., 1994).

2.3.1 Application of Buffer Widths

An overall conclusion of the review of scientific literature is that, to protect a given habitat function or group of functions, the width of effective buffers depends on numerous site-specific factors. The importance of riparian functions can vary by stream size and channel width. Small headwater tributary streams are strongly influenced by riparian vegetation, where such vegetation provides shading of waters and contributes large amounts of organic material (Washington Department of Game, 1984). Temperatures in larger streams below headwaters benefit less from overhanging vegetation. In general, as stream size increases, the importance of shading and terrestrial organic inputs decrease, with a increasing significance of algal or rooted vascular plant production and organic transport from upstream (Vannote, et al., 1980). Aspect, soil type and slope all play a role in buffer effectiveness. In riparian areas located on steep slopes and/or highly erodible soils, larger buffers may be appropriate to reduce risks of erosion and delivery of fine sediment to streams. Gravel recruitment naturally occurs through undercutting of banks and scouring, but larger riparian widths in steep slope areas are required to protect the unstable soils (Budd et al., 1987).

Studies of buffer widths for moderation of stream temperatures generally range from 35 to 150 feet (Knutson and Naef, 1997). Much of the variability in the literature is related to the presence or absence of a mature tree canopy. For example, forested buffers of 75 to 100 feet

were found to provide 60 to 80 percent of the shade conditions found in fully forested watersheds (Brazier & Brown, 1973; Steinblums et al., 1984).

Recommended buffer widths for sediment and pollutant retention vary from 15 to 860 feet (URS, 2002; Knutson and Naef, 1997). This wide variation is due in general to the particular pollutant being evaluated. Doyle et al. (1977) found that buffers less than four meters (approximately 13 feet) reduced Nitrogen (N), Phosphorus (P), Potassium (K) and fecal bacteria levels. Wooded riparian buffers in Maryland coastal region were found to remove as much as 80 percent of excess P and 89 percent of excess N in the first 19 meters (approximately 62 feet) (Shisler et al.,1987). Buffers of 50 to 100 feet may provide substantial pollutant removal benefits, and can remove 75 to 80 percent of pollutants depending on site-specific conditions and buffer type (Lynch et al., 1985; Castelle & Johnson, 2000; Wong & McCuen, 1982; Castelle et al., 1992). Studies have concluded that buffers of 100 feet can achieve sediment removal efficiencies of 75 to 100 percent. Most papers also conclude that larger buffers are required on steeper slopes to reach the same level of pollutant removal.

Riparian vegetation may contribute up to 90 percent of the biotic input in headwater stream systems (Budd et al., 1987). Recommended buffers for maintenance of benthic communities range from 33 feet to greater than 100 feet. However, most studies found that buffers of 100 feet were necessary to maintain healthy benthic communities (Roby et al., 1977; Newbold et al., 1980; Castelle & Johnson, 2000).

Because riparian areas store and slowly release water, they provide a continuous flow of water to streams. The effectiveness of the buffer for this function is significantly influenced by site-specific conditions such as soil type, subsoil permeability, and topography, including the morphology of the streambed and floodplain area, among other factors. Riparian areas with properly functioning conditions (PFC's) can reduce the effects of flood flows and desynchronize peak crests and flow rates of floods (Novitzki, 1979).

Riparian buffer widths for wildlife habitat vary greatly depending on individual wildlife species, but are generally on the order of 25to 984 feet (Knutson and Naef, 1997). Studies have found that a buffer of 100 feet is optimum for maintaining macro-invertebrate diversity (Gregory et al., 1980 and May et al., 1997). Riparian buffers provide wildlife habitat, which is discussed in the Wildlife Best Available Science Technical Memorandum (Adolfson, 2003).

2.4 Stream Management in Urban Environments

Two recent studies have focused on the general effects of urbanization on streams in the lowland Puget Sound region, Booth, 2000, and Horner and May, 1999. In these studies, a general trend has emerged that places a greater emphasis on evaluation of buffer effectiveness in the context of other watersheds and evaluation of landscape-level alterations to watersheds (Roni et al., 2002; Richards et al., 1996).

The loss or disturbance of native riparian area is closely tied to urbanization in a watershed (Horner and May, 1999; Leavitt, 1998). However, cumulative impacts to water quality and

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increasing amounts of impervious area have also been associated with stream degradation and impacts to native riparian areas. The adverse impacts of impervious area and water quality functions are compounded by degradation of riparian areas (Bledsoe and Watson, 2001; May et al., 1997).

Land uses, such as high-density residential development or commercial development, located adjacent to riparian areas can result in greater impacts than lower density single-family residential uses (Pitt et al., 1986).

In most urban areas, prescriptive buffers may not be adequate to restore streams because most of the functions of buffers have been compromised by past land use actions. For example, restoration of the natural woody debris recruitment function of riparian areas is difficult in areas that lack mature forested streamside vegetation (Larson, 2000). New watershed-based strategies may need to be implemented that would address hydrology, water quality, and riparian functions to successfully address management of buffer width and quality, land use controls, and stormwater management (Booth, 2000; Horner and May, 1999). When applied in the context of a basin-wide change, these strategies may most effectively address protection, enhancement, and restoration of stream systems.

Barriers like lengthy and/or inappropriately installed culverts and stormwater control structures can inhibit fish migration and prohibit fish from accessing upstream habitats. Barriers that do not prevent the migration of fish may limit many natural processes necessary for salmonid fish production including the natural redistribution of substrate and woody debris. Restoring fish passage is an effective way to increase the quality and accessibility of habitat and can result in relatively large increases in potential fish production at a nominal cost (Roni et al., 2002). Stream channels with high quality habitat (low gradient, high pool frequency, high woody debris recruitment from riparian areas produce greater benefits (Roni et al., 2002). Land use actions or incentives that address such issues can help conserve and enhance Woodinville stream functions necessary to maintain and restore populations of anadromous fish.

3.0 FISHERIES HABITAT AND SALMONID USE IN THE CITY OF WOODINVILLE

The City of Woodinville contains one river and five tributary streams that have documented salmonid use. The City contains many small watercourses that are remnant portions of previously existing natural drainage systems that originate from the slopes located west of the Sammamish River. No information is available as to the presence or absence of fish within these smaller drainages.

The Washington Administrative Code (WAC) states that special consideration must be given to "measures necessary to preserve or enhance anadromous fisheries." Consideration for "anadromous" fish species refers to those species that reproduce in fresh water and migrate to salt water for some portion of their life, returning to fresh water. The term "fisheries" commonly

refers to stocks of fish that are managed for commercial, recreational, cultural, or ceremonial uses (WDFW, 1997).

The geographic location, topography, geology, and level of existing urbanization in the City of Woodinville limit the extent to which its streams can provide the necessary biological requirements for salmonid species and other aquatic organisms. The species potentially present in Woodinville waterbodies include at least 24 different non-native species of fish (Kerwin, 2001). These fish are likely to be present within the Sammamish River along with 11 species of anadromous and resident fishes. Anadromous salmonid species include bull trout (*Salvelinus confluentus*), Chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*O.* keta), coho salmon (*O. kisutch*), cutthroat trout (*Salmo clarki*), Kokanee (*O. nerka*) , pink salmon (*O. gorbuscha*), sockeye salmon (*O.* nerka), steelhead trout (*O. mykiss*). Other anadromous species such as lamprey (*Lampetra sp.*), and sculpin (*Cottus sp.*) are also found in the Sammamish River (DEA, 2002).

The use of stream habitats varies by species, by developmental phase, or even by individuals within the larger population (Reiser and Bjornn, 1979). There are, however, many needs that are common to all anadromous fish, as well as to the overall health of many other aquatic organisms including benthic macroinvertebrates, which are an important food source for salmonids and other animals. These elements include clean and cold water, suitably-sized spawning gravels and other in-stream diversity for use as habitat, food sources, rearing habitats in proximity to food, refuges from predators, and environmental conditions such as sufficiently high flows, and unconstrained migration routes.

In urban settings where individual functions and elements of stream habitat are not optimal for salmonids, the combined effect of conditions in a stream basin may allow salmonids to successfully use its habitats. The combined effects of the individual processes that form and support habitat, such as input of organic material and substrate types, are sufficient to allow some salmonids to live and reproduce. In addition, small changes in stream function (e.g., improving habitat access by removing a fish-passage barrier), in combination with watershed-based restoration strategies, may provide substantial benefits to salmonid populations in urbanized basins.

3.1.1 Sammamish River

The Sammamish River flows generally northwest through the City of Woodinville from approximately River Mile (RM) 5 to RM 8. The Cedar-Sammamish watershed is often referred to as the Water Resources Inventory Area 8 (WRIA 8) (Kerwin, 2001). The Sammamish River is formed at the outlet of Lake Sammamish where it flows in a northwesterly direction before discharging into Lake Washington (Williams et al., 1975). The Corps of Engineers channelized the entire Sammamish River to aid in flood control in 1964. Man-made modifications beginning in the 1870's to 1964 reduced the drainage to its present configuration, which is one-half its original extent (Kerwin, 2001).

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The extensive water regime and channel modifications have resulted in existing habitat conditions not historically present in the Sammamish River system. Channel modifications have greatly reduced the floodplain connectivity and cut off many smaller streams resulting in the loss of refugia and/or forage areas (Kerwin, 2001). Williams (1975) states that the lower portion of the Sammamish River, including the portion flowing through Woodinville, is "utilized only as transportation and rearing water" for salmonids. Salmonids do utilize tributary streams (e.g. Woodin Creek and Little Bear Creek) within the City of Woodinville for spawning and rearing.

The species potentially present in Woodinville waterbodies include at least 24 different non-native species of fish (Kerwin, 2001). These fish are likely to be present within the Sammamish River along with 11 species of anadromous and resident fishes. Little Bear Creek

The Little Bear Creek Habitat Assessment provided useful information on the status of Little Bear Creek within the City of Woodinville. The document and associated stream studies were performed by David Evans and Associates (DEA) for the City of Woodinville. Little Bear Creek is a 7.7 mile (12.4 km) second order stream[3] that drains a 9600-acre watershed in both King and Snohomish counties, Washington (DEA, 2002). Little Bear Creek flows from its source in a peat bog in Snohomish County through the City of Woodinville for approximately 2.2 miles (3.5 km) from NE 205th Street to its mouth on the Sammamish River at RM 5.4 and has several unnamed tributaries (DEA, 2002). Overall stream gradients in Little Bear Creek vary from 0.6 percent to 0.8 percent (DEA, 2002; Kerwin, 2001)

Little Bear Creek is a salmon-bearing stream, and has been utilized by at least nine species of resident and anadromous fish as investigated by David Evans and Associates (2002). Some species such as pink and chum salmon have only been documented as single occurrences within Little Bear Creek by WDFW. Chinook salmon occur in low numbers, while coho salmon, cutthroat trout, and sockeye salmon have been documented in abundance. Other documented species include kokanee, western brook lamprey (*Lampetra richardsoni*) and coast range sculpin (*Cottus aleuticus*). Undocumented species could also be present within Little Bear Creek as a result of its connection to the Sammamish River. These species may include steelhead (*O. mykiss*) and other species of sculpins (*Cottus sp.*). Native char (Dolly varden/bull trout) are not likely to be present within Little Bear Creek due to the lack of suitable habitat. Theoretically it is possible for bull trout to enter the Sammamish river system, but at present no bull trout have been documented within Little Bear Creek (DEA, 2002).

3.1.2 Woodin Creek

Woodin Creek is located on the left bank of the Sammamish River south of the center of the City of Woodinville. The Woodin Creek Basin drains a significant portion of the City of Woodinville east of the Sammamish River. Woodin Creek originates from groundwater seeps in residential

[3] Second order streams are those which have as tributaries only first order channels and first order streams are those which have no tributaries (Leopold, 1994). Therefore, a second order stream would empty to a third order stream. The Sammamish River would qualify as a third order stream.

areas in the eastern portion of the City and King County and then flows generally west through the heavily developed floor of the Sammamish River Valley within the City. One tributary with two distinct branches originates from groundwater seeps and enters Woodin Creek from the north.

Limited site-specific data was found that describes fish use in Woodin Creek. The Washington Department of Fish and Wildlife Priority Habitat and Species map does not identify Woodin Creek or identify fish presence within Woodin Creek; however, King County Water Resources Inventory Area 8 data contains some information on fish presence within Woodin Creek. There is also sufficient data available related to the larger Sammamish River Basin that allows information on fish use within the area, or potential fish use, to be discussed until site specific fish use survey data within Woodin Creek become available. At the City's request, Adolfson is currently preparing a habitat assessment on Woodin Creek, which will include spawning surveys.

Puget Sound/Strait of Georgia coho salmon were listed as candidates under the ESA in July 1995. Coho salmon utilize small streams for spawning and are found in virtually all of the accessible reaches of smaller Lake Washington tributaries. Based on declining escapement numbers, however, Lake Washington coho runs are considered "depressed." Coho spawn timing occurs from late October to mid-December and is very similar to hatchery coho spawn timing (WDFW and WWTIT, 1994). Spawning surveys in 1996 identified adult coho salmon spawning activity within the lower reaches of Woodin Creek (King County, 2001). Juvenile salmonid fish, likely to be coho fry, were observed by Adolfson biologists as well as resident cutthroat trout during site visits in February 2003.

3.1.3 Unnamed Streams 0090 and 0091

Tributary 0090 (also known as Derby Creek) enters the right bank of the Sammamish River at RM 7.3 and has documented coho salmon use (Williams et al., 1975). The stream flows from King County and passes through a small portion of the very southeast extent of the City of Woodinville north of the Woodinville-Redmond Road and NE 145th Street junction. It is unknown at this time whether or not the stream is still used by coho, or whether they still have access to the stream from the Sammamish River. Derby Creek is disconnected from the Sammamish River in that the outflow is contained in an 18-inch diameter pipe that hangs about 15 feet above the waterline. It is highly unlikely if not impossible for fish to reach the pipe. King County has documented cutthroat trout up to RM 0.5.

Unnamed Tributary 0091 enters the left bank of the Sammamish River at RM 7.4 and the WRIA 8 database documents that in 1997 the Muckleshoot Indian Tribe observed juvenile coho salmon use in the lower reaches of the stream. The stream is located in the southern limits of the City of Woodinville and King County. It is unknown if the stream currently supports salmonids or has direct access to the Sammamish River. Small fry of some kind (not known if these are salmonids) have recently been observed in this creek

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3.1.4 Lake Leota and Cold Creek

Lake Leota is a 10-acre lake that exists in the northeast portion of the City of Woodinville. Lake Leota has an average depth of approximately 12 feet with a maximum depth of 24 feet. The lake is bordered on all sides by residential development. Cold Creek, a tributary to Bear Creek, enters Lake Leota from the northwest and leaves the lake from the southeast where it flows to its confluence with Cottage Lake Creek. Fish use in this system is not well documented, but King County did document Kokanee spawning in 1997 below Lake Leota in Cold Creek (King County, unpublished data). No documentation exists as to fish use of Lake Leota; however, Cold Creek does have documented use by cutthroat trout (Pentico, personal communication, 2003).

3.1.5 Other Minor Tributaries

The City contains many small watercourses that are remnant portions of previously existing natural drainage systems that originate from the slopes located west of the Sammamish River. No information exists as to the presence or absence of fish within these drainages. Development of the valley floor west of the Sammamish River has likely cut off salmonid access to these streams.

One small, unnamed lake (approximately 3 acres) exists in the northwestern portion of the City of Woodinville west of Highway 522 and south of NE 193rd Place. This small Lake is bordered by residential development, wetlands, and sensitive area easements. Fish use of the lake is unknown at this time.

3.2 Functions and Values of Streams and Riparian Areas in Woodinville

The City of Woodinville is in the process of updating their stream inventory. In this inventory, streams will be mapped and evaluated as to their ability to perform basic stream functions such as contributing to stream baseflow, water quality improvement, and providing in-stream habitat and structure (Adolfson, 2003). Little Bear Creek has already been assessed and is well documented. Woodin Creek is currently in the process of being inventoried.

The majority of streams in Woodinville originate from groundwater seeps on hillside slopes. The heavy development and the high levels of impervious area of the valley floor have caused precipitation and stormwater runoff to become major contributors to stream baseflows in these reaches.

Water quality for the streams in Woodinville is documented fairly well. In general, temperature ranges for Woodinville watercourses are likely to fall within the upper levels of acceptable limits for healthy salmonid populations (Kerwin, 2001). As with many urban stream systems, the likely contributors to increased stream temperatures in Woodinville are lack of shade, low baseflows, degraded channels (high width-to-depth ratios), and warm water inputs from stormwater runoff Water temperatures likely exert some influence on dissolved oxygen levels in

the City's streams. The steeper sections of the Sammamish River tributaries are likely to have high dissolved oxygen levels. The slower and shallower gradient sections of streams are likely to have low dissolved oxygen levels that may not be healthy for fish, especially in late summer and early fall when water levels are at their lowest. The ecological condition of benthic macroinvertebrates communities is often measured using the multi-metric Puget Sound Lowland Benthic Index of Biotic Integrity (B-IBI) developed by Kleindl (1995) and Karr (1991). It is a tool used to show a direct relationship between urbanization and biotic integrity and is an overall measure of water quality. No B-IBI data is available at this time for Woodinville streams.

The Sammamish River has been listed on the state 303(d) list.[4] Little Bear Creek contains three 303d listed stream reaches due to elevated fecal coliform levels (Kerwin, 2001). A recent King County small stream pesticide study indicates that Little Bear Creek contains a variety of pesticides in concentrations high enough to be "toxic" to test species (Kerwin, 2001). Woodin Creek and several of the smaller watercourses may not have 303(d) listed reaches; however, the 303(d) list often does not include smaller tributaries. Data collected by the City of Woodinville over a two-year period has shown elevated fecal coliform and nitrate/nitrite levels within Woodin Creek in excess of the 303(d) criteria.

In-stream habitat structure includes substrate, LWD, pool quality and frequency, and refugia. All species of salmonids present in Woodinville streams require clean gravel to spawn, and under natural conditions, bank erosion and channel movement replenish stream gravel, providing new gravel for spawning. NOAA Fisheries (1996) states that in order for substrates to be properly functioning, the interstitial spaces between gravels must be clear and contain less than 20 percent fines. Fines in excess of 20 percent will begin to limit oxygen circulation around unhatched eggs, and limit the success rate of spawning adults. Woodin Creek substrate is primarily sands and silts in the lower reaches, resulting from erosion in the upper watershed (Adolfson. 2003). The middle reach from 140th Avenue NE to NE 174th Street (approximately 1350 feet) is completely culverted denying salmonid access to spawning substrates upstream. Little Bear Creek contains medium to very coarse-grained gravels, which is good for spawning, but the substrates are embedded with sand/silt from 20 to 30 percent making spawning success limited (DEA, 2002). Off-channel wetlands and side channels are rare in the City of Woodinville, as most of the wetlands are disconnected from streams, and many of the stream channels have been historically modified and straightened.

Pool quality and frequency within Little Bear Creek has been assessed and Woodin Creek is currently in the process of being assessed. Little Bear Creek was found to still contain some good quality spawning habitat but due to degradation, few pools that are deep enough and exist frequently enough to support healthy populations of salmonids (DEA, 2002). Salmonid productivity is a strong indicator of the water quality of a stream and the quality of the streams surrounding riparian ecosystems. Alterations or disturbances to the riparian systems will eventually be manifested in the stream. Impacts are greatest in small streams because the dilution

[4] The 303 (d) list identifies waterbodies with impaired conditions for temperature, fecal coliform, and/or dissolved oxygen levels.

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factor is lower than in large streams. The major salmonid habitats affected by its riparian counterpart and correlated with stream corridor widths are stream temperature, food supply, structure, and sedimentation (Budd et al. 1987). If you look at general habitat conditions, Little Bear Creek contains better habitat than Woodin Creek and thus productivity is higher in terms of higher salmonid use in its basin.

Riparian stream buffers in the City of Woodinville are varied in width and condition depending on location in the watershed. Typically, the headwater and upper portions of streams in Woodinville have intact, forested buffers. This is partly due to their location (steep hillside slopes), which are less appealing to development and restricted by CAO steep slope limitations. The buffers in most of the headwaters of Little Bear Creek are in good condition and are important for regulating stream temperatures and permit large woody debris recruitment within the stream (DEA, 2002). However, in the lower sections of Little Bear Creek, urbanization has encroached upon or completely removed the riparian zone, and the ability of buffers to perform the function of large woody debris recruitment or water quality improvement have been compromised (DEA, 2002). The existing buffers in Woodin Creek and other tributaries to the Sammamish have reduced opportunity to provide LWD recruitment due to lack of trees in the riparian areas, and in many areas the dominant vegetation along the streams are non-native plants such as reed canary grass and Himalayan blackberry that inhibit growth of more desirable native plant species. Non-native plant monocultures in turn limit wildlife use of these areas. Trails, roads and parking lots, and local businesses occupy much of the riparian buffer zones in the developed valley floor.

3.3 Data Gaps

Two data gaps were discovered in the preparation of this study. The first is the lack of best available science literature pertaining to urbanizing watersheds in the Pacific Northwest. Little research-based information is available in the urban environment pertaining to streams. The vast majority of the scientific literature pertaining to streams in the Pacific Northwest has been developed from studies conducted in the forests of Washington, Oregon, Idaho, Montana, and British Columbia. In Washington, most of the best available science in and adjacent to streams was funded by and conducted in lands regulated by forest practices.

The second data gap is the lack of detailed and specific information on a majority of Woodinville's streams (Excluding Little Bear and Woodin Creeks) and their associated riparian habitat. In addition to the watercourse inventory currently being prepared by the City, an assessment of fish and wildlife use in Woodinville's streams and riparian corridors would prove useful in making policy decisions and modifications regarding sensitive areas. In addition, documentation of water quality parameters and buffer quality could be included as part of this background documentation.

4.0 STATE OF THE SCIENCE FOR WETLANDS AND WETLAND BUFFERS

This section summarizes the state of the science, or "best available science" for wetlands and wetland buffers. As previously discussed under streams, this information is a summary of existing literature and is not intended to be an exclusive list of all best available science currently published on wetlands. The purpose is to provide a brief overview of scientifically valid information that would be useful for local planning.

4.1 Importance of Wetlands and Buffers

Wetlands provide important functions and values for both the human and biological environment. These functions include flood control, water quality improvement, base flow contribution, nutrient production, and education (Mitsch and Gosselink, 2000; Hruby et al., 1999; Cooke, 2000). This section builds on the existing information regarding wetlands in the City found in the existing Sensitive Areas Ordinance by discussing in greater detail relevant research pertaining to wetland functions and values, as well as the challenges of managing wetland areas in urban settings and developed areas such as those found in Woodinville.

4.2 Wetland Definition

Wetlands are formally defined by the Corps of Engineers (Corps) (Federal Register, 1982), the Environmental Protection Agency (EPA) (Federal Register, 1986), the Washington Shoreline Management Act (SMA) (1971) and the Washington State Growth Management Act (GMA) (1992) as "… those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (Federal Register, 1982, 1986). The City of Woodinville Zoning Code Title 21.06.710 also defines wetlands as described above.

In addition, the SMA and the GMA definitions add:

> "Wetlands do not include those artificial wetlands intentionally created from non-wetland site, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990 that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificially created wetlands intentionally created from non-wetland areas to mitigate the conversion of wetlands".

This same definition of wetland is used in the Washington State Wetlands Identification and Delineation Manual (Ecology, 1997).

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4.3 Wetland Functions and Values

Wetlands are integral parts of the natural landscape. Their "functions and values" to both the environment and to the general public depend on several elements including their size and location within a basin, as well as their diversity and quality. While each wetland provides various beneficial functions, not all wetlands perform all functions, nor do they perform all functions equally well (Novitski et al., 1995).

Several studies have found that wetland functions and values are compromised by urbanization (Azous and Horner, 2001; Mitsch and Gosselink, 2000; Castelle et al., 1992a; May et al., 1997; Booth, 2000; City of Portland, 2001). In urban settings individual functions of wetlands may not be optimally functioning. For example, wetlands can provide significant stormwater control, even if they are degraded and comprise only a small percentage of area within a basin. Also, wetlands are important elements of stream systems and fish habitat. Within the urban environment, even degraded wetlands can provide rearing and refuge habitat for fish and other wildlife, along with other benefits to keeping streams healthy.

The geographic location, topography, geology, and level of existing urbanization in the City of Woodinville limit to what extent its wetlands can provide the functions described below. However, even in urban settings where individual functions of wetlands are not optimal, the combined effect of the functional conditions within the wetland systems may provide many of the functional benefits to be expressed.

The functions provided by wetlands and their assigned human-based values have been identified and evaluated through several studies (Cowardin et al., 1979; Adamus et al., 1987; Mitsch and Gosselink, 2000; Hruby, 1995; Reppert et al., 1979; Cooke, 1995). These functions include:

- Flood water attenuation and flood peak desynchronization;
- Stream base flow maintenance and groundwater support;
- Shoreline protection;
- Water quality improvement;
- Biological support and wildlife habitat; and
- Recreation, education, and open space.

4.3.1 Flood Water Attenuation and Flood Peak Desynchronization

Flood water attenuation and flood peak desynchronization can be aided by a wetlands ability to control flood water and stormwater flow and to slowly release it to adjacent water bodies and/or groundwater (Novitzki, 1979; Verry and Boelter, 1979 *in* Mitsch and Gosselink, 2000). A wetlands effectiveness in controlling flood waters is based on factors such as the storage capacity and outlet discharge capacity of the wetland relative to the magnitude of stormwater inflow (Marble, 1992; Reinelt and Horner, 1991). Forested and scrub/shrub wetlands are particularly effective in flood water attenuation due to surface roughness.

The loss of wetlands in urban areas affects the ability of the remaining wetland systems to function in attenuating stormwater runoff, resulting in increased flood frequency and higher peak flood flows in drainage basins (Azous and Horner, 2001; Mitsch and Gosselink, 2000; Booth, 2000). Reduced flood storage capacity can be partially replaced through wetland restoration, stormwater control facilities, or the use of isolated, degraded, and low-value wetlands as stormwater facilities. However, even in basins where flood storage has been maintained, discharge volumes from detention facilities in areas with moderate to high levels of impervious surface are still substantially higher than in less-urbanized or natural environments because of reduced rainfall infiltration into pervious soils (Booth, 2000). As a result, while wetlands can substantially contribute to flood control in basins, reduction of total impervious surface is also necessary to reduce flood flows and peaks (Booth, 2000). However, increased discharge to wetlands can alter the hydrodynamics and hydroperiod (the pattern of fluctuating water levels) in a wetland, resulting in substantial modifications to plant and animal communities adapted to pre-existing hydrologic conditions (Azous and Horner, 2001).

Increasingly higher storm flows in urbanized basins, relative to undisturbed watersheds, can result in sediment loading of streams and destruction of habitat for fish and other aquatic organisms (Richter, 2001, Ludwa, 2001, Richter and Azous, 2001, Azous and Horner, 2001). Wetlands providing erosion control functions are typically found in shallow, floodplain systems where velocities are slow and vegetation is dense and woody (Carter, 1986; Greeson et al., 1979; Sather and Smith; 1984; Brinson, 1993). They are found less frequently in sloped, groundwater driven systems.

4.3.2 Stream Base Flow Maintenance and Groundwater Support

Stream baseflow and groundwater recharge are functions of wetlands performed by retaining large quantities of water and slowly releasing it to streams or groundwater (Mitsch and Gosselink, 2000; Erwin, 1990). In general, relevant studies on wetland deep aquifer recharge are lacking, while the contribution of wetlands to near-surface (surficial) aquifers has been well documented. Maintaining stream flow is an important function of freshwater wetlands to stream-flow-sensitive salmonids in the Pacific Northwest. Wetlands provide baseflow during the region's typically dry season (City of Portland, 2001; Booth, 2000; May et al., 1997; Mitsch and Gosselink, 2000).

Generally, large, permanently flooded, depressional wetlands that are the headwaters of or connected to salmonid streams, located in the upper one-third of the watershed have the best ability to provide stream baseflow and groundwater support (Brinson, 1993; Gwin et al., 1999; Cooke, 2000). Many studies have found that wetland loss, reduction, and vegetation alteration reduce most wetlands' capacity to provide baseflow support to streams (Booth, 2000; Schueler, 2000; City of Portland, 2001; Mitsch and Gosselink, 2000; Brinson, 1993).

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4.3.3 Shoreline Protection

Wetlands adjacent to waterbodies serve to provide protection for the shoreline of that stream, river, or lake. Decreased water velocity, vegetative structure, root soil-binding properties, and substrate type in wetlands influence the effects of water-related erosion in adjacent water bodies (Carter, 1986; Greeson et al., 1979; Sather and Smith; 1984; Brinson, 1993). The erosion control function is particularly effective in floodplain wetlands where velocities are slow and vegetation is dense and woody. Wetlands in basins that have relatively undeveloped shorelines and stream banks that contain dense woody vegetation along the Ordinary High Water Mark (OHWM) of a lake or stream and extend more than 200 to 600 feet from the OHWM provide the highest level of shoreline protection and erosion control. Wetlands that extend less than 200 feet provide less protection. (Hruby et al., 1999; Cooke, 2000).

4.3.4 Water Quality Improvement

Removal of sediment and pollutants from storm water are important water quality functions of wetlands (Mitsch and Gosselink, 2000; Cooke, 1995). A wetland's ability to perform water quality improvements can depend on a wetland's size, location within the basin, vegetation community structure, and productivity (Washington Department of Ecology, 1996; Marble, 1992).

Wetland vegetation is important for nutrient cycling. The vegetative structure of wetlands slows the flow of water, causing sediments, nutrients such as nitrogen and phosphorous, petroleum products, heavy metals, pesticides, and herbicides to settle out of the water column. Particulates are removed through settling, and then stored in wetland sediments (Washington Department of Ecology, 1996; Sather and Smith, 1984). Forested areas store greater amounts of nutrients for longer periods but generally offer less surface area contact to water flow, where dense emergent vegetation creates frictional resistance to water flows, takes up nutrients rapidly, and releases it seasonally (Washington Department of Ecology, 1996). However, wetlands have limits to the amount of sediments, nutrients and toxicants they can assimilate, and these will be transported out of the wetland once a wetland reaches capacity (Mitsch and Gosselink, 2000; Washington Department of Ecology, 1996).

Alteration of wetlands eliminates or reduces their ability to process sediment, nutrients, and chemicals. In urbanized watersheds, pollutant concentrations in wetlands are generally higher than those in undeveloped watersheds (Horner et al., 1996). An increase or decrease in sedimentation rate can result from severe water fluctuations, and can limit denitrification and phosphorous retention (Washington Department of Ecology, 1996). Most studies have focused on a wetland's ability to treat runoff, and few have directly addressed the impacts of urban runoff on water quality in the wetlands themselves. Long-term impacts to wetlands from accumulation of pollutants have not been well studied. In addition, sedimentation and pollutants are found to have a negative effect on invertebrates, amphibians, and fish, particularly salmonids, in riparian wetlands, urban streams, and lakes (City of Portland, 2001; Booth, 2000; May et al., 1997; Mitsch and Gosselink, 2000; Schueler, 1994).

4.3.5 Biological Support and Wildlife Habitat

Wetlands provide opportunities for grazing of living plants by wildlife, and for organisms that depend on detritus and/or organic debris for a food source (Erwin, 1990; Zedler et al., 1990). Both wetland vegetation and upland forest habitats are highly productive for food production (Hruby et al., 1999), and streamside vegetation can contribute up to 90 percent of the energy in aquatic food webs of headwater streams (Budd et al., 1987). These food sources are especially important for fish that feed on both terrestrial and aquatic insects, which in turn feed on organic matter exported from adjacent riparian areas (including wetlands) (Cummins, 1974 and Gregory et al., 1991 *in* City of Portland, 2001; Higgs et al., 1995).

Wetland habitats generally provide greater structural and plant diversity, more edge habitat where two or more habitat types adjoin, more varied forage, and a predictable water source that increases wildlife species abundance and diversity than upland habitats (Kauffman, et al., 2001; O'Connell et al., 2000). Many species of waterfowl, amphibians, insects, and some species of fish and mammals (such as muskrat) depend on wetlands for foraging, breeding, and refuge. It has been found that wildlife species richness increases when wetlands are surrounded by natural undisturbed upland habitat (WDFW, 1992; Richter and Azous, 2001; Azous and Horner, 2001; Hruby et al., 1999). Wetlands and surrounding uplands provide specialized habitat and wildlife linkages for many species of wildlife including special status species (e.g., endangered, threatened, proposed, candidate, sensitive, monitor) and species of local importance (Mitsch and Gosselink, 2000; Hruby et al., 1999). Alterations in hydroperiod can cause excess flooding, increased flood frequency, or drying of wetlands, which can be harmful or lethal to amphibians and their eggs (Richter et al., 1991).

4.3.6 Recreation, Education, and Open Space

In urbanizing areas, aquatic resources and adjacent uplands provide opportunities for greenways and open space. In Woodinville, wetlands and adjacent uplands provide important resources for wildlife viewing, passive recreation, and education about natural wetland-upland ecosystems. The Sammamish River Trail, which lies adjacent to wetlands along the river, connects Woodinville with Seattle and Redmond and provides non-motorized recreation opportunities as well as an equestrian trail between 175th in Woodinville and Marymoor Park in Redmond.

The Little Bear Creek Linear Park Master Plan is a conceptual vision for a linear park that will provide recreation, non-motorized transportation, and habitat restoration along the banks of the Little Bear Creek as it passes through the City. The Plan features trails, interpretive facilities, picnic facilities, and areas for active recreation stretching from the northern City limits to the mouth of Little Bear Creek at the Sammamish River. If implemented it will provide connectivity between downtown Woodinville and local neighborhoods; promote safe school access to Woodinville High School and Woodin Elementary; and link facilities such as the Rotary Community Park with the Sammamish River Trail.

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4.4 Wetland Functional Assessment Methods

As described above, the functions provided by wetlands and their assigned human-based values have been identified and evaluated through many scientific studies (Cowardin et al., 1979; Adamus et al., 1987; Mitsch and Gosselink, 2000; Hruby, 1995; Reppert et al., 1979; Cooke, 1995). Several functional assessment methods have been developed to identify functions performed in a wetland and evaluate the effectiveness of the wetland in performing that function. Some methods are quantitative, while others are qualitative.

The Reppert method is a qualitative functional assessment based on vegetative and wetland habitat features, and uses the wetland classification system adopted by the USFWS. A semi-quantitative assessment method was developed by Cooke in 1996, and was based on a the Reppert method. Quantitative assessment methods include the US Army Corps of Engineers Hydrogeomorphic Method (HGM). HGM is based on the concept that wetland functions are driven primarily by the wetland's geomorphology (i.e., position in the landscape) and hydrologic characteristics (Brinson, 1993; Brinson, 1995). Other semi-quantitative functional assessment methods include the Wetland Evaluation Technique (WET) developed by Adamus et al. (1987) and the Indicator Value Assessment (IVA) by Hruby et al. (1995).

In 1996, Washington Department of Ecology (Ecology) began the Washington State Wetland Function Assessment Method (WFAM) project. This functional assessment method, which was published in 1999, is a modified version of the HGM approach and is designed to provide a more scientific approach to assessing wetland functions (Hruby et al, 1999). The Washington Department of Transportation (WDOT) developed another method for rapid wetland assessments for linear projects (Null et al., 2000). Both the WFAM and the WDOT methods are cited in the OCD citations for best available science. The WDOT method is considered a qualitative method.

4.5 Wetland Rating System

Wetlands are typically preserved or protected based upon size and habitat and their relative functions and values. Consequently, higher functioning wetlands or larger high quality wetlands are considered a greater priority for protection than lower quality smaller wetlands with lesser functions. Local governments strive to prioritize or rank wetlands from higher function and value to lower function and value in order to determine development standards and protective measures which are tailored to the relative importance of different wetlands.

In the State of Washington, the Department of Ecology (Ecology) has developed a wetland rating system for ranking wetlands according relative importance. This rating system is outlined in the *Washington State Wetland Rating System for Western Washington* (Publication No. 93-74, Ecology 1993). Wetlands in this system are rated into four distinct categories; from Category I wetlands of highest value to Category IV wetlands of lowest value. Category I and IV wetlands are defined specifically in the rating system. However, Category II and III wetlands are determined by the summarized results of a rating form. The rating form uses semi-quantitative criteria such as size, level of disturbance, habitat diversity, connectivity to streams or other

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habitats, and buffer quality to classify wetlands as Category II or III. Ecology is currently re-evaluating the old wetland rating system for western Washington and will be updating this system in the near future.

4.6 Functions and Values of Wetland Buffers

Wetland buffers are vegetated upland areas immediately adjacent to wetlands. These areas provide beneficial functions that enhance and protect the many functions and values of wetlands described above. Terrestrial habitats surrounding wetlands provide a buffer to help mitigate the impacts of urbanization.

Buffer areas retain sediments, nutrients, pesticides, pathogens, and other pollutants that may be present in runoff (Washington Department of Ecology, 1996). Reduction of sediment and pollutant discharge to wetlands prevents alterations to plant and animal communities and degradation of water quality in wetlands. Buffers also increase the ability of wetlands to further provide sediment and pollutant removal as a result. Upland buffers infiltrate flood water, reducing the effect of water level fluctuations within wetlands. Buffers composed of forested and shrub vegetation provide shade which in turn helps to maintain water and wildlife habitat quality. For example, shading can reduce water temperature in wetlands that provide rearing habitat for amphibians and fish.

A scientific literature review indicates that buffer widths to protect a given habitat function or group of functions depend on numerous site-specific factors. These factors include the plant community (species, density, and age), aspect, slope, and soil type, as well as adjacent land use. The body of science indicates that the appropriate buffer width for a given wetland is specific to the environmental setting and functions to be achieved by that buffer (Castelle et al., 1992a; Castelle and Johnson, 2000; Desbonnet et al., 1994; FEMAT, 1993).

Several literature reviews have been published summarizing the effectiveness of various buffer widths, mainly for riparian areas, but also for wetlands (Castelle et al., 1992a; Castelle and Johnson, 2000; Desbonnet et al., 1994; FEMAT, 1993). Generally, the riparian buffer literature also applies to wetlands because very similar functions are provided by riparian buffers and wetland buffers. However, the effects of elements of buffers on streams and fish habitat differ from the effects on wetlands. For example, large woody debris from riparian areas along streams primarily contributes to instream structure and fish habitat, while large woody debris in wetlands provides structure or foraging habitat for a variety of wildlife species. Buffers provide area in which sediment or pollutant removal can occur, and for flood flow attenuation. McMillan (2000) provides the most recent literature review specific to wetland buffers in western Washington.

Wildlife species that use wetlands for a portion of their life cycle also depend on terrestrial habitats for food, cover, nesting, and/or travel corridors. A variety of wildlife species utilize the edge habitat between wetlands and uplands habitat. Terrestrial habitat areas provide a source of large woody debris used by wildlife for foraging, nesting, and cover (O'Connell, 2000). Terrestrial habitats surrounding wetlands provide a buffer to help mitigate the impacts of

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urbanization. Buffers provide separation between wetland habitat and human disturbance. This distance improves the quality of wildlife habitat by lessening the effects of noise, light, and human motion/activity upon animal species sensitive to these disturbances.

Studies of buffers in forest practices and agriculture indicate that buffers ranging from 25 to 100 feet may be adequate to preserve many of the beneficial functions to wetlands. However, urban wetlands have many different variables affecting wetland functions and applying these buffer ranges may or may not be adequate to protect the wetland systems. Due to the type and degree of cumulative impacts to urban wetlands (and streams) that have already occurred as a result of high levels of total impervious area and past disturbance to wetlands, it may be necessary to develop new strategies to successfully address the issue of adequate buffers in the context of basin-wide change (Booth, 2000; Azous and Horner, 2001; Booth and Reinelt, 1993).

Several studies indicate that buffers ranging from 100 to 150 feet wide provide most (on the order of 80 percent) of potential functions in most situations. In these studies, the relationship between buffer width and effectiveness is logarithmic, so that after a certain width an incremental increase in buffer width provides diminishing functional effectiveness. One study indicates that 90 percent of sediment removal can be accomplished within the first 100 feet of a riparian buffer, but an additional 80 feet of buffer is needed to remove just five percent more sediment (Wong and McCuen, 1982). However, studies show that wildlife responses to human disturbance are varied and a buffer of 50 to 150 feet may not provide enough separation or protection (Knutson and Naef 1997; Cooke, 1992). Rather, wildlife use of wetland and riparian buffers is highly dependent upon the species in question and site-specific characteristics (i.e., type of wetland, geographic setting, etc.). A buffer of 200 or 300 feet or more from the aquatic resource has been documented in the scientific literature as more appropriate for some wildlife species.

4.6.1 Wetland Mitigation & Enhancement Strategies

The Clean Water Act Section 404(b)(1) Guidelines for wetland mitigation require "no net loss" of wetlands by first avoiding, minimizing, rectifying, and reducing impacts to wetlands and their functions. Where loss of wetland acreage and/or functions is necessary, replacement or compensatory mitigation should be required. In compliance with GMA, the majority of local jurisdictions in Washington implement these guidelines through local critical area regulations. Most local jurisdictions require compensatory mitigation for impacts to wetlands and/or their buffers resulting from development or associated activities. Jurisdictions generally allow four types of mitigation: creation, restoration, enhancement, and exchange (Gwin et al., 1999). The different types of mitigation are generally considered to be in-kind (replacement of same functions and acreage as the impacted wetland) and are typically constructed on the development site where the wetland impact occurred.

Off-site and out-of-kind wetland mitigation has also been allowed by agencies in certain cases. The U.S. Army Corps of Engineers and other agencies have allowed off-site mitigation of wetlands, and there has been growing interest in mitigation banks in Washington. Mitigation banking may give developers additional options for mitigation; banking also allows creation or

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preservation of larger and higher quality wetlands than might have been established on any one development site. Use of a single site for multiple mitigation efforts also facilitates adequate maintenance and monitoring, which in turn, increases the success of the project. Ecology has written a draft Mitigation Banking Rule to facilitate the use of this type of mitigation. The Office of Community Development (OCD) Draft Model Critical Areas Ordinance also includes mitigation banking as an allowed type of mitigation.

4.6.2 Wetland and Buffer Mitigation Success

Most wetland mitigation projects in Washington have not been successful for various reasons and have resulted in lost acreage, wetland types, and wetland functions (Castelle et al., 1992b; Washington Department of Ecology, 2001; Mockler et al., 1998). An initial study by Ecology (Castelle et al., 1992b) reported that 50 percent or more of the mitigation projects studied did not meet permit requirements. Common problems included:

- Inadequate design;
- Failure to implement the design;
- Lack of proper maintenance, site infestation by exotic species;
- Grazing by geese or other animals;
- Destruction by floods, erosion, fires, or other catastrophic events;
- Failure to maintain water levels and failure to protect projects from on-site and off-site impacts such as sediment and pollutant loading; and
- Off-road vehicles.

A predominant problem throughout wetland mitigation sites is the invasion of the site by non-native plant species. Studies have found that at least 50 percent of species in mitigation sites were non-native (Magee et al., 1999; Ecology, 2001). Mitigation areas that were not protected by upland buffer had a larger percentage of non-natives, and long-term maintenance of sites resulted in lower percentages of non-natives. Gwin et al., (1999) also found mitigation areas to be functionally different from replaced wetlands, resulting in net loss of function and, in some cases, net loss of wetland area. The use of wetland exchange and enhancement of existing wetlands to replace lost wetlands does not actually create new wetlands but improves or modifies the functions of existing wetlands to compensate for those lost, therefore resulting in a "net loss" of wetland acreage and possibly wetland functions (depending on how the enhancement was implemented) (Shaffer et al., 1999; Gwin et al., 1999; Ecology, 2001).

Twenty four mitigation sites in Washington were analyzed by Ecology (2001) and found that although mitigation success has improved in the last 10 years, there is still much room for improvement. The Ecology study had the following findings:

- 29 percent of the projects were achieving all of their specified measures;
- 84 percent of the total acreage of mitigation was actually established;

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- 65 percent of the total acreage of lost wetlands was replaced with new wetlands;
- 54 percent of the projects were found to be minimally successful or not successful;
- Wetland enhancement as a type of mitigation performed poorly, compared to creation (50 percent of enhancement sites provided minimal or no contribution to overall wetland functions; 75 percent of sites provided minimal or no contribution to general habitat function); and
- 60 percent of created wetlands were moderately or fully successful and provided significant contribution to water quality and quantity functions.

Mitigation has been more successful for some wetland types, including emergent and open water wetlands (Castelle et al., 1992b). Other wetland types have been very difficult or impossible to replicate, such as mature forested or bog systems[5], or wetlands that contain habitat for sensitive wildlife species. Restoration of prior wetlands was often found to be easiest to achieve. The likelihood of success of restoration is greater than other types of mitigation because the site will benefit from restored hydrology, and seed sources from the original wetland may be present and viable. However, some authors suggest that mitigation projects in urban settings may not be able to recreate a historic wetland ecosystem due to changes in water regime and nutrient input (Ehrenfeld, 2000; Horner, 1997; Booth, 2000).

Ecology (2001) concluded that although better site selection, design and performance standards will help to improve wetland mitigation, consistent follow-up [adaptive management], both to correct problems with current projects and to provide feedback for decision-making on future projects, will result in the greatest overall improvement. Most successful projects had long-term monitoring of at least five years and applied adaptive management strategies. Other studies support long-term (at least five years) monitoring for mitigation projects (Kentula, 2002; Kusler and Kentula, 1990).

The literature indicates that on-site, mitigation is desirable and can be most successful at replacing lost wetland functions, but success is dependent on site constraints, particularly hydrologic conditions. The literature is conflicting on whether on-site mitigation or off-site mitigation can adequately compensate for loss of wetlands and their functions (Erwin, 1990; Castelle et al., 1992a; Kusler, 1992). However, Kusler (1992) suggests that in cases where there are many small isolated wetlands and compensatory mitigation has been determined to be necessary (after evaluating mitigation sequencing), off-site mitigation may be more successful at replacing lost wetland acreage and functions, because replacement of these small wetlands is difficult to achieve. More functional benefit may be reached through a larger mitigation that is established within the context of landscape level assessment to determine optimum location to meet the "needs" of the hydrologic and ecological system (Kusler, 1992; Washington Department of Ecology, 2001; Bedford, 1996).

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[5] Mature forest takes many years to develop, and bog systems depend on the existence of acidic substrate not easy to replicate.

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Buffer mitigation projects generally are affected by the same factors as wetland mitigation. Success of plant growth in the buffer depends on water, nutrient and soil requirements for plants, and controlling the invasion of non-native species (Gwin et al., 1999; Magee et al., 1999).

Success of buffer mitigation projects also depends on human disturbance in the buffer. Buffers in some urban environments, due to close proximity to development, have been altered through dumping of debris, clearing, conversions to residential lawns, and other human disturbances (Desbonnet et al., 1994; Cooke, 1992, Castelle et al., 1992a). However, impacts to buffer areas were less likely in areas where residents had been educated about the value of buffers (Gwin et al., 1999; Kentula, 2002).

4.6.3 Mitigation Ratios

Generally, wetland mitigation is implemented over a larger area than the wetland area adversely affected by a proposed project. Mitigation ratios are typically greater than 1:1 for several reasons, some of which are based on science and others that are policy-driven. Higher ratios act as disincentives to fill wetlands. They provide an opportunity to recreate certain functions over a larger area, thus compensating for a temporal loss of function from the smaller but presumably more mature impact site. In addition they compensate for the inability to achieve full replacement acreage of lost wetlands (Washington Department of Ecology, 2001; Kusler and Kentula, 1990).

Several authors and agencies have recommended various replacement ratios (Castelle et al., 1992b; OCD 2002). Most ratios are based on known failures of compensatory mitigation and designed to compensate for historic loss of wetlands. Studies of the success of mitigation projects suggest that replacement ratios based on mitigation success could be between 1:1.25 and 3:1. Mitigation ratios for wetlands in most local jurisdictions in western Washington currently range between 1:1 and 4:1. However, more information is needed to understand whether lost wetland functions and acreage can be entirely compensated. The Draft OCD Model Critical Areas Ordinance (2002) recommends the following wetland mitigation ratios by classification of wetland:

Category I wetlands - 6:1

Category II wetlands - 3:1

Category III wetlands - 2:1

Category IV wetlands - 1.5:1

4.7 Functions and Values of Wetlands and Wetland Buffers in Woodinville

The City of Woodinville has GIS information on critical areas occurring in the city, including wetlands. The initial information was based primarily on the King County Wetland Inventory, which used the National Wetlands Inventory (NWI). The City has since added further wetland

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information to its GIS database based on input from the Planning and Community Development Department and permitted development projects. Our review is based upon two days of field reconnaissance in August of 2003 and preliminary information on wetlands provided by the City.

Wetlands in the City fall into four categories; large and small forested and scrub-shrub patches, riparian wetlands associated with the major streams (e.g. Little Bear Creek, Woodin Creek), degraded emergent wetlands, and floodplain wetlands on agricultural land. Most of these wetlands are supported by perennial hydrology. In general, many of the City's wetlands lie within developed areas, and have degraded and narrow buffers.

Larger and less disturbed forested/scrub-shrub wetland complexes, such as one located south of NE North Woodinville-Duvall Road and immediately west of 144th Avenue, contain diverse vegetation are most effective for improving water quality. This particular wetland has a partially completed 'Sensitive Area Trail' that was established by the City as part of a housing development. This trail provides educational and recreational opportunities as well protection of habitat and existing wetland functions.

Smaller disturbed wetlands, such as the linear forested/scrub-shrub wetland located north of Lake Leota and the NE North Woodinville-Duvall Road, have a more limited ability to improve water quality due to their small size and less diverse vegetation cover. However, small wetlands may be the only wetlands existing in the eastern portion of the city due to the preponderance of residential development, and therefore, are important for providing water quality, stormwater control, and habitat functions.

Riparian wetlands, such as those found along Little Bear and Woodin Creeks, provide the highest level of stream base flow benefits. Groundwater discharge from wetlands and uplands are the primary contributor to base flow in wetlands and streams in Woodinville. Providing base flow for streams is an important function of wetlands in Woodinville due to the high levels of impervious surface, which limit infiltration in upland areas. Base flow is particularly important for salmonid-bearing streams, such as Little Bear Creek, that have low flows during the dry season. The size and vegetative structure of many riparian wetlands along the Sammamish River and Little Bear Creek have been reduced or altered (DEA 2002; Shannon & Wilson, 2001), compromising their ability to provide stream base flow and possibly groundwater support.

Where wetlands have been protected along streams, such as Little Bear Creek, flood water may be attenuated. In these areas, development has been limited within the natural floodway of the streams, and forested/scrub-shrub wetlands provide a high level of stormwater control. The City of Woodinville has recently acquired an 18-acre parcel as Little Bear Creek Lineal Park, which will be developed to provide recreation, non-motorized transportation, and habitat restoration along the banks of the Little Bear Creek as it passes through the City. This park will also protect and ultimately enhance the functions and value of the riparian wetlands along the stream.

Prior to farming and diking of the Sammamish River, the emergent wetlands adjacent to the river provided stormwater desynchronization and contributed to base flows (King County, 1993). The river was channelized in 1964 to prevent flooding and provide irrigation (see Section 2.4.1). The

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former floodplain wetlands that remain are highly modified and provide limited functions and values due to their current disconnection from the river (Shannon and Wilson, 2001). An aquatic bed/scrub-shrub wetland occurs in the northern portion of the City, west of 136th Avenue and immediately south of NE 190th Place. This wetland contains diverse vegetation and provides undisturbed habitat as well as water quality improvement. It is currently well-marked by City of Woodinville Sensitive Areas signage.

Few wetlands in the City have been used formally for stormwater detention; however, informal use of wetlands in stormwater treatment is a common practice. Due to urbanization in the City, wetland buffers are typically degraded and narrow. Non-native blackberry is a common shrub component in disturbed buffer areas. In steeper areas such as hillsides and valley walls, wetland buffers are less degraded due to constraints on development from steep slopes.

Although some areas are degraded, wetlands and wetland buffers do support wildlife habitat within the City limits (see the Wildlife Technical Memo). Wildlife species in Woodinville may forage on riparian- and wetland-dependent species such as insects, stream-dwelling invertebrates, and fish Wetlands within and along wildlife linkages, linear strips of habitat that link larger habitat areas, also provide critical habitat for fish and wildlife, for example rearing areas for juvenile salmon, and water sources for all wildlife. The Wildlife Best Available Science Memorandum (Adolfson, 2003) includes an expanded discussion of wildlife linkages and habitat). Relatively intact habitat structure in Woodinville for nest and roost sites and productive areas for forage for wildlife species is limited, but is mainly present in riparian and wetland areas. These areas are highly valued, particularly within urban communities such as Woodinville.

5.0 DATA GAPS

One data gap was discovered in the preparation of this study: the lack of detailed and current information on each of Woodinville's wetlands and riparian habitats. A critical areas map was provided by the City for this study, which included wetlands. However, updated information including ground-truthing of mapped wetlands, habitat types, wetland functions and values, and buffer quality is needed.

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REPORT REQUIREMENTS – WETLANDS

Critical area report – Requirements for wetlands. Critical area reports for wetlands must meet the requirements of this Section. Critical area reports for two or more types of critical areas must meet the report requirements for each relevant type of critical area.

A. **Prepared by a qualified professional.** A critical areas report for wetlands shall be prepared by a qualified professional who is a wetland biologist with experience preparing wetland reports.

B. **Area addressed in critical area report**. The following areas shall be addressed in a critical area report for wetlands:

1. The project area of the proposed activity;

2. All wetlands and recommended buffers within three hundred (300) feet of the project area;[1] and

3. All shoreline areas, water features, floodplains, and other critical areas, and related buffers within three hundred (300) feet of the project area.

C. **Wetland analysis.** In addition the minimum required contents of *Critical area reports - requirements* [Section X.10.200], a critical area report for wetlands shall contain an analysis of the wetlands including the following site- and proposal-related information at a minimum:

1. A written assessment and accompanying maps of the wetlands and buffers within three hundred (300) feet of the project area, including the following information at a minimum:

   a. Wetland delineation and required buffers;

   b. Existing wetland acreage;

   c. Wetland category; vegetative, faunal, and hydrologic characteristics (data sheets);

   d. Soil and substrate conditions; and

   e. Topographic elevations, at two-foot contours.

2. A discussion of measures, including avoidance, minimization and mitigation, proposed to preserve existing wetlands and restore any wetlands that were degraded prior to the current proposed land use activity.

[1] Critical area reports should consider wetlands and other critical areas within three hundred (300) feet due to the maximum potential buffer size for wetlands.

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3. A habitat and native vegetation conservation strategy that addresses methods to protect and enhance on-site habitat and wetland functions.

D. Mitigation Plan Report Requirements

The City of Woodinville regulates sensitive areas under 21.24. A mitigation plan is required for any unavoidable sensitive areas or buffer impacts. The following information is minimum information required for minor mitigation projects. Mitigation must be based on an approved plan, and includes submittal of a mitigation report detailing the project.

Mitigation Plan Graphic Requirements

1. North Arrow.
2. Existing structures.
3. Scale.
4. Grading Plan.
5. Wetland edge or top of bank and centerline of streams.
6. Buffer edge line and building setback line.
7. Existing Trees.
8. If proposed, water control structures and special features including level spreaders, weirs, leaky berms, quarry spalls, etc.
9. Habitat features.
10. Erosion control measures.
11. Planting plan and detail for trees, shrubs, herbaceous plants, and any top-seeding.

Best Management Practices are required for erosion control in mitigation implementation by use of temporary and permanent erosion control structures. A schedule and sequencing must be provided for removal of temporary erosion control structures. All plants used for mitigation must be native to the Puget lowlands of Western Washington. Plant selection and placement should be guided by moisture, light, and other habitat needs. Mitigation sites must included permanent Native Growth Protection Area signs, placed in a visible location.

Mitigation Plan Report Requirements

A mitigation report is included with plan graphics to increase legibility and comprehensibility of the mitigation plan. The City of Woodinville requires that sensitive area impacts be avoided or minimized to the greatest extent practicable.

The mitigation report shall include the following:

1. Demonstrate that mitigation sequencing was followed, with how impacts have been avoided, reduced, or minimized.
2. Goals- an overview of intended results and a list of major wetland or stream functions to be achieved.
3. Objectives- specifics of the goal.
4. Performance Standards- measurable, quantifiable indicators of mitigation performance relative to objectives and goals.

5. Monitoring methods- how performance standards will be assessed.
6. Contingency plan
7. Installation specifications- including soils amendments, plantings, and interim hydrology.
8. Monitoring
9. Maintenance- includes removal of invasive species, replacement of failed plantings, and replacement of missing required structures such as signs and fencing.

A contingency plan is included in the mitigation plan to ensure the goals and objectives are satisfactorily met at commencement of the mitigation monitoring. The monitoring period is for five years from successful installation inspection. Minimum required elements of a monitoring report are: 1) Report on plant survival, vigor, aerial coverage, etc. from every plant community. 2) Site hydrology, 3) Wildlife observations.

Enhancement measures must be selected on a case-by-case basis; what is appropriate for one site is not appropriate for another. Examples of enhancement measures include, but are not limited to, the following:

- Removal of non-native invasive species, and replacement with appropriate species native to Woodinville;
- Removal of refuse or structures or paving from a sensitive area or buffer;
- Installation of additional native plantings in order to increase species and structural diversity;
- Placement of woody material, weirs, rocks, and /or other structures below the high water marks of a stream as determined by a qualified biologist and approved by WDFW through the Hydraulic Project Approval.

5. A discussion of ongoing management practices that will protect wetlands after the project site has been developed, including proposed monitoring and maintenance programs.

D. **Additional information may be required.** When appropriate, the [director] may also require the critical area report to include an evaluation by the Department of Ecology or an independent qualified expert regarding the applicant's analysis and the effectiveness of any proposed mitigating measures or programs, and to include any recommendations as appropriate.

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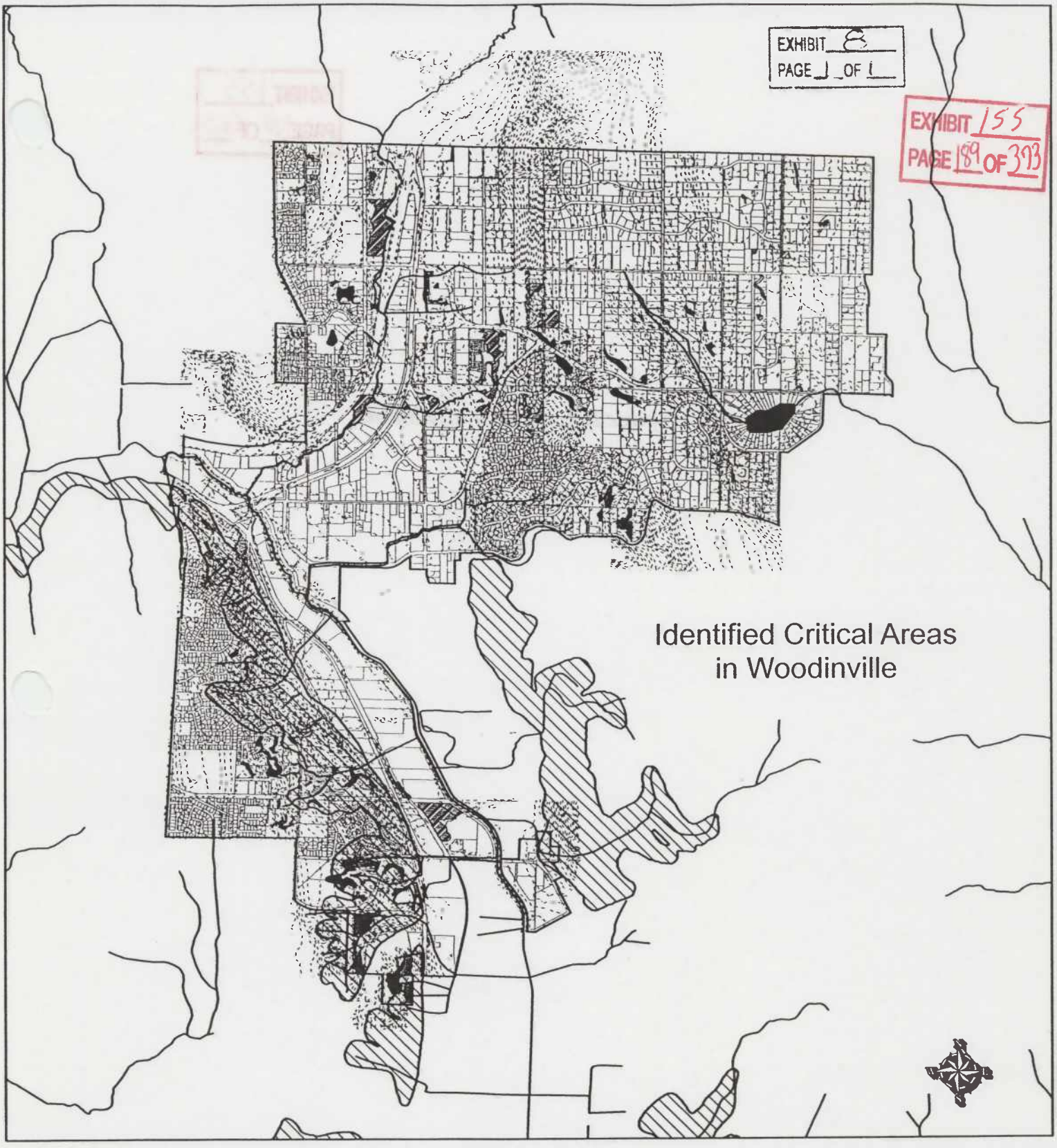

Legend

- Landslide Hazzard Area
- 10 Foot-contours
- 40 % Slopes
- 30 % Slopes
- Woodinville Streams
- Woodinville Wetlands

0 750 1,500 3,000 4,500 6,000 Feet

Note The Critical Areas Map is a pictorial representation and the City does not warrant its accurate depiction. This map is not inclusive of all sensitive areas within the City. This map is a work in progress.

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Gap Analysis Report

November 2003

Prepared for:

City of Woodinville

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1.0 INTRODUCTION

1.1 Project Authorization

At the request of the City of Woodinville, Adolfson Associates, Inc. (Adolfson) has prepared this technical memorandum that summarizes the gaps identified between the City's existing regulations, the 4(d) Rule of the Endangered Species Act (ESA), and best available science as required by the Growth Management Act. This report includes general recommended options for the City to consider for ESA compliance and provides guidance to the City in development and revision of the City's code regarding sensitive areas—Woodinville Municipal Code (WMC) Chapter 21.24 Environmentally Sensitive Areas.

The evaluation was based on review of the City's regulations for Environmentally Sensitive Areas, the 4(d) Rule as published in the Federal Register, the *Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Near-Term Action Agenda for Salmon Habitat Conservation*, technical memoranda prepared for the City on streams and wetlands, wildlife, critical aquifer recharge areas, and geologic hazard areas, and literature related to the best available science for protecting critical areas. Adolfson was supported in the review of the City's regulations for geologic hazard areas by Shannon and Wilson. This report only evaluates the critical areas listed here and does not include flooded areas, stormwater regulations, or shoreline regulations.

1.2 Endangered Species Act

The ESA was enacted in 1973 to conserve endangered and threatened species and the critical habitat upon which these species depend. The ESA is administered by the National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) and the U.S. Fish and Wildlife Service (USFWS). The two agencies are jointly referred to as the Services. Terrestrial species are the responsibility of the USFWS, while marine and anadromous species are the responsibility of NOAA Fisheries. The ESA defines an endangered species as one in danger of extinction throughout all or a significant portion of its range and a threatened species as any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. The ESA includes protective regulations for listed endangered or threatened species. A species can be listed independently by the Services, or any person can petition to list a species. Once an agency receives a petition for species listing, it must determine if a listing is warranted. A listing is based solely on the species' biological status.

The protective regulations of the ESA are included in Sections 7, 9 and 4(d) of the Act. Section 7 of the Act addresses the impacts of federal actions on listed species and states that no federal agency may take an action that would jeopardize a listed species. This section of the Act requires that any agency undertaking an action that might affect a listed species is required to consult with the USFWS or NOAA Fisheries. This "consultation" requirement extends to non-federal actions that receive federal funding or require a federal permit (a federal nexus). The consultation is achieved through a Biological Assessment (BA), which determines the potential

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effect of the action on listed species. The BA is submitted to the Services for concurrence. If it is determined that an action has the potential to have an adverse effect on a species, the Services must prepare a Biological Opinion in which the agency recommends reasonable and prudent alternatives for project modifications to avoid jeopardy to the species.

Section 9 of the Act prohibits any person from "taking" a listed species. To "take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect a species. The Services have defined harm to include significant damage to habitat, and the United States Supreme Court has upheld this interpretation. When a species is listed as an endangered species, the Section 9 prohibitions on take are automatically in effect.

Section 4(d) requires the Services to issue any regulations deemed necessary to conserve the listed species. The 4(d) Rule provides the Services with the flexibility to adopt rules needed to protect a species and specific to the individual circumstances of that species. Section 4(d) applies only to threatened species, not endangered species. The NOAA Fisheries has adopted a 4(d) Rule for threatened salmonid species in the Pacific Northwest and California. This rule is described in the following section of this memorandum.

The ESA is a strict and specific law, but it does contain some exceptions to its protective regulations. The 4(d) Rule described below in Section 1.2.1 is one example of an exception to the regulations. Another circumstance under which an exception to the prohibitions may be granted is found in Section 10 of the Act. Landowners may request what is known as an "incidental take permit," under which the Services allow otherwise lawful activities to occur that might result in an incidental take of a listed species (Sec. 10(a)(1)(B)). The landowner is required to develop and implement a Habitat Conservation Plan (HCP) that includes a description of the anticipated effect of a proposed taking on the affected species and explains the mitigation and conservation measures that will be used to minimize the take. The HCPs often include such provisions as allowing habitat to be disturbed on one land area in exchange for enhancing habitat in other areas. To encourage landowners to develop HCPs, the Services guarantee that they will not require any additional commitments or restrictions on the land area during the length of the incidental take permit period. Preparation of an HCP can be a lengthy and complicated process involving negotiations with the Services, public involvement, and preparation of an Environmental Impact Statement under the National Environmental Policy Act. Most HCPs in the Pacific Northwest have been or are being developed by large agencies or companies. Examples include an HCP prepared by the Washington Department of Natural Resources for its state-owned lands, and the City of Tacoma HCP for the Green River Water Supply Program.

The ESA provides both civil and criminal penalties for violations of the Act. An agency may assess a civil penalty of up to $25,000 against any person who knowingly violates the take prohibition of 4(d) regulations. Criminal penalties of up to one year or a fine of up to $50,000 or both against any person who knowingly violates the take prohibition or a protective regulation. The Services have rarely used criminal or civil prosecutions for violations of the ESA. The Services are more likely to contact individuals or entities who may be in violation of the Act, requiring actions to avoid ESA penalties. The ESA also permits citizen suits to compel ESA compliance. Any person may file a suit against another person, company or governmental entity.

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1.2.1 4(d) Rule and the Municipal, Residential, Commercial and Industrial Exception

In July 2000, NOAA Fisheries adopted the final 4(d) Rule to protect the 14 groups of salmon and steelhead listed as threatened or endangered under the ESA in Idaho, Washington, Oregon, and California. The rule took effect 180 days later on January 8, 2001. The 4(d) Rule is a regulation that provides for the conservation of listed threatened species. The rule prohibits the "take" of a threatened species and includes exceptions or "limits" to the take prohibitions (NOAA Fisheries, 2000). The limits are programs or activities for which NOAA Fisheries will not apply the Section 9 take prohibitions because it has determined that the programs or activities minimize impacts on threatened species enough that additional federal protections are not needed. The 4(d) Rule applies to actions carried out by state, tribal, and local governments and private parties.

The 4(d) Rule lists categories of activities that NOAA Fisheries considers likely to harm listed species. Also described are so-called "limitations on the take prohibition." These limitations are often referred to as exceptions or exemptions; they are activities that will be considered acceptable if carried out under NOAA Fisheries-approved programs. In cases where activities are conducted in conformity with current permits but do not provide adequate protection for listed species, NOAA Fisheries would not undertake enforcement activities, but would work with the responsible agency to make necessary changes in the program. If a proposed activity appears likely to take a listed species, project proponents are encouraged to change that activity to avoid take and to seek: 1) NOAA Fisheries authorization for an incidental take under ESA section 1, 2) an ESA section 7 consultation, or 3) a limit on the take prohibitions provided in this rule.

An important tool used by the Services in reviewing Section 7 consultations (BAs) is "properly functioning conditions" (PFCs). Properly functioning conditions, as used in this context, refer to the physical ability of streams to provide self-sustaining salmonid habitat. Stream characteristics commonly evaluated in terms of PFCs include water quality (temperature, sediment, and chemical contaminants), habitat access, substrate, large woody debris, pool frequency, channel condition and dynamics, and hydrology factors such as peak and base flows. An evaluation of PFCs is used to assess potential to harm a salmonid species.

The following categories of activities are considered by NOAA Fisheries to be most likely to result in a take according to NOAA Fisheries' harm rule (Long Live the Kings, 2000):

- Constructing or maintaining barriers that eliminate or impede a listed species' access to habitat or ability to migrate;
- Discharging pollutants, such as oil, toxic chemicals, radioactivity, carcinogens, mutagens, teratogens or organic nutrient-laden water including sewage water into a listed species' habitat;
- Removing, poisoning, or contaminating plants, fish, wildlife, or other biota required by the listed species for feeding, sheltering, or other essential behavioral patterns;
- Removing or altering rocks, soil, gravel, vegetation or other physical structures that are essential to the integrity and function of a listed species' habitat;

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- Removing water or otherwise altering streamflow when it significantly impairs spawning, migration, feeding or other essential behavioral patterns;
- Releasing non-indigenous or artificially propagated species into a listed species' habitat or where they may access the habitat of listed species;
- Constructing or operating dams or water diversion structures with inadequate fish screens or fish passage facilities in a listed species' habitat;
- Constructing, maintaining, or using inadequate bridges, roads, or trails on stream banks or unstable hill slopes adjacent to or above a listed species' habitat;
- Conducting timber harvest, grazing, mining, earth-moving, or other operations that result in substantially increased sediment input into streams;
- Conducting land use activities in riparian areas and areas susceptible to mass wasting and surface erosion, which may disturb soil and increase sediment delivered to streams, such as logging, grazing, farming, and road construction;
- Illegal fishing. Harvest in violation of fishing regulations will be a top enforcement concern;
- Various streambed disturbances that may trample eggs or trap adult fish preparing to spawn. The disturbance could be mechanical and caused by constructing push-up dams, removing gravel, mining, or other work in a stream channel. It may also take the form of egg trampling or smothering by livestock in the streambed or by vehicles or equipment being driven across or down the streambed (as well as any similar physical disruption);
- Interstate and foreign commerce dealing in listed salmonids and importing or exporting listed salmonids unless it can be shown through an ESA permit that they were harvested in a manner that complies with ESA requirements;
- Altering lands or waters in a manner that promotes unusual concentrations of predators;
- Shoreline and riparian disturbances (whether in the riverine, estuarine, marine, or floodplain environment) that may retard or prevent the development of certain habitat characteristics upon which the fish depend; and
- Filling or isolating side channels, ponds, and intermittent waters.

The 4(d) Rule includes several exceptions or limits to the take prohibition that have been approved by NOAA Fisheries. These include species taken under an "incidental take permit (Section 10) and certain research, salvage, management, and maintenance activities. The complete list of exceptions or limits is provided in Appendix A. Of particular interest to local governments in the Puget Sound region is the Municipal, Residential, Commercial, and Industrial (MRCI) exception:

- Municipal, residential, commercial and industrial development and redevelopment (MRCI) governed by and conducted in accordance with city, county, or regional government ordinances or plans that NMFS has found to adequately protect species or

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activities conducted under the Portland Metro Urban Growth Management Functional Plan once NMFS has found it adequately protective. For NMFS to determine that they adequately conserve listed species, MRCI development ordinances will be evaluated according to 12 criteria. Several of these criteria, listed below, directly relate to critical areas regulations.

A. Ensures that development will avoid inappropriate areas such as unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites.

B. Avoids stormwater discharge impacts to water quality and quantity or to the hydrograph of the watershed, including peak and base flows of perennial streams.

C. Provides adequately protective riparian area management requirements to attain or maintain properly functioning conditions (PFC) around all rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Compensatory mitigation is provided, where necessary, to offset unavoidable damage to PFC due to MRCI development impacts to riparian areas.

D. Avoids stream crossings by roads, utilities, and other linear development wherever possible, and, where crossings must be provided, minimizes impacts through choice of mode, sizing, and placement.

E. Adequately protects historical stream meander patterns and channel migration zones and avoids hardening of stream banks and shorelines.

F. Adequately protects wetlands and wetland functions, including isolated wetlands.

G. Adequately preserves the hydrologic capacity of permanent and intermittent streams to pass peak flows.

H. Includes adequate provisions for landscaping with native vegetation to reduce need for watering and application of herbicides, pesticides, and fertilizer.

I. Includes adequate provisions to prevent erosion and sediment run-off during construction.

J. Ensures that water supply demands can be met without impacting flows needed for threatened salmonids either directly or through groundwater withdrawals and that any new water diversions are positioned and screened in a way that prevents injury or death to salmonids.

K. Provides necessary enforcement, funding, reporting, and implementation mechanisms and formal plan evaluations at intervals that do not exceed 5 years.

L. Complies with all other state and federal environmental and natural resource laws and permits.

Jurisdictions, entities, and individuals are not required to seek inclusion in a 4(d) Rule limit, and a jurisdiction is not necessarily in violation of the ESA if its program is not approved by NMFS. A jurisdiction, entity, or individual may informally comply with the 4(d) Rule limit by modifying its programs to be consistent with the approved program of another jurisdiction. However, a jurisdiction is only assured of compliance if it receives written approval of its program from NMFS.

1.2.2 Implications for Local Governments

Local governments are subject to the regulations of the ESA under both Sections 7 and 9. Section 7 of the Act prohibits all federal agencies from funding, permitting or carrying out any activity that will jeopardize the continued existence of a listed species. Local governments involved in activities requiring a federal permit or receiving federal funding are subject to this section of the Act and must consult with the Services through the Biological Assessment process. Section 9 prohibits "any person" from taking a listed species; local governments are included in the Act's broad definition of "any person."
Many of the take activities listed in the 4(d) Rule are activities that local governments could be involved in through their programs, policies, or permitting. The 4(d) Rule also contains several limits on take that could apply to local governments.

One consideration for local governments is the use of "Best Available Science" in determining potential harm to habitat of federally-listed species. NMFS requires that the scientific justification used to determine potential impacts to salmonids be based on credible science. Credible science does not require that exhaustive studies be conducted by an agency or local government. However, all available scientific information, preferably from peer-reviewed articles, should be used in decision-making processes involving the species. This credible science requirement is similar to the best available science requirement in the state Growth Management Act revising for comprehensive plans and critical areas ordinances (WAC 365-195-900) (Section 1.3 of this report).

1.2.3 WRIA 8 Near Term Action Agenda and Conservation Plan

In 1998, the State of Washington enacted the Salmon Recovery Act (RCW 77.85, often referred to as S.B. 2496). This bill authorized multi-stakeholder (steering) committees to plan for salmon recovery within the state's Water Resource Inventory Areas (WRIAs). In 1998, the steering committee for the Lake Washington/Cedar/Sammamish WRIA (WRIA 8) was created. The 1999 listing of Puget Sound chinook salmon as a threatened species under the ESA added impetus to the watershed conservation effort. In WRIA 8, 27 jurisdictions, including Snohomish and King Counties and 25 cities are involved in a collaborative process to conserve salmon habitat in the watershed. The City of Woodinville is one of the participating cities under an interlocal agreement, signed in 2001, that funds the joint planning effort.

The ultimate goal of the WRIA 8 planning process is to produce a conservation plan that will describe strategies for protecting and restoring salmon habitat in the watershed. The Conservation Plan will be based on a technical assessment of the watershed and will include regulatory and policy recommendations; education and public involvement; and adaptive management, monitoring, and research. A major component of the conservation plan will be the prioritization of habitat protection and restoration projects. The conservation plan will be presented to the county or city councils of the participating jurisdictions for possible adoption. Technical studies that will provide the basis for the conservation plan are currently being prepared. The conservation plan is expected to be completed in 2005.

The *Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Near-Term Action Agenda for Salmon Habitat Conservation* (Action Agenda) was developed to provide jurisdictions with interim guidance while the longer-term conservation plan is being prepared. The Action Agenda lists several projects for habitat protection and restoration in the watershed, including projects in Woodinville. The projects listed in the Action Agenda are considered priority projects for funding. The Action Agenda also includes general regulatory and policy recommendations that are applicable to the City's evaluation of its critical areas regulations. These include:

- Prohibit the removal of in-channel large woody debris as well as large woody debris on adjacent banks, except in situations where public health and safety of significant infrastructure are threatened. In these cases, relocate large woody debris to sites (preferably within the same sub-area) where it can provide similar benefits.
- Protect existing wetlands and their buffers. The goal should be no net loss of function and acreage.
- When feasible, enhance or restore riparian areas surrounding wetlands where functions have been lost or compromised.
- Wetland mitigation should be considered only after it has been demonstrated that local government cannot legally prohibit alteration to a wetland. In these cases, the state's mitigation sequencing approach should be used, which starts with avoidance and minimization of impacts on all functions for the long term. Mitigation should occur in the same sub-basin.
- Ensure that any variances and reasonable use exceptions issued do not undermine the ecological functions and values that regulations are trying to protect. Monitor variances and reasonable use exceptions for cumulative effects on achieving ecological objectives. If necessary, provide funds to purchase property or development rights to ensure protection of the land.

1.3 State Growth Management Act Requirements

Rules promulgated under the 1990 Washington State Growth Management Act (GMA) (RCW 360.70A.060) required counties and cities to adopt development regulations that protect the functions and values of critical areas, including streams, wetlands, wildlife habitat, critical aquifer recharge areas, geologic hazard areas, and flooded areas. In 1995, the Washington State legislature added a new section to the GMA to ensure that counties and cities consider reliable scientific information when adopting policies and development regulations to designate and protect critical areas. In accordance with RCW 36.70A.172(1), communities "shall include the best available science in developing policies and development regulations to protect the functions and values of critical areas, including wetlands." In addition, jurisdictions must give "special consideration" to protecting, preserving, and enhancing anadromous fisheries.

The state developed administrative rules to assist jurisdictions in identifying and including best available science in their policies and regulations (WAC 365-195-900 to 925. One source of "best available science" is information that local, state, or federal agencies have determined meets best available science. The Office of Community Development has issued a list of

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citations of recommended sources for "best available science" related to critical areas (Office of Community Development, 2001). The administrative rules recommend that any agency list of resources should be evaluated for local applicability (WAC 365-195-905(2).

The administrative rules outline the characteristics of the scientific process that should be evaluated when determining whether or not a source is the "best available science" and the common sources of scientific information. These characteristics are:

- Peer review—the information has been reviewed by other persons who are qualified scientific experts in that scientific discipline.
- Methods—the methods that were used to obtain the information are clearly stated and able to be replicated.
- Logical conclusions and reasonable inferences—the conclusions that are presented are based on reasonable assumptions supported by other studies and consistent with the general theory underlying the assumptions. The conclusions are logically and reasonably derived from the assumptions and supported by the data presented.
- Quantitative analysis—the data have been analyzed using appropriate statistical or quantitative methods.
- Context—the information is placed in proper context of the prevailing body of scientific knowledge.
- References—the assumptions, analytical techniques, and conclusions are well referenced with citations to relevant, credible literature and other pertinent existing information.

The administrative rules also assess the role of nonscientific information. Nonscientific information can provide important information to supplement scientific information, but should not be considered a substitute for scientific information. Common sources of nonscientific information are:

- Anecdotal information—one or more observations which are not part of an organized scientific effort.
- Non-expert opinion—opinion of a person who is not a qualified scientific expert in a pertinent scientific discipline.
- Hearsay—information repeated from communication with others.

There are also guidelines for including best available science in the development of policies and development regulations. The following must be identified in the administrative record to demonstrate that best available science has been included in the development of critical areas regulations:

- The specific policies and development regulations adopted to protect the functions and values of critical areas.
- The relevant sources of scientific information included in the decision-making.

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- Any nonscientific information used as a basis for critical area policies and regulations that depart from best available science recommendations.

The nonscientific information can include legal, social, cultural, economic, and political information. The administrative rules state that any jurisdiction that departs from best available science recommendations should:

- Identify the information in the record that supports the decision to depart from science-based recommendations;
- Explain its rationale for departing from the recommendations; and
- Identify potential risks to the functions and values of critical areas and any additional measures chose to limit the risks.

State Environmental Policy Action (SEPA) review can provide the opportunity to document and publish the record of this assessment.

In situations where there is a lack of valid scientific information or incomplete scientific information for a jurisdiction's critical areas, jurisdictions are advised to either use a "precautionary or a no risk approach" or to develop an effective adaptive management program to evaluate how well regulatory and non regulatory actions achieve their objectives (WAC 365-195-920). The "precautionary approach" requires development and land use activities to be severely limited until the uncertainty is resolved. An adaptive management program treats management, policy, and regulatory actions as "experiments that are purposefully monitored and evaluated to determine whether they are effective." Adaptive management requires that if the actions are not effective, they be improved to increase their effectiveness.

The Growth Management Act requires that jurisdictions designate critical areas (RCW 36.70A.170). Critical areas are defined as wetlands, areas with a critical recharging effect on aquifers used for potable water, fish and wildlife habitat conservation areas, frequently flooded areas, and geologically hazardous areas (RCW 36.70A.030)

1.4 Overview of City Environment and Listed Species in the City

The City of Woodinville is an urbanizing city located in the Sammamish River Valley in King County, Washington. It is approximately 5.66 square miles in size and has an estimated population of 9,809 (as of April 2003). The Sammamish River flows through the City and to the west toward Lake Washington. Little Bear Creek also flows through Woodinville and into the Sammamish River. Woodinville's commercial, industrial and agricultural areas are generally confined to the valley floor, while residential neighborhoods occupy the surrounding plateaus and slopes, many of which are heavily forested.

The Sammamish River Valley was historically a valley bottom filled with wetlands and meandering and braided channels (U.S. Army Corps of Engineers and King County Department of Natural Resources and Parks, 2003). The river channel and valley have been drastically altered by development. For example, forests have been cleared, wetlands have been drained,

the river has been confined to one channel, the Lake Washington lake level has been lowered altering the flow pattern of the river, and the river has been constrained for flood control. Farming in the valley has led to draining and ditching of wetland habitats once associated with the Sammamish River and tributary drainages.

The city limits are generally described as the lands bounded on the north by the Snohomish/King County line, on the east by 170th Ave NE north of NE Woodinville-Duvall Road and the Sammamish River, on the south by NE 145th Street (State Route 202), and on the west by 124th Avenue NE.

Wildlife and wildlife habitat in the City of Woodinville is scattered throughout the city in and around the main watercourses, lowland forest patches, riparian areas, and wetlands. The largest contiguous areas of habitat are: 1) along Little Bear Creek, 2) the forested slopes above the Sammamish River, and 3) remaining riparian areas in the City (WDFW 2003). Although there is information on salmonid use of Little Bear Creek and salmon and wildlife use of Woodin Creek, there is a lack of detailed inventory information for wildlife use and wildlife habitat for most of the City. Knowledge of wildlife habitat in the City is based on Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species mapping, aerial photographs, and limited August field reconnaissance performed in support of this project. Wildlife habitat, wetlands and streams, and critical aquifer recharge areas in the City are described, respectively, in the best available science Technical Memoranda (Adolfson 2003a. 2003b, and 2003c) prepared for this project.

Federally listed species in the Woodinville area include bald eagle, chinook salmon, and bull trout. In addition, coho salmon are a federal candidate species. Chinook and coho salmon migrate through the City using the Sammamish River and may utilize tributaries within the City for rearing and feeding. Bald eagle are common along the Sammamish River, but there are no known nests within the city limits.

2.0 CURRENT WOODINVILLE CRITICAL AREA REGULATIONS

The City of Woodinville was incorporated in 1993. As part of the incorporation process, the City adopted many parts of King County's Development Regulations as its Zoning Code (Woodinville Municipal Code (WMC) Chapter 21). Regulations for Environmentally Sensitive Areas are located in WMC 21.24 and include regulations for wetlands, streams, geologic hazard areas, and aquifer recharge areas. Similar to King County, the City code does not contain separate regulations for fish and wildlife habitat.

2.1 Wetlands and Streams

The Woodinville Environmentally Sensitive Areas regulations regulate wetlands in Sections 21.24.310 to 340 and streams in Sections 21.24.350 to 370. Wetland and stream classifications are located in WMC 21.06, Definitions.

The wetlands section includes buffers around wetlands of 100 feet for Class 1, 50 feet for Class 2, and 25 feet for Class 3 wetlands. Buffer width averaging is permitted so long as additional protection is provided and the total buffer area does not decreased. The City can require increased buffer widths when necessary. Alterations to wetlands are permitted only under specific circumstances. The regulations include requirements for locating public facilities such as utilities, sewer utility corridors, stormwater retention and detention, and trails. Wetland mitigation measures guidelines are included with replacement rations of 2:1 for Class 1 and 2 wetlands and 1:1 for Class 3 wetlands. The code contains guidelines for alteration of isolated wetlands. A limited exemption is permitted for alteration of wetlands less than 1,000 square feet after the City evaluates the cumulative impacts and if mitigation is completed.

The development standards for streams require buffers of 100 feet for Class 1 and Class 2 streams used by salmonids, 50 feet for other Class 2 streams, and 25 feet for Class 3 streams. Buffer width averaging may be allowed and the City shall require increased buffers when necessary to protect streams. Permitted alteration regulations, including public facilities, are similar to those for wetlands. The regulations include provisions that restrict stream crossings and stream relocations. Stream enhancement and minor stream restoration are permitted. Mitigation is required for stream alteration that are permitted and those that are in violation of the law and restoration requirements are included.

2.2 Fish and Wildlife Habitat Conservation Areas

As stated above, the Environmentally Sensitive Areas regulations do not include separate regulations for fish and wildlife or their habitats. According to WAC 365-190-080, fish and wildlife habitat conservation areas include a broad range of habitat types. The ones listed in WAC 365-190-080 that are most likely to be located in Woodinville are listed below.

- Areas with which endangered, threatened, and sensitive species have a primary association;
- Habitats and species of local importance;
- Naturally occurring ponds under twenty acres and their submerged aquatic beds that provide fish or wildlife habitat:
- Waters of the state; or
- Lakes, ponds, streams, and rivers planted with game fish by a governmental or tribal entity.

In WMC 21.24.010 (3), one of the purposes of the Environmentally Sensitive Areas chapter is: "Protecting unique, fragile and valuable elements of the environment including, but not limited to, wildlife and its habitat". The wetlands section of WMC 21.24.310 to 340 includes several references to wildlife habitat or "critical fish and wildlife habitat," or "significant habitat for listed species," but these terms are not defined in the WMC. Fish habitat is protected in part by the regulations related to stream protection described in Section 2.1 above.

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2.3 Critical Aquifer Recharge Areas

The Environmentally Sensitive Areas regulations include development standards and permitted alterations for aquifer recharge areas (WMC 21.24.200), but do not include a definition for aquifer recharge area. There is no mention of or definition for critical aquifer recharge areas. The regulations require that the locations of recharge areas be shown on the face of the site design and/or plat. Alterations to aquifer recharge areas are only allowed if a site-specific evaluation shows the development is not located in an aquifer recharge area or if mitigation can be implemented that either eliminates or minimizes the risk to the aquifer. The regulations also state that the Building Official can prohibit the use of hazardous substances, pesticides and fertilizer and the installation of on-site septic systems in designated aquifer recharge areas.

2.4 Geologic Hazards

The City regulates geologic areas including erosion hazard areas (WMC 21.24.210), landslide hazard areas (WMC 21.24.270), seismic hazard areas (WMC 21.24.280), and steep slope hazard areas (WMC 21.24.300). Erosion hazard areas are defined as areas underlain by soils that are subject to severe erosion when disturbed. The erosion hazards section includes restrictions on clearing and vegetation removal and requires water quality monitoring under certain conditions. Landslide hazard areas are defined as areas subject to severe risk of landslides based on slope steepness, soil types, the presence of springs or groundwater seepage, history of landslide activity, subject to stream incision, location on an alluvial fan, and at risk from snow avalanches. Steep slopes are defined as those 40 percent or steeper with a vertical elevation change of at lest 10 feet. The landslide and steep slope hazard areas sections require a 50-foot buffer from the edge of the landslide hazard area and from any slope 40 percent or steeper. Vegetation removal is restricted. Seismic hazard areas are defined as areas subject to severe risk of earthquake damage as a result of soil liquefaction (WMC 21.06.535). The seismic hazard regulations establish the review criteria for development proposals in a seismic hazard area.

3.0 GAP ANALYSIS

The following sections summarize the identified gaps between the ESA and best available science recommendations and the existing Woodinville regulations. The gaps are identified in more detail in the matrices in Tables 1, 2, and 3 (Appendix B). The gaps associated with wildlife, wetlands and streams are combined in Table 1 because of the overlap in the issues related to these critical areas. Table 2 evaluates critical aquifer recharge areas, and Table 3 evaluates geologic hazard areas.

Aspects of the Woodinville Environmentally Sensitive Areas regulations for wetlands and streams meet the requirements of the ESA and best available science. Wetlands and streams are protected based on the ecological values. Regulations limit the alteration of streams and wetlands. The lack of regulations specific to fish and wildlife habitat conservation areas results in several gaps in wildlife protection. There are also major gaps in the aquifer recharge area regulations created by the lack of information about aquifer recharge areas in the City and by the

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general nature of the regulations. Geologic hazard area protection generally meets the requirements of best available science, but could be refined to clarify protection.

3.1 Wetlands and Streams

In Table 1, the first column contains the MRCI category of activity from the 4(d) Rule (see Section 1.2.1). Categories B, I, and J are not included in the evaluation because they do not relate to critical areas protection. Column 2 contains applicable policy recommendations from the WRIA 8 Action Agenda. Column 3 summarizes the existing Woodinville regulations. The fourth column contains general guidance from best available science that relate to critical areas. The fifth column identifies the gap between the recommendations and existing regulations. The last column contains Adolfson comments related to the topics, if applicable.

Many aspects of the existing Woodinville regulations for the protection of wetlands and streams generally meet the requirements of the 4(d) Rule and the best available science guidelines. For both wetlands and streams, research indicates that buffers ranging from 100 to 150 feet will provide approximately 80 percent of the potential buffer functions (Castelle et al., 1994). The City's maximum buffer is currently 100 feet. However, the city should evaluate the best available science related to buffer widths to determine if larger buffers are warranted to protect salmonid habitat or wetland functions.

The City classifies wetlands into three classes. Class 1 wetlands include those that provide significant habitat for listed species. The buffer requirements for wetlands are located in WMC 21.24.310. These buffer widths are typical widths for urban jurisdictions in the Puget Sound area. The existing Woodinville regulations may be inconsistent with the 4(d) Rule regarding the protection of isolated wetlands. The wetland mitigation ratios are smaller than those recommended by the Department of Ecology. The existing regulations do not include the mitigation sequencing approach recommended by Ecology.

The City classified streams into three classes based on whether the stream is a shoreline of the state, has perennial or intermittent flow, and the presence of salmonids. These classifications are similar to those recommended by the state, but are less complicated than the state classification.. Stream and buffer crossings are regulated in WMC 21.24.360 and include requirements to avoid fish impacts. The existing regulations do not specifically address maintaining historical stream meander patterns and channel migration zones. The stream regulations do not mention primary functioning conditions (PFCs).

3.2 Fish and Wildlife Habitat Conservation Areas

The gaps for wildlife protection are evaluated in Table 1 along with wetlands and streams. The WMC does not define terms related to fish and wildlife habitat, properly functioning condition, channel migration zones, habitat linkages, and sensitive species. The WMC lacks a section for protection of fish and wildlife conservation areas other than the protections provided by stream and wetland buffers. The City of Woodinville is in the process of inventorying stream and salmonid resources in the City. This information is not included in one consolidated stream and

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fisheries resource map. Channel migration zones are not mapped within the City. Fish habitat is protected in part by the stream section of the code 21.24.350-370. There is no process for designation of fish and wildlife habitat conservation areas or critical habitats for sensitive species. Studies indicate that buffers for wildlife habitat can range up to 600 feet and more, depending on the species. Existing regulations do not provide buffers or other protection measures for wildlife habitat other than stream buffers and protection for fish.

3.3 Critical Aquifer Recharge Areas

The gaps in the critical aquifer recharge area regulations are analyzed in Table 2. There are no 4(d) Rule or WRIA 8 Action Agenda recommendations for aquifer recharge areas, so the existing regulations are only compared to best available science recommendations.

There has been no study of critical aquifer recharge areas in the City of Woodinville and none are designated in the City. The existing code does not define aquifer recharge areas, but does regulate them. Best available science guidelines for the protection of critical aquifer recharge areas recommend that activities with a high risk for contamination should be prohibited. The existing regulations prohibit alterations to aquifer recharge areas unless site specific studies indicate the development would not be in an aquifer recharge area or unless mitigation measures eliminate or minimize the risk to the aquifer. The existing regulations do not specifically prohibit high-risk activities. Best available science also recommends that best management practices can be required for activities in critical aquifer recharge areas to minimize the risk of contamination. The existing regulations state that alterations to recharge areas can be permitted if mitigated, but provide no guidance on appropriate types of mitigation. The City's non-specific regulations for aquifer recharge areas could permit high-risk activities to locate in an aquifer recharge area without appropriate mitigation. At the same time, the ordinance could prevent some activities from locating in an aquifer recharge area that could be safely mitigated with appropriate best management practices. The existing regulations state that the Building Official can prohibit the use of hazardous substances, pesticides and fertilizer and the installation of on-site septic systems in designated aquifer recharge areas. There are no definitions or other guidelines to indicate under what circumstances it would be appropriate to ban such materials.

3.4 Geologic Hazards

Gaps associated with geologic hazard protection are analyzed in Table 3. There are no WRIA 8 Action Agenda recommendations for geologic hazards and only one applicable 4(d) rule category. The existing regulations meet ESA guidance by providing protection to minimize erosion from unstable slopes. The source of best available science guidance is the Washington Office of Community, Trade, and Economic Development's Critical Areas Assistance Handbook (CTED, 2003).

The existing Woodinville regulations for geologic hazard areas are generally similar to the best available science guidance in the Critical Areas Assistance Handbook. The primary gaps between the existing regulations and best available science guidance are in how geologic hazard areas are defined and the requirements for evaluating those hazards in critical area reports. The

guidance Critical Areas Assistance Handbook for development standards are more detailed and comprehensive than those in the existing Woodinville code.

4.0 RECOMMENDATIONS

Adolfson provides the following preliminary recommendations to the City based on identified gaps between ESA guidelines and best available science. These recommendations are preliminary and general in nature at this time. Other recommendations for code revisions will be made later as code revisions are developed, including recommendations to improve the clarity of the code and to address specific best available science recommendations from the Technical Memoranda.

It was not in the scope of this gap analysis to evaluate the City's floodplain, stormwater or shoreline regulations. Both regulations are important for the protection of endangered fish species. The City should evaluate those regulations in view of both the ESA and best available science. The City should also evaluate its Comprehensive Plan to ensure that its goals and policies meet ESA and best available science guidelines.

Concern has been expressed by the federal Services and in the WRIA 8 Action Agenda, that variances and reasonable use exceptions are a threat to otherwise adequate protection of endangered species. The City should consider adding decisional criteria to the variance and reasonable use sections of the code to consider best available science and address listed species.

4.1 Critical Areas Recommendations

4.1.1 Wetlands and Streams

The City should evaluate its wetland and stream rating systems for consistency with state recommended rating systems. Buffer widths for wetlands and streams should also be evaluated to determine if they should be increased to meet best available science guidance. The exemption criteria for protection of isolated wetlands should be evaluated to ensure that these wetlands are being protected. The City should add the Ecology mitigation sequence approach to its wetland mitigation section.

4.1.2 Fish and Wildlife Habitat Conservation Areas

Definitions for fish and wildlife conservation areas, properly functioning conditions, sensitive species, channel migration zones, and habitat linkage should be included in the definition section of the WMC. A section of Chapter 21 addressing fish and wildlife habitat conservation areas could be added. The section could include the process for the designation of fish and wildlife conservation areas, and conservation measures including tree retention, prescriptive buffers, or development of a habitat management plan. Fish and wildlife conservation areas need to included threatened and endangered species. The City of Woodinville is in the process of

inventorying stream and salmonid resources in the City. This information could be included in one stream and fisheries resource map.

ESA guidelines recommends protecting channel migration zones and setting stream buffers from the zones. Channel migrations zones for the Sammamish River are restricted by levees and mapping of these areas could be difficult. However, the City should consider mapping channel migration zones for streams in the City.

4.1.3 Critical Aquifer Recharge Areas

The aquifer recharge section should be revised to clarify that critical aquifer recharge areas are being protected. Definitions are needed for critical aquifer recharge areas, hazardous substances, and other terms in this section of the code. The section should be revised to include prohibitions on high-risk activities and to include more specific recommendations on best management practices for permitted activities.

4.1.4 Geologic Hazard Areas

The sections of the City's regulations that address different geologic hazard areas should be revised in view of best available science to incorporate new definitions and criteria for protection. Adoption of the recommendations from best available science guidance would provide the City with a more detailed and comprehensive protection for geologic hazard areas, especially for erosion, landslide, and seismic hazard areas. The City should compare its definitions for hazard areas in view of the recommendations in the Department of Community and Economic Development's Critical Areas Handbook (CTED, 2003). The evaluation could determine a reasonable level of protection for geologic hazard areas based on existing conditions in the City. The City should incorporate the state licensing requirements for geologists, engineering geologists, and hydrogeologists into its code. The City should continue to require erosion control measures in erosion-prone areas, especially near streams and wetlands.

4.2 Other Policies and Plans

The City may consider development and use of other non-regulatory policies and plans to protect critical areas and anadromous fish. These include development of an adaptive management policy, a review of stormwater regulations, a review of maintenance and operations plans, and development of habitat restoration plans for the City. For example, the City is presently working on a Surface Water Comprehensive Plan, maintenance crews utilize best management practices, and the City will be using the Little Bear Creek and Woodin Creeks studies as the basis for Habitat Restoration Plans. Further, the City will need to consider best available science in updating its Comprehensive Plan and Shoreline Management Master Program.

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APPENDIX A
EXCEPTIONS OF LIMITS OF THE 4(d) RULE

EXCEPTIONS OF LIMITS OF THE 4(d) RULE

- Activities conducted under a section 10 ESA permit or those receiving other ESA exemptions.
- Ongoing scientific research that was applied for through the National Oceanic and Atmospheric Administration within 90 days of the rule being published (October 2000).
- Rescue and salvage operations conducted by certain agencies and official personnel to aid injured or stranded fish or to salvage a dead fish for scientific study.
- Fishery management activities undertaken under a Fisheries Management and Evaluation Plan (FMEP) approved by NMFS.
- Artificial propagation and hatchery activities under the authority of a NMFS approved Hatchery and Genetics Management Plan (HGMP).
- Activities that are part of joint tribal/state plans developed under the *United States v. Washington* or the *United States v. Oregon* settlement process.
- Scientific research activities conducted by state fishery management agencies that have received written approval from NMFS.
- Habitat restoration activities conducted as part of a NMFS approved state watershed conservation plan.
- Water diversions screened, operated, and maintained in a manner consistent with NMFS juvenile fish screening criteria. NMFS must be allowed access to inspect the diversion.
- Routine road maintenance activities that are conducted by employees or agents of a state, county, city or port under a program that complies substantially with the program adopted by the Oregon Department of Transportation (ODOT) or under a program that maintains or attains proper functioning conditions (PFC).
- The City of Portland Parks and Recreation Department's Pest Management program.
- Municipal, residential, commercial and industrial development and redevelopment (MRCI) governed by and conducted in accordance with city, county, or regional government ordinances or plans that NMFS has found to adequately protect species or activities conducted under the Portland Metro Urban Growth Management Functional Plan once NMFS has found it adequately protective. For NMFS to determine that they adequately conserve listed species, MRCI development ordinances will be evaluated according to 12 criteria.
- Non-federal forest management activities conducted under the Washington Forests and Fish Report (FFR) when adopted by the Washington Forest Practices Board in a form at least as protective as laid out in the FFR.

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Appendix B - Tables

Table 1. Wildlife, Wetland and Streams Gap Analysis

ESA NMFS 4(d) Rule	Action Agenda Recommendations	Existing Woodinville Regulations	Best Available Science Guidelines	Identified Gaps	Comments
A) MRCI development ordinance or plan ensures that development will avoid inappropriate areas such as unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites.	Protect existing wetlands and their buffers. The goal should be no net loss of function and acreage	WMC 21.24, Environmentally Sensitive Areas, avoids development in unstable slopes, wetlands, streams, buffers, areas with unique, fragile, and valuable elements including, but not limited to, wildlife and its habitat.	**General Guidance:** Wetlands, streams, and riparian areas provide many functions and values to wildlife and fish species. Wetlands associated with salmonid streams are important to fish habitat.	Areas of high habitat value for listed fish and salmonids, particularly high value wetlands associated with salmonid-bearing streams, have not been specifically designated or evaluated in the City. Areas of critical wildlife habitat have not been designated by the City. The Variance and Reasonable Use Exception processes do not specifically consider affects to federally-listed species and habitats.	Habitats for listed species should be designated as Critical Fish and Wildlife Habitats in the sensitive areas regulations (this term should be defined in the definition section of the code). Decisional criteria could be added to the variance and reasonable use sections of the code that address listed species.
C) MRCI development ordinance or plan provides adequately protective riparian area management requirements to attain or maintain PFC around all rivers, estuaries, streams, lakes, deep water habitats, and intermittent streams. *Compensatory mitigation is provided, where necessary, to offset*		Riparian management is attained through establishment of stream buffers and building setbacks. Streams are classified into three classes according to stream size, perennial flow, and fish usage Stream buffers vary according to class and	**General Guidance:** Riparian zones provide many functions for streams including provision of large woody debris (LWD) and wildlife habitat, to filtering sediments, and maintaining benthic communities. Presence of LWD plays a large role in the creation and maintenance of	Properly Functioning Conditions (PFC) are not the goal of the City of Woodinville sensitive area regulations; rather the goal is to provide general protection to rivers, streams, lakes and riparian areas. PFC is not defined in WMC. Baseline data for PFC have not been summarized for the City of Woodinville except for Little Bear Creek.	

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ESA NMFS 4(d) Rule	Action Agenda Recommendations	Existing Woodinville Regulations	Best Available Science Guidelines	Identified Gaps	Comments
unavoidable damage to PFC due to MRCI development impacts to riparian management zones.		are measured from the ordinary high water mark. Mitigation for impacts to streams associated with stream crossings or placement of utilities as specified not associated with PFCs. Lakes are not defined in WMC 21.24. Specific protections for lakes are included in the shoreline code but not in the sensitive areas regulations.	salmonid habitat. LWD creates pools and provides habitat for rearing salmonids, while overhanging wood and vegetation provides protection from predators. Woody debris adds roughness which slows water velocities and reduces scour potential of floodwaters. LWD also provides input of organic matter, moderates stream temperature, and stabilizes stream banks.	Determining limiting factors for salmon recovery and documenting current conditions could assist the City in establishing a City-specific 4(d) proposal for NMFS review. Mitigation for impacts to streams associated with stream crossings or placement of utilities as specified not associated with PFCs. Gaps in definitions and terms used by NMFS. Channel migration zones are not designated or known in the City. The code does not allow structures in channel relocation and stream meander areas, but does not establish riparian management zones or buffers from such areas. Lakes are protected solely by the shoreline regulations in the City of Woodinville. No sensitive area buffers apply within the City to Lake Washington.	The City of Woodinville lies entirely within the Urban Growth Area; rural designations for riparian management are not applicable.

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ESA NMFS 4(d) Rule	Action Agenda Recommendations	Existing Woodinville Regulations	Best Available Science Guidelines	Identified Gaps	Comments
		Compensatory mitigation is required to offset impacts to sensitive areas and their buffers.	**General Guidance:** Wetland mitigation is not always successful. Improper design, lack of maintenance, and inadequate water levels can be issues. Mitigation is more successful for open water wetlands. Sequencing should include avoiding, minimizing, rectifying, reducing, and finally compensating for impacts.	The goal of mitigating to offset damage to PFCs for salmonids is not addressed in the City's ordinance. Mitigation ratios and requirements may need to be addressed for impacts to salmonid-bearing streams and buffers.	
*** As an example in the proposed 4(d) rule, NMFS refers to one site-potential tree height (i.e., 200 feet) as an important distance from the stream to protect riparian functions, particularly to ensure input of large woody debris into the stream. Although not a prescriptive buffer, the 200 foot distance is used as an example buffer width by NMFS for entities assessing their impacts on riparian zones in the context of the 4(d) rule's urban development limit.*	Prohibit the removal of in-channel large woody debris as well as large woody debris on adjacent banks, except in situations where public health and safety of significant infrastructure are threatened.	• Class 1 streams--100- foot buffer. • Class 2 streams, with salmonids present—100-foot buffer. • Class 2 streams, with no salmonids—50-foot buffer. • Class 3 streams, which are seasonal and non-salmonid bearing—25-foot buffer.	**General Guidance**: Many studies indicate that buffers ranging from 100 to 150 feet will provide most (on the order of 80 %) of potential buffer functions in most situations. Buffers for wildlife habitat can range up to 600 feet and more. See discussion of PFC above.	The City of Woodinville sensitive areas regulations do not extend past 100 feet for salmonid-bearing streams. The City needs to use best available science to determine appropriate buffers within the City environment. The City has no specific regulations to retain large woody debris in streams or in riparian corridors.	The purpose of the riparian zone is to protect PFCs of the stream. NMFS states in a response to a comment to the Draft 4(d) Rule concerning the 200-foot riparian buffer example, that it considers approximately 200 feet to be a good starting point for assessing riparian function and value under the urban development limit. However, NMFS notes that land ownership patterns and local conditions would alter the actual extent of the riparian zone in a given area.

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ESA NMFS 4(d) Rule	Action Agenda Recommendations	Existing Woodinville Regulations	Best Available Science Guidelines	Identified Gaps	Comments
D) MRCI Development ordinance or plan avoids stream crossings by roads, utilities, and other linear development wherever possible, and, where crossings must be provided, minimize impacts through choice of mode, sizing and placement.		WMC 21.24 requires avoidance of stream and buffer crossings by linear developments. In the event that such crossings are unavoidable, then the City requires under Section 21.24.360 (Streams: Permitted Alterations) that crossings protect fish resources. Stream crossing may be allowed if construction does not disturb the streambed or bank, uses bottom-less culverts or trenchless technologies, will not harm fish passage and migration, avoids stream disturbance during periods critical to salmonids, and if crossings do not occur over salmonid spawning areas unless the City determines that no other possible crossing site exists.	**General Guidance:** None specific to roads and utilities. However, road and utility crossings can introduce barriers such as culverts that can inhibit fish passage and access to upstream habitats. They may limit natural processes necessary for salmonid fish production, including the natural redistribution of substrate and woody debris. They may cause direct loss of habitat.	No significant gaps in policy are apparent at this time. City regulations including the variance process would need to be carefully evaluated for consistency with the intent of the 4(d) rule with the goal of providing PFCs.	

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ESA NMFS 4(d) Rule	Action Agenda Recommendations	Existing Woodinville Regulations	Best Available Science Guidelines	Identified Gaps	Comments
E) MRCI development ordinance or plan adequately protects historical stream meander patterns and channel migration zones and avoids hardening of stream banks and shorelines.		Stream meander patterns and channel migration zones are not included in the Woodinville code. Regulations for stream relocation and restoration are located in WMC 21.24.360. Buffers are required to be set back from the ordinary high water mark, not the channel migration zone.	**General Guidance:** CMZs help maintain watershed processes: routing of wood, gravel, and nutrients. Bank hardening and channel confinement increase water velocity and remove natural connectivity between river and off-channel habitat. Channelizing also restricts interchange of organic material, nutrients (leaf litter, wood, invertebrates). Local aquifers/hyphorheic zones can be dewatered.	Gaps in definitions and terms used by NMFS. PFC are not the intended goal of the City's sensitive areas ordinance. Channel migration zones are not designated or known in the City.	The channel migration zone of the Sammamish River has been cut off by channelizing and diking the river.
F) MRCI development ordinance or plan adequately protects wetlands and wetland functions, including isolated wetlands.	Wetland mitigation should be considered only after it has been demonstrated that local government cannot legally prohibit alteration to a wetland. In these cases, the state's mitigation sequencing approach should be used, which starts with avoidance and minimization of impacts on all functions for the long term. Mitigation should occur in the same sub-basin.	Wetlands, including isolated wetlands, are protected in the City through provisions of the WMC. However, the connection of these wetlands to salmonid-bearing streams, as well as the functions wetlands provide to stream support, are not well known in the City. Provisions of the code allow for development in certain small isolated wetlands. Mitigation is required to be on-site or in the same sub-basin.	**General Guidance:** Wetland functions include water quality improvement, aquifer recharge, flood storage/retention, stream base flow support, wildlife habitat, and societal values (education, enjoyment, research).	Generally, strong protection of wetlands in Woodinville. Protection afforded to "isolated wetlands" may be inconsistent with the 4(d) rule and could be considered a gap. Connections of wetlands to salmonid-bearing streams may not be protected to a degree that maintains PFC. The wetland mitigation section of the code does not include mitigation sequencing.	The City should add the Ecology mitigation sequencing approach to its wetland regulations.

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ESA NMFS 4(d) Rule	Action Agenda Recommendations	Existing Woodinville Regulations	Best Available Science Guidelines	Identified Gaps	Comments
		Wetlands are classified into three classes based on size, wetland type, and habitat for listed species. Class 1 wetlands include those that provide significant habitat for listed species. • Class 1 Wetlands require a 100-foot buffer. • Class 2 Wetlands require a 50-foot buffer. • Class 3 Wetlands require a 25-foot buffer.	**General Guidance**: Many studies indicate that buffers ranging from 100 to 150 feet will provide most (on the order of 80 %) of potential buffer functions in most situations. Buffers for wildlife habitat can range up to 600 feet and more. Wetlands associated with salmonid streams are important to fish habitat.	No significant gaps identified. Wetland buffers in the City are not required to extend further than 100 feet. High value wetlands associated with salmonid-bearing streams have not been specifically designated or evaluated in the City.	The City should use best available science to determine appropriate buffer widths for wetlands in the City.
H) Includes adequate provisions for landscaping with native vegetation to reduce need for watering and application of herbicides, pesticides, and fertilizer.		For both wetlands and stream, the City can prohibit hazardous substances, pesticides and fertilizer in buffers. No non-indigenous plant or animal species can be introduced to buffers.		No gap identified.	

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ESA NMFS 4(d) Rule	Action Agenda Recommendations	Existing Woodinville Regulations	Best Available Science Guidelines	Identified Gaps	Comments
K) MRCI development ordinance or plan provides necessary enforcement, funding, reporting, and implementation mechanisms and formal plan evaluations at intervals that do not exceed 5 years.		As part of its development regulations the City requires monitoring and maintenance of mitigation sites. Developers must post bonds to insure that sites are monitored and maintained. The bonds are posted for a period of 5 years..The regulations do not specify review criteria for release of the bonds.		The City does not have formal review criteria specified for release of bonds and does not review projects after the bonds are released.	The City should consider adding specific criteria to its bonding requirements for mitigation sites. The City should consider an inspection program for mitigation sites after the bonds have been released.
MRCI development ordinance and plan complies with all other state and Federal environmental and natural resource laws and permits.		Current regulations comply with state and other federal laws.		No gap identified.	
	When feasible, enhance or restore riparian areas surrounding wetlands where functions have been lost or compromised.	Wetland regulations encourage the restoration of wetlands. Stream enhancement and minor stream restoration are allowed (WMC 21.24.360).			

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Table 2. Critical Aquifer Recharge Areas Gap Analysis

ESA NMFS 4(d) Rule	Action Agenda Recommendations	Existing Woodinville Regulations	Best Available Science Guidelines	Identified Gaps	Comments
None	None		Critical Aquifer Recharge Areas should be designated according to guidance from the Department of Ecology	There has been no designation of critical aquifer recharge areas in the City.	
None	None	City regulations prohibit alterations to aquifer recharge areas unless site-specific studies indicate the development would not be in an aquifer recharge area or unless mitigation measures eliminate or minimize the risk.	Activities with a high potential for contamination, such as landfills and underground injection wells, should be prohibited from critical aquifer recharge areas.	Existing regulations do not specifically prohibit high risk activities except the use of hazardous substances, pesticides and fertilizers and on-site septic systems.	Other activities not listed may pose a higher risk to the aquifer.
None	None	Alterations can be permitted to aquifer recharge areas if mitigation can eliminate or minimize risk to the aquifer.	Best management practices can be required of activities in aquifer recharge areas to minimize the risk of contamination.	The regulations provide no guidelines on appropriate types of mitigation.	The City could be preventing some activities from aquifer recharge areas that could be permitted if more specific guidance were provided on appropriate best management practices.
			The amount of impervious surface in critical aquifer recharge areas should be minimized to protect recharge potential.	There are no specific requirements for reducing impervious surface in aquifer recharge areas.	

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Table 3. Geologic Hazards Gap Analysis

ESA NMFS 4(d) Rule	Existing Woodinville Regulations	Best Available Science Guidelines	Identified Gaps	Comments
A) Ensures that development will avoid inappropriate areas such as unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites.	WMC 21.24 includes regulations for erosion hazard areas, landslide hazard areas and steep slopes.			
	21.06.215 "Erosion hazard areas" are defined as soil units that are classified severe to very severe erosion hazards according to the Soil Conservation Service (SCS) King County Soil Survey (1973.)	"Erosion hazard areas" are defined as areas identified by the Natural Resources Conservation Service (NRCS) as having severe rill and inter-rill erosion hazard.	Best available science guidelines include "moderate to severe," in addition to "severe and very severe." The guidelines update the government agency designation from SCS to NRCS.	The City should continue the use of "severe to very severe", because inclusion of moderate, as suggested in the best available science guidelines would include all of city, and is not warranted. The City should revise the agency name to National Resources Conservation Service (NRCS)
	21.06.283 The "Geologist" definition refers to a minimum academic credential and four years of professional experience.	Best available science guidelines are silent regarding the definition of a geologist, but refer to a geologist's involvement in the hazard evaluation process.	Since 2001, the State of Washington requires that anyone calling themselves a geologist or performing geologic activities for the public must be licensed, having been approved by the state board of licensing.	The City should adopt state law (RCW 18.220), that includes the definition of geologist, engineering geologist and hydrogeologist.
	21.06. 350 "Landslide" is defined as the episodic downslope movement of a mass including, but not limited to, soil, rock or snow.		Landslide needs to be differentiated from soil creep, which is the imperceptible movement of soil that occurs on all slopes in Woodinville and the Puget Lowland.	The City should add the word "perceptible" to the existing code definition, based on definition of the word in the Dictionary of Geological Terms, so areas with soil creep are not improperly included as landslides.

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ESA NMFS 4(d) Rule	Existing Woodinville Regulations	Best Available Science Guidelines	Identified Gaps	Comments
	21.06.353 Woodinville defines "Landslide hazard areas" with five criteria that include (1) a combination of geologic factors, (2) areas that have shown movement in the past 10,000 years, (3) areas potentially unstable as a result of rapid stream incision or undercutting, (4) areas at risk of snow avalanche, and (5) areas located on an alluvial fan or subject to debris flows.	Best available science guidelines define "Landslide hazard areas" with nine criteria that include all of the Woodinville factors as well as (1) historic, mapped landslides, (2) slopes that are parallel to planes of rock or soil weakness, (3) slopes steeper than 80 % that are subject to rockfall, and (4) slopes that are 40% or steeper.	All four of the additional factors that are in the best available science guidelines are gaps with regard to landslide hazard areas.	The City should add the BAS paragraphs on the historic landslide areas that are shown on existing geologic maps, but not as indicated in the NRCS soil survey. It is generally agreed among geologists that the NRCS soil units are not good indicators of slope stability. The City should also add the slopes that are 40% or steeper and those slopes that are parallel to planes of weakness. The City should not adopt the paragraphs on rockfall of snow avalanches, because the city does not have rockfall or snow avalanche risk.
	21.06.535 The City defines "Seismic hazard areas" as those subject to severe risk of damage due to liquefaction or other seismically induced settlement.	Best available science guidelines define "Seismic hazard areas" as subject to severe risk of damage as a result of earthquake induced ground shaking, slope failure, settlement, soil liquefaction, lateral spreading, or surface faulting.	The best available science guidelines definition is better than the existing City code, because it is based on a more current understanding of the types of earthquakes that affect the Puget Lowland and seismic hazards here.	The City should adopt new definition, which is more comprehensive than the City's definition. However, there are no "severe" seismic hazards in the parts of the city that have been mapped by the State of Washington DNR in the Kirkland Quadrangle, and none expected to be identified in the other parts of the city that are going to be mapped and analyzed next year.
	21.06.628 The City defines "Steep slope hazard areas" as those that are 40% or steeper, and details how that measurement is taken.	Steep slopes are defined by best available science guidelines as one of the factors that determine an area's inclusion in a landslide hazard area.	There are no gaps.	The City should retain its definition because it is more explicit.

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ESA NMFS 4(d) Rule	Existing Woodinville Regulations	Best Available Science Guidelines	Identified Gaps	Comments
	21.24.210 Development standards and alterations in "Erosion hazard areas" generally cover the timing of work, requirement of erosion control plans, the clearing of land, and the use of hazardous substances on the land.	Performance standards in "Erosion and landslide hazard areas" are lumped together in the best available science guidelilnes, and cover more items, such as required buffers, alterations to the land, design standards, vegetation removal, seasonal restrictions, utilities, subdivisions and prohibited development.	The example code in best available science guidelines are organized differently and have different content than the City's code.	The City should incorporate the recommendations from the best available science guidelinessection into its existing erosion hazard section.
	21.24.270 Development standards and alterations in "Landslide hazard areas" generally cover the timing of work, requirement of erosion control plans, the clearing of land, and the use of hazardous substances on the land.	Performance standards in "Erosion and landslide hazard areas" are lumped together in the best available science guidelines, and cover more items, such as required buffers, alterations to the land, design standards, vegetation removal, seasonal restrictions, utilities, subdivisions and prohibited development. Best available science guidance includes requirements for criteria that should be addressed in critical area reports for landslide and erosion hazard areas, such as a site plan, geotechnical analysis, erosion control plan, drainage plan, mitigation plan, and surface water monitoring.	The example code in the best available science guidance is a different approach to development standards than the existing Woodinville code, and is similar to the approaches used by Seattle, Bellevue, and Burien, all of which have been successfully implemented.	The City should adopt the entire recommended section on erosion and landslide hazards into its regulations.
	21.24.280 Development standards and alterations in "Seismic hazard areas" generally cover the types of structures that can be built in seismic hazard areas and the need for	Performance standards in "Seismic hazard areas" require that the site not be developed for a critical facility or may be developed for other facilities if the site is certified as safe by a qualified engineer or geologist. This would require a report by a professional geologist and/or engineer	The example code in the best available science guidance is a more detailed and comprehensive approach to seismic hazards than the Woodinville code.	The City should adopt the applicable sections from the example code because they are an integrated method of dealing with seismic hazards in the City. Presently, no seismic hazards have been identified, but if new faults are found, or if new geologic mapping or site-specific engineering studies

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ESA NMFS 4(d) Rule	Existing Woodinville Regulations	Best Available Science Guidelines	Identified Gaps	Comments
	engineering and geologic studies if certain structures are constructed there.	and would require a fault study and a geotechnical analysis of the impacts of seismic activity.		indicate that there is high hazard for liquefaction, then such performance standards would be applicable.

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Chad Armour Qualifications

Chad Armour has over 20 years of experience addressing a wide variety of natural resource issues. He is a certified wetland delineator with extensive experience in wetland and riparian ecology, forestry, and fish and wildlife sciences. He is intimately familiar with federal (ESA, CWA and NEPA), state (SEPA, GMA, SMA, and FPA), and local laws and regulations. Over the years he has developed an excellent working relationship with many experts in a wide variety of fields, including biologists (fisheries, wildlife, and wetland), engineers (geotechnical, civil, and environmental), regulatory specialists (U. S. Army Corps of Engineers, Department of Fish and Wildlife, local jurisdictions, etc.), planners, graphic artists, geologists, hydrologists, and attorneys. He also has considerable experience working on sites with hazardous materials concerns.

Professional Experience

Wetland Sciences—Chad Armour is an accomplished botanist with a firm grasp of the principals of soils and hydrology. Wetland experience includes reconnaissance (assessing site development potential in advance of capital expenditures), delineation (identifying wetland boundaries), impact assessment (evaluating wetland functions and value), mitigation planning, permitting, restoration and construction, and long-term monitoring. Mr. Armour has also evaluated potential impacts to aquatic habitats related to fate and transport of toxic substances.

Wildlife Sciences—Chad Armour has been a key player on many environmental impact statement (EIS) and environmental assessment (EA) projects related to mine permitting, master planned developments, and real estate development. In this capacity, he has assessed existing conditions, the expected impacts of the proposed action and alternatives, and mitigating measures for unavoidable impacts to wildlife, including threatened and endangered species and their habitats.

Fisheries Sciences—Chad Armour has completed stream assessments in a wide variety of riparian settings throughout the state of Washington. Aquatic experience includes assessing aquatic habitat in streams and watersheds, determining the presence/absence of fish using portable electroshocking equipment, developing mitigation and restoration plans, permitting, and writing biological assessments.

Forestry—Chad Armour has managed numerous reforestation projects on private industrial timberland, coordinated timber inventories, pruned and topped hazard trees, managed watershed analysis, conducted insect and disease surveys, collected cones, and pollinated trees for genetic research. He has worked with numerous landowners in the Pacific Northwest and the Rocky Mountains including the U. S. Forest Service, private industrial concerns, municipalities, National Parks, state forests, various Indian Tribes, and small private wood lot owners.

Education

M.S., University of Idaho, Forest Management, 1982
B.S., University of Idaho, Wildlife-Fisheries Management, 1976

Certifications

Certified Wetland Delineator
NASDS Certified SCUBA Diver
Certificate in Commercial Real Estate

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October 8, 2003
Job No. 03-016

Subject: Draft Critical Areas Best Available Science Memoranda Review Report
City of Woodinville, Washington

EXECUTIVE SUMMARY

We are pleased to present the results of our review of the draft critical areas (wetlands and streams, wildlife, and critical aquifer recharge areas) best available science (BAS) technical memoranda prepared by Adolfson Associates, Inc (Adolfson) for the City of Woodinville, Washington. The purpose of the work was to assess the completeness and accuracy of the draft BAS analyses developed by Aldolfson and provide guidance on the City of Woodinville's (City) process for updating its current Critical Areas Ordinance (CAO).

The purpose of the draft critical areas technical memoranda is to present an overview of the BAS pertaining to wetlands and streams, wildlife, and critical aquifer recharge areas. In the context of critical areas protection, a valid scientific process is one that produces reliable information useful in understanding the consequences of a local government's regulatory decisions. In general the wetland, stream, and wildlife memoranda lack critical information necessary for the City to adequately evaluate them relative to the current regulations. In contrast, the critical aquifer recharge areas memorandum appears to be presented in a more balanced manner. Critical information missing or that received short shrift in the wetland, stream, and wildlife memoranda include the following:

- The Growth Management Act (GMA) mandate to concentrate growth within the limits of the Urban Growth Area (UGA) and how this mandate must be satisfied as well as the GMA mandate to protect critical areas;
- The City's current critical areas regulations as compared to critical area regulations for other relevant jurisdictions;
- The relative lack of scientific data on streams in the urban environment and that the vast majority of data for streams was developed from research conducted in the forested rural environment; and
- Protecting critical areas in the urban environment using only passive buffer widening techniques without presenting other valid active management techniques.

We have included more detailed comments on the interlineated versions of the Adolfson memoranda in Attachments A, B, and C to this report.

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GROWTH MANAGEMENT ACT

A discussion of the GMA relative to its mandate to focus development within UGA and how it must be satisfied together with critical areas protection is appropriate and warranted. The GMA encourages directing population growth into urban areas. UGAs are areas designated by a county, with input from towns and cities, where urban development is to occur. UGAs need to provide for urban densities and urban services as well as greenbelt and open space areas. The City is in the UGA, so to ignore the UGA portion of the GMA in the context of these memoranda is to do the City and its constituents a disservice.

WETLANDS

Over the past 20 some years, a great deal of research has been conducted in wetlands, including wetlands in the urban environment. This body of evidence is generally presented in a balanced manner; however, there is room for improvement. We noticed that only the Department of Ecology's (Ecology) rating systems and mitigation ratios were presented. There are several other rating systems and mitigation ratios being used in the region. Adolfson should present the merits and limitations of other rating systems and mitigation ratios for comparison. Similarly, a presentation of the City's current wetland regulations is appropriate.

In our opinion, wetland (and stream) regulations in many jurisdictions are not very flexible and unnecessarily constrain planners. For example, buffer reduction can be appropriate in some instances as well as buffer averaging. Unlike the City, other jurisdictions allow for buffer reduction and buffer averaging under certain circumstances. Exploring ways to modify regulations that simultaneously protect the resource and allow planners to be creative should be included in this memoranda. Exploring wetland regulations from other jurisdictions - presenting the parts that work and those that don't - would be useful.

STREAMS

In general the stream portion of the wetlands and streams memorandum was unbalanced and inadequate with respect to BAS. The tone was generally negative, with the author focusing on damaging processes at the expense of useful processes. To be fair to City decision makers, both useful and damaging processes about streams should be presented.

Very little information pertaining to streams is available in the urban environment. The vast majority of the scientific literature pertaining to streams in the Pacific Northwest has been developed from studies conducted in the forests of Washington, Oregon, Idaho, Montana, and British Columbia. In Washington, much of the BAS in and adjacent to streams was funded by and conducted in forests owned by private commercial concerns and the Department of Natural Resources (DNR). These forests, which are located east and west of the I-5 corridor in the Coast Range and the foothills of the Cascade Mountains, are typically unaffected by the processes observed in the urban environment. In the last 10 to 15 years the Forest Service also conducted numerous stream studies in the Cascade and Olympic Mountains. Based on the results of their studies, the Forest Service chose to protect streams with very wide buffers. For this reason, a significant portion of Forest Service land is locked up and very little of their land base is currently

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available for timber harvest. Strategies for protecting streams in commercial, state, and federal forests are not practical in an urban area.

The stream treatise focuses on habitat at the expense of the other three important variables that can and do affect salmonids populations. They are hatcheries, hydropower (dams), and harvest (which also include ambient ocean conditions and how they affect salmonids populations). For a balanced report that embraces BAS, it is appropriate to at least touch on the other three H's and their context relative to salmonids in the City streams.

We also noted that an inordinate amount of the presentation was dedicated to wildlife as related to buffer width. Aquatic organisms need cool clean water to survive and thrive. Wide buffers for wildlife are in no way connected to or related to the proper functioning of streams. This lengthy discussion on the benefits of 'wide' buffers for wildlife habitat is inappropriate for a memorandum on streams.

Furthermore, with regard to buffers, Table 1 of the Adolfson memorandum presents one agency's opinion about the recommended buffer widths for streams. Presenting only this table does not adequately represent the BAS necessary and required by a public entity to make an informed decision about modifying their CAO. Two such examples of a comparative analysis for stream buffers are presented in the attached Draft Wetlands and Stream Best Available Science Technical Memorandum markup (Attachment A).

WILDLIFE HABITIAT

Adolfson correctly identifies *Wildlife–Habitat Relationships in Oregon and Washington* by Johnson and O'Neil as the most current compendium of wildlife related scientific data in the two-state area. Importantly, this book devotes an entire chapter to the existing body of knowledge relative to urban wildlife. This book appears to supplant or at least has incorporated the data presented in *Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington* as edited by Brown. Although Brown's text does not specifically address urban wildlife, the manner in which he presents the data may yield useful information about wildlife occurrence in many of the habitats present in the City.

The wildlife memorandum tends to focus on special status species - species that are generally uncommon and therefore have received special treatment by regulatory authorities sometimes at the expense of more common species of wildlife. To a reader unfamiliar with the City, the assumption is that the City only harbors special status wildlife. To present a balanced report on wildlife, the report must also discuss the most common wildlife habitat and species known or thought to be present in the City. It should begin by describing the four types of wildlife habitat followed by the species that typically inhabit these environs. Then tell us which special status species are present or have the potential to be present in the City (Attachment B).

CRITICAL AQUIFER RECHARGE AREAS

In general the critical aquifer recharge areas memorandum appeared to be presented in a balanced and unbiased manner. An executive summary at the beginning and a conclusion at the end of the memorandum would be helpful. See specific comments imbedded in the attached marked up version of the Draft Critical Aquifer Recharge Areas Best Available Science Technical Memorandum (Attachment C).

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CONCLUSIONS

It would be difficult if not impossible for the City to draw valid conclusions regarding the current state of scientific understanding relative to critical areas, particularly streams and wildlife in an urban environment based on the draft Adolfson memoranda.

Recommendations

We recommend that Adolfson revise each of the four memoranda to reflect the current body of knowledge relative to wetlands, streams, wildlife habitat, and critical aquifer recharge areas based on BAS. The revised memoranda should present both positive and negative aspects of the science as it pertains to the individual disciplines. It should also present the limitations of the science, particularly the science associated with streams. It should provide more information in regard to studies of critical areas and strategies in urban areas and acknowledge that most of the studies do not deal with urban areas. Before getting into the science, Adolfson should set the stage by presenting information about the UGA provisions of the GMA, the City's current critical areas regulations and how they came to be, critical area regulations of other jurisdictions particularly those that border the city, and the limitations of the data. Most importantly, the studies should spend equal time on strategies other than buffer width, as a way to protect critical areas. We also recommend that Adolfson respond and revise the memoranda, as appropriate, to address our comments imbedded in Attachments A, B, and C.

LIMITATIONS

Work for this project was performed, and this letter report prepared, in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

Any questions regarding our work and this report, the presentation of the information, and the interpretation of the data are welcome and should be referred to Chad Armour, LLC.

Attachment A – Marked up version of the Draft Wetlands and Streams Best Available Science Technical Memorandum
Attachment B – Marked up version of the Draft Wildlife Best Available Science Technical Memorandum
Attachment C – Marked up version of the Draft Critical Aquifer Recharge Areas Best Available Science Technical Memorandum

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March 30, 2004
Job No. 03-016

Subject: Proposed Critical Areas Rules Review Report
City of Woodinville, Washington

EXECUTIVE SUMMARY

We are pleased to present the results of our review of the draft critical areas (stream and wetlands) rules for the City of Woodinville (Woodinville). The purpose of the work was to assess the proposed rules and to provide an alternative set of rules based on the best available science (BAS) as presented by Woodinville and King County (County).

The stream and wetland rules proposed by Woodinville are relatively inflexible and unduly constrain site development potential as well as limit the potential to improve the quality of stream and wetland resources. We propose a more flexible set of rules that allows landowners to more fully utilize their assets as a tradeoff for improving the quality of streams, wetlands, and/or their buffers.

For example the degraded buffer of a Type 1 stream could be enhance in exchange for reducing the width of the remaining buffer. Enhancements could include replacing non-native grasses and shrubs with native trees, shrubs, and herbs, as well as placing habitat amenities in the stream and the buffer.

Another consideration is the relatively vague language of the proposed rules. This vagueness will likely create considerable uncertainty and be an avenue for future challenges.

PROPOSED WOODINVILLE STREAM AND WETLAND RULES

By law jurisdictions that regulate critical areas are to have updated their critical areas rules by the end of 2004. Woodinville like many jurisdictions has been in the process of doing so for several months or more. A review of BAS, a necessary part of the rule updating process, is intended to provide the basis for developing the new rules. We reviewed and submitted a report on Woodinville's BAS documents prepared for Woodinville for wetlands, streams, wildlife habitat, and critical aquifer recharge areas to the Little Bear Creek Property Owners Association in October 2003. A copy of this report and Chad Armour's resume are included in this submittal for convenience. This time we reviewed Woodinville's proposed rules for streams and wetlands and BAS documents prepared by County staff for the same critical areas.

Streams

The proposed Woodinville stream rules list four stream types. Type 1 Streams are Shorelines of the State and include the Sammamish River and Little Bear Creek. Type 2 Streams are used by salmonids. Type 3 Streams are used by non-salmonid fish and Type 4 Streams are not used by fish.

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The following table compares Woodinville's draft stream rules to and rules proposed by King County.

Proposed Updated Stream Rules

Jurisdiction	Streams	Buffers	Buffer Averaging Minimum Width	Buffer Reduction Minimum Width	Alterations Allowed?
King County (Urban Area)	Type S	115'	86.25'	Not Specified	Yes
	Type F	115'	86.25'	Not Specified	Yes
	Type N	65'	48.75'	Not Specified	Yes
	Type O	25'	18.75'	Not Specified	Yes
Woodinville	Type 1	150'	Not allowed	115'	?
	Type 2	115'	Not allowed	100'	Crossing
	Type 3	75'	Not allowed	50'	Relocation
	Type 4	50'	Not allowed	25'	Relocation

The following table compares Woodinville's current and proposed buffers for streams.

Type	Current	Proposed	With Reduction
1	100 feet	150 feet	115 feet
2	100 feet[a]	115 feet	100 feet
3	50 feet[b]	75 feet	50 feet
4	25 feet[c]	50 feet	25 feet

[a] Class 2S
[b] Class 2
[c] Class 3

Note that the proposed increase in buffer widths for all stream types range from 15 to 100 percent.

Best Available Science Comparative Analysis

Based on the BAS documents prepared by Woodinville and the County there appears to be ample scientific information available regarding streams. Based on what we consider limited and selective data Woodinville has proposed a wide range of changes to the stream rules. Notably the rule changes focus on buffers, permitted alterations, and mitigation.

The range of effective buffers for streams varies considerably in the technical literature. As we pointed out in our October report, most of this information is related to streams located in managed forests rather than urban and urbanizing areas. Buffers ranging from as little as 13 feet to as wide as 984 feet are reported to adequately protect streams. This begs the question "Why is a narrow buffer adequate in one instance when a wider buffer is necessary in another?" This question was not addressed in either the Woodinville or the County BAS document and as such the notion of narrow buffers relative to wide buffers cannot be adequately evaluated. Clearly functions such as shade are dependent on the width of the stream as well as the width of the buffer and its plant community. Other functions such as pollutant removal are obviously linked to the

width and condition of the buffer relative to the proximity and concentration of the constituent. Regardless, the data seems to show that it is possible to protect streams with narrow buffers.

Buffer Averaging/Reduction

The proposed Woodinville stream rules do not allow for buffer averaging but do allow for reducing the width of stream buffers if the buffer is significantly degraded or the stream has an urban designation. Generally the proposed buffer reduction rules would allow a landowner to reduce the width of stream buffers so that the resultant buffer width is consistent with current stream buffer width rules. By disallowing buffer averaging Woodinville reduces the flexibility typically afforded landowners, urban planners, and resource managers. In contrast, the proposed buffer reduction rules provide some but very little flexibility.

Stream Alteration

The proposed stream alteration rules appear to be reasonable yet incomplete. For example, stream crossings are allowed for Type 2 and Type 3 streams, but there is no mention of stream crossings for Type 1 and Type 4 streams. We can only assume that crossings may be allowed for these two stream types. Relative to stream relocation, all stream types can be relocated as part of a public road project. With the exception of public road projects, we assume that Type 2 streams cannot be relocated. In contrast, it seems that Type 3 and Type 4 streams can be relocated as a part of a development project.

Wetlands

The proposed Woodinville rules define three wetland classes that generally follow Ecology's wetland classification system: Among other things, Class 1 wetlands are associated with streams that support listed fish species and Class 2 wetlands are associated with streams that support fish. Class 3 wetlands include lower quality wetlands.

The following table page compares Woodinville's draft wetland rules to proposed rules by the County.

Proposed Updated Wetland Rules

Jurisdiction	Wetlands	Buffers	Buffer Averaging Minimum Width	Buffer Reduction Minimum Width	Alterations Allowed?
King County (Urban Area)	Class 1 Class 2 Class 3 Class 4	100' 50' 50' 25'	Allowed but width not specified	Allowed if 50% affordable housing is provided	Very limited opportunities to alter wetlands or their buffers
Woodinville	Class 1 Class 2 Class 3	150' 100' 50'	120' 80' 50'	Not allowed Not allowed Not allowed	Yes Yes Yes

Best Available Science Comparative Analysis is Generally Lacking

A common deficiency in both the Woodinville and County BAS documents is the relative lack of scientific data supporting the recommended buffer widths for wetlands. Of the six

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or so wetland functions typically cited in the literature, buffers ranging from 10 to 200 feet were said to offer some degree of water quality protection. A comparative analysis of buffer widths for the remaining wetland functions, including shoreline protection, hydrologic support, storm/flood abatement, groundwater exchange, and natural biological support was not presented. As indicated in the following table the proposed Woodinville rules specify wider buffers in comparison to existing buffer width rules. Yet there is little scientific data to support this proposed increase.

Class	Current	Proposed
1	100'	150'
2	50'	100'
3	25'	50'

Buffer Averaging/Reduction

The proposed Woodinville rules provide for averaging the width of wetland buffers but do not provide the option to reduce the width of the same. The proposed buffer width averaging provision allows for a 20 percent reduction in the width of the buffer or 50-foot reduction, which ever is greater. A case can be made for reducing wetland buffers when the existing buffer is dominated by non-native grass when a narrower buffer dominated by native trees and shrubs can offer more functionality.

Wetland Alteration

To their credit, Woodinville proposes to retain their provision to alter wetlands. Although it is not clear if the proposed provision allowing wetland alteration will be limited to citing utilities and trails or if other activities will be allowed. If the proposed alteration rule does allow for citing other improvements, then this rule will provide Woodinville and landowners some flexibility needed to fully utilize the land while protecting the resource. A major omission in the proposed wetland rules is the exception for exempting unintentionally created artificial wetlands. Examples of unintentionally created artificial wetlands include but are not necessarily limited to drainage ditches, stormwater facilities, and areas adjacent to linear features (e.g., roads and pipelines) that formed when the flow of near-surface groundwater has been impeded. The new rules should have such a provision.

CONCLUSIONS

As we pointed out in our October report, it would be difficult if not impossible for Woodinville to draw valid conclusions regarding stream and wetland rule changes based on their BAS documents. The same can be said of the County BAS document. One possible explanation for the relative lack of in-depth analysis is the possibility that the authors of both BAS documents may have had a solution in mind prior to presenting the data. Based on the data presented in both the Woodinville and County BAS documents, from our perspective it is reasonable to conclude that an alternative approach to protecting stream and wetland resources in conjunction with accommodating reasonable growth in urban areas can be made.

Recommended Stream Rules

We recommend the following rules modifications for stream resources. The recommended rules include a fairly wide buffer for Type 1 streams – streams that are

Shorelines of the State, moderately wide buffers for streams that support salmonids, and a narrow buffer for non-salmonid streams. These buffer widths would apply to both perennial and seasonal/intermittent streams.

Streams	Buffer Width	Buffer Averaging Minimum Width	Buffer Reduction Minimum Width	Alterations Allowed?
Type 1	100'	75'	50'	Yes
Type 2	50'	37.5'	25'	Yes
Type 3	25'	18.75'	18.75'	Yes

- Consultants science shows that 80% buffer function is reached in 100 ft 150 ft.

The recommended rules have provisions for buffer averaging as well as buffer reduction. The narrowest a buffer could be when averaged would be 75 percent of the standard width. This supposes that the difference is made up at an alternate on-site location so that the total buffer area remains the same. It also supposes that the reduced buffer area is enhanced, the on-site portion of the steam/buffer area is placed in a native growth protection area (NGPA), and the on-site portion of the steam/buffer area is fenced.

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The recommended buffer reduction rules would allow for reducing the stream buffer by up to 50 percent of the standard width. The trade off for allowing reduced buffer widths is requiring the applicant to enhance the entire on-site buffer as well as placing it in a NGPA and fencing it. Using the buffer reduction option, the resultant buffer widths fall within the BAS for stream buffer widths.

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Finally, the recommended rules allow for altering streams regardless of the stream type. Limiting alterations to public projects and utilities is inherently unfair and cannot be supported by BAS. Because Type 1 and Type 2 streams typically have greater ecological value than do Type 3 Streams, the standard for evaluating a proposed alteration should be greater for these two stream types.

Recommended Wetland Rules

We recommend the following rules for wetland resources. As with the recommended rules for streams, the recommended wetland rules include a fairly wide buffer for Class 1 wetlands, a moderately wide buffer for Class 2 wetlands, and a narrow buffer for Class 3 wetlands.

Wetlands	Buffer Width	Buffer Averaging Minimum Width	Buffer Reduction Minimum Width	Alterations Allowed?
Class 1	100'	75'	50'	Yes
Class 2	50'	37.5'	25'	Yes
Class 3	25'	18.75'	18.5'	Yes

- reference that science that shows this

The minimum buffer width in a buffer averaging scenario would be 75 percent of the standard buffer width. As with stream resources, the difference would be made up at an alternate on-site location, the reduced buffer area is enhanced, the on-site portion of the wetland/buffer area is placed in a native growth protection area (NGPA), and the on-site portion of the steam/buffer area is fenced.

- again bank!

Similarly, the minimum buffer width when buffer reduction is applied would be no more than 50 percent of the standard buffer width. Again the applicant would be required to enhance the remaining wetland buffer, place the wetland/buffer area in a NGPA, and fence the NGPA. Note that the recommended rules for buffer enhancement assume degraded conditions.

We also recommend that all wetland types be available for alteration. By definition Class 1 wetlands possess greater ecological functions than do the two lesser wetland classes. Similarly Class 2 wetlands possess greater ecological functions than do Class 3 wetlands. As such the basis for altering Class 1 wetlands should be scrutinized more closely than Class 2 Wetlands, and so on.

As previously discussed, the recommended rules are and should be flexible. This flexibility allows landowners to maximize the value of their land and the option to improve the quality of the resource. It also takes into account the body of knowledge and expertise that resource specialists have developed over the last 15 or so years with respect to enhancement and restoration. The former provides incentive to spend the money to improve what could be an otherwise degraded system. The latter provides resource specialists the leeway to be creative with respect to restoring otherwise degraded buffers.

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LIMITATIONS

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Attachment A – Marked up version of the Draft Wetlands and Streams Best Available Science Technical Memorandum
Attachment B – Marked up version of the Draft Wildlife Best Available Science Technical Memorandum
Attachment C – Marked up version of the Draft Critical Aquifer Recharge Areas Best Available Science Technical Memorandum
Attachment D – Chad Armour resume

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April 12, 2004
Job No. 03-016

Mr. Ralph Swanson, Sr.
Chief Executive Officer
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Kenmore, Washington 98028

Subject: Draft Supplemental BAS Report
City of Woodinville, Washington

We are pleased to present the results of our search for additional available information regarding best available science (BAS) for streams and wetlands. Our work was accomplished in accordance with your March 30, 2004 verbal request at the City of Woodinville (Woodinville) Best Available Science Citizens Advisory Panel (BASCAP) meeting to acquire additional scientific information on urban streams and wetlands.

As you know by now, there is an abundance of information on streams and wetlands, but very little information available for streams and wetlands in urban or urbanizing environments. To supplement the information presented to Woodinville by Adolfson and Associates (Adolfson), this report presents additional relevant general information about streams and to a lesser extent wetlands in addition to published information about streams and wetlands in urban and urbanizing environments. As an aid to the reader we have included relevant passages from Adolfson's technical memorandum for wetlands and streams. These passages are presented in italics to separate them from the supplemental information we present. You will find a list of the papers that we reviewed and cite in the text at the end of this report. The papers Adolfson cites in their passages are not included in our reference section.

EXECUTIVE SUMMARY

We found and reviewed six publications that address issues associated with streams in urban environments. Some of these publications were also referenced in Adolfson Associates (Adolfson) technical memorandum on streams and wetlands. We also reviewed three papers that presented information about engineered structures designed to mimic the functions of floodplains, wetlands, and their buffers. Finally we reviewed several publications for the purpose of supplementing the information presented by Adolfson.

In general we found that:

- Stormwater ponds effectively offset the negative attributes of impervious surfaces with respect to flood water attenuation and flood peak desynchronization;
- Impervious surfaces reduce groundwater recharge;

- Stormwater ponds and bioswales effectively remove as much pollution as buffers do;
- Streams in urban areas eventually reach a new base steady state and in at least one instance have better in-stream habitat than rural streams;
- Little Bear Creek's in-stream habitat is degraded relative to the characteristics of a properly functioning stream, but has several characteristics similar to streams in western Washington lowland forests;
- It is important to shade the ground as well as the stream to prevent elevated steam water temperatures;
- A qualified professional should be engaged to assess the appropriate buffer width;
- Fixed buffer widths are easy to administer but may result in arbitrary and inappropriate buffers; and
- Variable buffer widths are most difficult to administer but allow greater flexibility and eliminate the need to protect non-existent features.

STREAMS

Elements necessary for healthy salmonid populations and for other aquatic organisms rely on processes sustained by the dynamic interaction between the stream and the adjacent riparian area (Naiman et al., 1992).

- *Maintaining stream base flow;*
- *Maintaining water quality;*
- *Providing in-stream structural diversity; and*
- *Providing biotic input of insects and organic matter.*

Stream Flow

Stream flow is the amount and velocity of water flowing in a stream. In undisturbed stream basins, flows are variable depending upon site-specific conditions, but are generally more stable and not subject to the peak/base flow regimes of urbanized streams. Stream degradation has been associated with the quantity of impervious surface in a basin (Booth, 2000; May et al., 1997a; May et al. 1997b; Horner and May, 2000). Urbanization changes the volume, rate, and timing of water flowing through stream systems, which can impact the physical characteristics of the stream channel (Booth, 1991).

In an uncontrolled environment there is merit to this argument. Prior to the advent of regulations requiring stormwater management, surface water falling on impervious surfaces was discharged directly to receiving waters. As a result, steams conveyed enormous volumes of surface water runoff in a very short period of time. However for more than a decade now permitting authorities have required that stormwater collected from impervious surfaces on new development be detained prior to discharge. Among other things, the purpose of these ponds is to release surface water at a rate that closely approximates natural forested conditions. Numerous examples of these requirements are on file at various jurisdictions, presumably including Woodinville.

The following is but one example of how stormwater ponds ameliorate the deleterious effects of uncontrolled releases. As part of the permitting process Boeing was required to model pre- and post-development stormwater discharges from a large parcel in the Kent Valley. The following table illustrates the results of the analysis.

Estimated Run-off from the Pacific Gateway Business Park site[1]

	2-Year Storm Event	10-Year Storm Event	100-Year Storm Event
Pre-Development	16.9 cfs	33.4 cfs	54.5 cfs
Post-Development	4.9 cfs (-71%)	19.1 cfs (-43%)	25.0 cfs (-54%)

[1] from Barghausen Consulting Engineers (2000).

As this example illustrates stormwater discharged to Mill Creek will be reduced an estimated 43 to 71 percent following buildout. In addition to mimicking the release rate of a mature forest, the stormwater pond system was designed to capture and temporarily detain flood flows from Mill Creek (EA Engineering Science and Technology, 2000). Thus one could conclude that adding impervious surfaces where stormwater systems are properly designed and maintained can be beneficial with respect to stream flow.

Finkenbine et al. (2000) found that increased impervious area, which decreases groundwater recharge, resulted in decreased summer base flow in Vancouver, British Columbia streams. Streams with low summer flow typically have shallow water and reduced pool volume. Because there is less space available as rearing habitat, the number and size of resident fish is decreased.

Water Quality

Low stream temperature and high water quality are critical elements of essential habitat for all native salmonid fish. Good water quality is also important to other aquatic species adapted to living in Pacific Northwest streams as well.

The general range of temperatures required to support healthy salmonid populations is generally considered to be between about 39^0 and 63^0 F (NMFS, 1996; USFWS, 1998). Riparian vegetation, particularly forested riparian areas, can affect water temperature by providing shade to reduce solar exposure and regulate high ambient air temperatures, ameliorating water temperature increases (Brazier and Brown, 1973; Corbett and Lynch, 1985).

An experiment conducted in the Cascade Mountains of Washington evaluated several microclimate variables important to riparian ecosystems along five streams 6.5 to 13 feet wide. They found that buffer width did not appear to affect stream water temperature except where there was a complete absence of streamside trees. However, soil temperature appeared to exert a strong influence on stream water temperature. It appears that groundwater temperature is influenced by the temperature of the soil through which it passes (Brosofske, et al., 1997).

Other investigators found a similar relationship in Georgia. Here the authors investigated the effect harvesting timber had on stream temperature along two first order streams. Up to four years after timber harvest, stream temperatures in the affected stream averaged 12^0 F warmer than the control stream. However six years following timber harvest the temperature of the steam averaged about 2.5^0 F warmer than the control stream. Apparently the understory vegetation in the harvest unit, presumably

including the buffer, was sparse for several years following timber harvest. About six years following timber harvest the understory vegetation virtually the entire ground surface. The authors hypothesized that the average daily heat load on the affected stream was dominated more by effluent groundwater temperature than either heat exchange with the air or by direct solar radiation (Hewlett and Fortson, 1982).

The temperature of the water in Little Bear Creek ranged from 52^0 F and 59^0 F between June and August 1999 (King County. 2001).

Impervious surfaces collect and concentrate pollutants from different sources and deliver these materials to streams during rainstorms.

We reviewed several reports that addressed the pollutant issue. In fact the literature is quite robust in this area.

One study evaluated the effectiveness of natural buffer strips to remove phosphorous and suspended sediments from residential stormwater in Maine. All of the sites were typical of lakeshores and the gently sloping glacial till soils supported unevenaged stands of timber dominated by hardwoods and variable groundcover density. The authors concluded that the effectiveness of natural buffer strips is highly variable, but in most cases, a 50-foot wide natural buffer was effective in reducing phosphorous concentrations to background values. Total suspended solids (TSS) levels were also reduced but not as markedly. Further, the condition of the buffer seemed to be as important as its width or gradient. Underbrush and a thick mat of decomposing forest litter and duff acted as a natural filter, increasing infiltration rates and retention, thereby enhancing removal efficiencies. Exposed soil in the buffer strips actually contributed suspended solids to the overland flow (Woodward and Rock, 1995).

Another study investigated the use of grassy swales as biofilters to manage the quality of stormwater runoff from roads and other impervious surfaces associated with urban development. The investigators examined input and outflow levels of TSS, turbidity, total petroleum hydrocarbons (TPH), metals, nutrients, and fecal coliform bacteria in 100-foot and 200-foot long bioswales. They found that the pollutant concentrations in the waters flowing into the swales were relatively low. The 200-foot swale consistently removed particulate pollutants (TSS [83%], turbidity [65%]), metals with particulate characteristics (lead, zinc, iron, and aluminum (63-72%), and materials that adhere to the surface of grass (oil, grease, and TPH [74%]). Metals with less particulate character, such as copper and dissolved metals, were removed less consistently (some concentrations increased and others decreased about 30%). Nutrients were removed with varying success (40% bioavailable phosphorous, 29% total phosphorous, while ortho phosphorous and nitrate+nitrite-nitrogen either remained the same or increased). Fecal coliform bacteria removal was highly variable, decreasing sometimes and increasing at other times. Removing pollutants by biofiltration basically depends on the time the water remained in the swale and the extent of its contact with vegetation and soil surfaces. The authors concluded that the minimum length of biofiltration swales should be no less than 125 feet (Ransom and Kulzer, 1993).

This author also found that the concentration of pollutants in residential stormwater runoff was relatively low. Chad Armour LLC (2003) found that during site construction when bare soil was common on the site, a 188-foot long bioswale removed 54 to 74 percent of the TSS. After all 27 of the homes were completed and grass completely

covered the bare soil that was once so common on the site, the removal efficiency rate ranged from 17 to 77 percent. Covering the exposed soil with grass and impervious surfaces reduced the TSS output of the site. TPH was never detected in any water samples.

Analytical results of water quality sampling at the head and foot of a Tacoma Washington residential bioswale in mg/L

	TSS		Total Zinc		Dissolved Zinc		Dissolved Lead	
Date	Head	Foot	Head	Foot	Head	Foot	Head	Foot
Apr-01	180	47	0	0	0	0	0	0
Nov-01	341	156	0.007	0.05	0.005	0.04	0	0
Jun-02	13	3	0.01	0	0	0	0	0
Dec-02	6	5	0.02	0.01	0	0	0	0
Jan-03	3	2	0	0	0	0	0	0
Apr-03	5	3	0	0	0	0	0	0

Much of the natural buffer functions for hydrologic and water quality functions (peak flow attenuation, base flow releases, and water quality treatment) are removed from riparian buffer control by storm drain systems (City of Renton, 2003).

In-Stream Structural Diversity

In urban basins, increases in stormflow quantities and velocities can cause scouring that can displace stream substrates, which in turn reduces the quality and quantity of spawning areas (May et al., 1997).

Fish usually respond to the combined effect of two or more of the physical, chemical, and biological variables in their environment. The mix of environmental variables in any stream sets the carrying capacity of that stream for fish, and the capacity can be changed if one or more of the factors are altered. Low streamflows, high water temperatures, and excessive turbidities impede adult salmonids on their migration to spawning areas. The amount and suitability of stream substrate and flows in the spawning areas are key factors. Adequate flows of well-oxygenated water and relatively small amounts of fine sediments (organic and inorganic) dictate the number of young fish that will emerge from redds into the stream. The number and size of juvenile fish that can be produced in a stream is governed by the quality and quantity of space available, productivity of the stream, and the presence of competitors and predators (Bjornn and Reiser, 1991).

Finkenbine et al. (2000) found that urban streambeds in Vancouver British Columbia had less fine material than the rural streams, suggesting that the urban streams had recovered from the early stages of urbanization. And as would be expected, the urban streams had significantly higher intragravel oxygen concentrations than the rural streams. Urban streams also had a higher percentage of coarse bed material. Because large cobble and boulders help to shelter fish from predators, the authors concluded that urban streams provided better instream cover than the rural streams. Both of these factors improve spawning conditions.

Studies have shown that stream habitat in urban and urbanizing streams typically includes reduced pool frequency and reduced overall habitat quality (May, et al., 1997).

King County (2001) concluded that the quality of Little Bear Creek's in-stream habitat is at the low range of medium relative to the characteristics of a properly functioning stream. They reported that Little Bear Creek is composed of 25% pool, 19% riffle, and 56% glide habitat with an average of 26.2 pools per mile and 22 pieces of LWD per mile. A properly functioning stream has more than 80 pieces of LWD greater than 24 inches in diameter and 50 feet long and about 56 pools per mile.

Biotic Input

Most juvenile salmonids that rear in streams prey on aquatic invertebrates and terrestrial insects that fall into streams from overhanging vegetation (Horner and May, 1999; May et al., 1997). In some streams during the summer, an estimated 50 percent of the diet of juvenile salmonids is comprised of terrestrial insects (City of Portland, 2001).

We found only limited information to supplement this statement. Bjornn and Reiser (1991) state that much of the food eaten by salmonid fishes in streams is produced in the substrate. Sedimentation may reduce the abundance of invertebrates and the influence of fine sediments on aquatic invertebrates has not been clearly defined. The City of Renton (2003) found that the majority of plant material and insects that fall into streams comes from directly over or within a very short distance of the stream.

Functions and Values of Riparian Buffers

A general relationship between buffer width and buffer effectiveness is apparent in the research findings. Studies indicate that buffers 100- to 150-feet (30 to 45 meters) wide provide most (on the order of 80 percent) of the potential functions (Horner and May, 2000; Knutson and Naef, 1997; and Leavitt, 1998). However, there is little research on effectiveness of riparian buffers in urban environments (Herson-Jones et al., 1995). Buffer distances should be viewed mainly as guidelines, as the literature shows that site-specific factors may impact buffer effectiveness just as much as buffer width (Naiman et al., 1992; Castelle et al., 1994).

We concur with the last statement. The buffer recommendation presented in the Adolfson technical memorandum represent the opinion of a single state agency whose only mission is to protect fish and wildlife. There are several other opinions regarding the effectiveness of riparian buffers. For example, the recommended buffer width in the City of Renton's draft BAS literature review document is:

- 100 feet for Class 1 (shorelines of the state) and Class 2 (salmonid-bearing) streams;
- 75 feet for Class 3 (perennial non-fish-bearing) streams; and
- 35 feet for Class 4 (intermittent non fish-bearing) streams.

In comparison, the City of Kent's (2003) draft recommended buffer widths for streams is:

- 125 feet for Category 1 streams;
- 75 feet for Category 2 streams; and
- 50 feet for Category 3 streams.

Corbett and Lynch (1985) stated that a 40-foot buffer zone may be adequate to prevent excessive temperature increases in small streams, but a zone of 66 to 100 feet is usually

needed to protect the stream ecosystem. Karr and Schlosser (1977) concluded that a buffer strip 5 to 10 feet wide was as effective at temperature control as a strip 50 feet wide as long as its angular canopy density (a measure of the shading ability of the vegetation) was high. They found that small streams have the greatest temperature problem but they are also the easiest to control, due to the inverse relationship between temperature change and stream discharge for a given input of thermal radiation.

Johnson and Ryba (1992) recommend a minimum buffer distance of 50 to 100 feet and stated that a qualified professional should consider the quality of site conditions and buffers when determining the width of the buffer. They go on to say that fixed width buffers are easily enforced, do not require regulatory personnel with specialized knowledge of ecological principals, are easier and more economical to administer, but may result in arbitrary buffer distances that can be inappropriate. In contrast, variable width buffers allow greater flexibility for varying site conditions and land management practices for landowners and can be tailored to existing site conditions and desired functions, eliminating the need to protect non-existent features. The potentially more costly and time-consuming process may protect the environment more completely without causing undue loss to the landowner.

Finkenbine et al. (2000) conducted field studies of streams near Vancouver British Columbia to identify stream rehabilitation priorities in areas urbanized for at least 20 years. The only difference between the urban and rural streams was the amount of impervious surface in the basins studied. In urban areas impervious area averaged 39% and in rural areas impervious area averaged about 5%. The rural streams had an average gradient of 4%, bankfull width of 25 feet, and buffer width of 264 feet (range 140 – 550 feet). The urban streams had an average gradient of 4%, bankfull width of 25 feet, and buffer width of 266 feet (range 50 – 985 feet). Based on their findings the authors concluded that planting riparian zones and adding LWD are the most beneficial means for rehabilitating streams because the shade cast by trees reduces water temperature, their roots stabilize stream banks, and they contribute to LWD. They recognize that the time required for trees in the riparian area to grow large enough to provide effective LWD is a limiting factor. Thus artificially introducing well-anchored LWD should improve the quality of fish habitat by adding nutrients to the system, shielding fish from predators, and promoting pool formation, thereby increasing water depths during periods of summer low flows and providing resting areas for fish during periods of high flows.

The City of Renton (2003) echoed the notion that waiting for riparian trees to contribute LWD to streams is unlikely. Within the City of Renton urban areas, there are few if any mature trees and the potential of trees being allowed to grow to maturity and then naturally fall is remote. Most old and potentially unstable trees near developed areas are removed as hazard trees.

Little Bear Creek

Adolfson relied on a study conducted in 2002 to describe fish and fish habitat in Little Bear Creek. The work conducted by King County (2001) was also useful and informative. King County reported that where forest cover was present along Little Bear Creek, nearly half of it was deciduous, primarily dominated by red alder (*Alnus rubra*) and big-leaf maple (*Acer macrophyllum*). The forest covered 35% (range 32% to 38%)

of the riparian corridor and shrubs 34% (range 10% to 67%) of the same. The mean bankfull width of Little Bear Creek is 18 feet and the mean depth is 2.4 feet.

How does the Little Bear Creek riparian area compare to other riparian areas in western Washington? Carlson (1992) compiled data collected from over 58 miles of riparian management zones (RMZ) adjacent to Type 1, Type 2, and Type 3 streams in lowland western Washington forests following timber harvest. He found that 45% of the trees were deciduous and the total cover of trees averaged 84%. He also reported that shrubs represented 57% of the cover in RMZs and herbs 65% (53% forbs & 12% grass). The most common trees encountered were red alder and western hemlock (*Tsuga heterophylla*) and they averaged from 8 to 12 inches in diameter. The most common shrubs were salmonberry (*Rubus spectabilis*) and vinemaple (*Acer circinatum*).

WETLANDS

The functions provided by wetlands and their assigned human-based values have been identified and evaluated through several studies (Cowardin et al., 1979; Adamus et al., 1987; Mitsch and Gosselink, 2000; Hruby, 1995; Reppert et al., 1979; Cooke, 1995). These functions include:

- *Flood water attenuation and flood peak desynchronization;*
- *Stream base flow maintenance and groundwater support;*
- *Shoreline protection;*
- *Water quality improvement;*
- *Biological support and wildlife habitat; and*
- *Recreation, education, and open space.*

To the uninitiated every wetland no matter how large and no matter its position in the landscape provides the entire suite of functions on this list. In reality most wetlands provide some of these functions but not all of them. When considered as a whole, wetlands represent a small fraction of the pervious landscape. As such non-wetland pervious habitats, including for example forests, fields, and lawns can and do provide as much if not more base flow maintenance and groundwater support, water quality improvement, biological support, and recreation and open spaces as wetlands. Because stormwater treatment systems have become common in urbanizing areas, they likely contribute significantly to floodwater attenuation and flood peak desynchronization. Wetlands do however possess certain unique physical characteristics that can and do limit the numbers and distribution of certain species of wildlife.

Functions and Values of Wetland Buffers

Buffers are vegetated areas adjacent to an aquatic resource that can, through various physical, chemical, and/or biological processes, reduce impacts from adjacent land uses. The majority of research on buffers tends to focus on how buffers influence water quality. Far fewer studies examine the influence of a buffer's physical characteristic on attenuating rates of surface water flow (Washington State Department of Ecology, 2003). Buffers alone have limited influence on wetland hydroperiod. Land cover type in the contributing basin has stronger influence on the resulting hydroperiod of the wetland than the buffer does (Booth, 1991). An exception may be for wetlands that have a very small contributing basin.

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The ability of a buffer to provide physical filtering of sediments depends on slope, the characteristic of the sediment, condition of the vegetation, and the surface roughness. The presence of woody debris and vegetation on the ground slows flows, inhibits rill formation, and facilitates sediment deposition. The buffer's ability to remove toxins and pathogens is one of the least thoroughly studied. The most effective removal of toxic that adhere to sediment particles is through surface sheet flow through a grass filter strip (Washington State Department of Ecology, 2003).

Significant reductions in some pollutants, especially coarse sediments and the pollutants that adhered to them, can be accomplished in a relatively narrow buffer of 16 to 66 feet, but removal of fine sediments requires substantially wider buffers of 66 to 328 feet. Removing dissolved nutrients requires long retention times (dense vegetation and/or very low slope) and, more importantly, contact with fine roots in the upper soil profile. Distances for dissolved nutrient removal are quite variable, ranging in the literature from approximately 16 to 131 feet (Washington State Department of Ecology, 2003).

There is no simple generalized answer for what constitutes an effective buffer width for wildlife considerations. The width of the buffer is dependent upon the species in question and its life-history needs, whether the goal is to maintain connectivity of habitats across a landscape, or whether one is simply trying to screen wildlife from human interactions (Washington State Department of Ecology, 2003).

Human access and land uses adjacent to wetlands influence the use and habits of wildlife through visual and auditory intrusions, as well as elimination or degradation of appropriate upland habitats. Even "passive" activities such as bird/nature-watching have been shown to have effects on roosting and foraging birds. For protection and maintenance of wildlife habitat functions of wetlands, suggested effective buffer widths generally should range from: 25 to 75 feet for wetlands with minimal habitat functions and adjacent to low-intensity land uses; 50 to 150 feet for wetlands with moderate habitat functions or high intensity adjacent land use; and 150 to 300 feet for wetlands with high habitat functions (Washington State Department of Ecology, 2003).

McMillan (2000) recommends an approach that attempts to balance predictability with flexibility by setting standard buffer widths that can be altered on a case-by-case basis to adapt to site-specific factors. This approach for determining buffer width incorporates a rating system for wetlands, plus an assessment of the intensity of proposed or existing adjacent land use, to establish buffer widths ranging from 25 to 350 feet. It incorporates an understanding of the condition of the wetland, the buffer, and the proposed adjacent land use (Washington State Department of Ecology, 2003).

CONCLUSIONS

One thing that is clear from conducting this exercise is that there is very little scientific information regarding stream and wetland buffers in the urban environment. As such decisions about how best to protect these resources must be based on the existing body of literature regarding buffers in agricultural and forested settings. It is important however to also consider the evidence that does exist in the urban environment regarding buffers, including the role of stormwater management systems and human health and safety considerations. And although not science, landowners must be considered when deciding how to protect stream and wetland resources and manage buffers.

Based on the limited amount of information available regarding buffers, it seems that the most important buffer function in an urban setting is to limit access by people. Stormwater management is required on all new development – thus with the possible exception of some residential settings, the water quality functions of buffers has been superceded by stormwater systems. It is true that buffers provide habitat for wildlife, but unless the species being considered is a priority species requiring special consideration, wildlife should not be the primary factor for defining buffer widths. Protecting streams and wetlands by designating reasonable buffers would be far more effective if there is a fence along its perimeter. Further, the fence should support signs that warn people that the fenced area is special and identifies ways to protect it. And finally, it is important for the regulating authority to enforce the conditions of the permit. With respect to buffers, this means that the permitting authority must ensure that the permit holder honor their commitment to protect streams and wetlands and their adjacent buffers.

LIMITATIONS

Work for this project was performed, and this letter report prepared, in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

Any questions regarding our work and this report, the presentation of the information, and the interpretation of the data are welcome and should be referred to Chad Armour, LLC.

Sincerely,
Chad Armour, LLC

Chad Armour
Principal

Attachments:
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March 20, 2004

Mr. Jeff Smith
Little Bear Creek Property Owners Association
13632 NE 177th Place
Woodinville, WA 98072

Re: Review of Woodinville BAS and proposed revisions to the Environmentally Sensitive Areas Ordinance (Proj. No. 2004-002)

Dear Jeff:

At your request, Ecological Solutions, Inc. has reviewed the best available science (BAS) documents and proposed revisions to the City of Woodinville's (City) Environmentally Sensitive Areas Ordinance (ESA) prepared by Adolfson Associates, Inc. (Adolfson). As you are aware, the City is required by the Growth Management Act (GMA) to include BAS in their ESA. The Washington Department of Commerce, Trade and Economic Development (CTED, which was formerly the Office of Community Development or OCD) has promulgated rules (WAC 365-195-190 et seq.) and developed critical areas assistance guidelines for municipalities. Both the CTED rules and Critical Areas Assistance Handbook (guidelines), which has also been called the Model CAO, are available online at http://www.cted.wa.gov/DesktopModules/Documents/ViewDocument.aspx?DocumentID=1034. As it has undoubtedly become clear to you, considerable controversy surrounds the process of defining, identifying, and establishing appropriate protections for critical areas as required by GMA.

A few things are quite clear relative to GMA-mandates. Among the foremost requirements and goals of the law is protection of existing critical areas and their functions. Another of the goals of GMA is no net loss critical areas or their functions. Another primary consideration, however, is the intent of GMA to focus growth within urban growth areas (UGAs) where infrastructure exists and can support such additional growth. A corollary to this concept is to prevent sprawl into more rural areas that do not have the necessary infrastructure to support such growth. Implicit in the latter concept is that higher quality or functioning critical areas, such as wetlands, streams and fish and wildlife habitat conservation areas (FWHCA), are present in the more rural areas. Another important consideration is that the science required to protect critical areas must be adapted to conditions and functions of critical areas within each municipality (i.e., the "local applicability" language of WAC 365-195-905(2)). Regardless of the final form of the Woodinville BAS and revised ESA, it is clear there will be additional burden and costs on project applicants and the City.

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As you have likely discerned from Adolfson's BAS documents, there is some uncertainty pertaining to what constitutes BAS. This is especially evident pertaining to the science and functions of wetlands, streams, and FHWCAs and buffers in urban areas. There is also a wide range in the functions of critical areas and buffers, which may not be clearly evident from Adolfson's documents. As they state, not all environmentally sensitive areas or their wetlands provide all functions that are often attributed to them. Levels of functions are related to existing physical, chemical, ecological, and biological processes within the sensitive areas and their buffers. Adolfson acknowledges the general lack of science specific to the Pacific Northwest and they also identify some of the impacts from urbanization to streams, wetlands, and FHWCA. They also have accurately characterized the other gaps in the literature and existing Woodinville ESA.

In addition to these general observations, this letter report provides my opinion and assessment of Adolfson's BAS and their suggested revisions to Woodinville's ESA. As agreed, I have identified those references that appear central to Adolfson's assessment of the BAS. For those references that I am unfamiliar with and appear central to the Woodinville BAS, my estimation whether each of these meets the CTED criteria for BAS has been identified. In addition, I have provided some other sources of literature that appear to be important and/or may provide a different perspective on the BAS and protection of critical area and buffer functions in the City. Some recommendations are made with respect to additional research and the estimated costs for completing it. Lastly, I have analyzed the proposed revisions to the City's ESA and made some recommendations to reflect your concerns.

While I have had a considerable amount of experience identifying BAS for other municipalities and can evaluate Adolfson's BAS and their suggested revisions to Woodinville's ESA, none of the information or opinions in this report is intended as legal advice. For such advice, it is strongly recommended that you retain a land use attorney to assist you with your concerns, especially regarding potential constraints on your properties and property rights.

WOODINVILLE BAS

The following sections summarize concerns and comments on BAS pertaining to streams, wetlands, and FHWCA. Focus has been given to whether functions of critical areas within the City have been clearly identified; gaps; references that appear to be central to the BAS and whether these appear to meet CTED criteria for BAS (WAC 365-195-905), and other information that should be considered and possibly included in the BAS. Although I have focused on Little Bear Creek (LBC) as you have requested, it is imperative to note that resource management is typically done within a watershed or regional context. Hence, I have made suggestions to emphasize this BAS in a watershed or regional emphasis, especially as it pertains to salmon stocks and wildlife.

STREAMS AND RIPARIAN BUFFERS

Adolfson has provided a relatively cursory overview of the functions of streams, riparian buffers, and some of the habitat requirements of salmonids. Although it is correctly indicated that there is a lack of

scientific studies of Pacific Northwest streams and buffers in urban areas, there is a tremendous volume of literature on the functions of streams and their riparian buffers. Among these are the compilation of information contained in Naiman et al. (1992), which meets CTED's criterion of BAS and is cited. One of the documents, which is not familiar to me and may not meet the CTED criteria but appears to receive considerable emphasis, is City of Portland (2001). Other useful references that contain more detailed information on the life history and habitat requirements of salmon and trout are available in publications that are not cited (e.g., Bjorn and Reiser, 1991; Groot and Margolis, 1991; and Stouder et al., 1997). LBC is used as spawning and rearing habitat by Chinook, coho, chum, pink, and sockeye salmon as well as resident cutthroat trout. The effects of existing development on stream and riparian functions also is identified but perhaps not sufficiently emphasized. For example, the impacts of urban and agricultural runoff on water and habitat quality are discussed but should receive greater emphasis. In addition, it seems apparent from statements about spawning gravel quality (percent fines) that urban runoff and associated changes in hydrology have contributed to degraded habitat. A major function often articulated and attributed to riparian buffers is water quality protection. This receives scant attention. Furthermore, an important component of any discussion on this function must include the conditions of the buffer (vegetation density, structure, slope, and soils) as well as whether stormwater is effectively collected in conveyance systems and routed directly to sensitive areas thus bypassing this function. Furthermore, as stated, the pollutant removal qualities of buffers are dependent on diffuse or sheet flow across the buffer. It is unclear whether such conditions are common in Woodinville.

What is clear is that there are gaps pertaining to functions of existing habitat and the effects of existing development on these functions. This is significant as without clearly identifying the existing functions, it becomes unclear how best to protect them (i.e., buffer size). Adolfson does correctly articulate the general impacts of urbanization on hydrology, but this is not well integrated into the existing conditions or habitat functions within LBC. However, more emphasis should be given to the amount of impervious surface in the watershed and its effects on existing habitat quality and functions. In addition, the contribution of LBC to the preservation of existing listed species needs to be put in clear context with the management and preservation of both stocks of listed and resident species. There is little or no discussion on the management of salmon stocks in WRIA 8 or the relationship of LBC to sustaining these stocks. I suspect that LBC contributes little to the overall escapement goals. Adolfson does identify some pertinent documents, including the Sammamish River Near Term Action Plan. However, the Lake Washington/Cedar/Sammamish River Near-Term Action Agenda for Salmon Habitat Conservation WRIA Action Plan, a newer document available online at http://dnr.metrokc.gov/wrias/8/near-term-action-agenda.htm, apparently has not been included. At any rate, the document generally does not integrate these more regionally-oriented documents into the BAS document and put Woodinville resources and jurisdiction into the proper perspective.

It appears clear that Adolfson's scope did not include detailed inventory of existing habitat conditions. They did two days of reconnaissance. In all fairness, this makes it difficult at best to identify local conditions and existing functions or appropriate regulations for protecting them. Consequently, the document appears to rely heavily on a single document, a habitat inventory of LBC completed by David Evans Associates (DEA 2002). I am unfamiliar with this document. Assuming that it has been prepared by a qualified biologist, this is likely pertinent information to include and meets the BAS criteria. It

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seems that the findings of this document could be more clearly articulated, particularly relative to existing pool to riffle ratios, channel and substrate characteristics, riparian zone condition, and aquatic invertebrate community composition. Other documents that likely contain useful information and perhaps should be considered include, the Northshore Community Plan (now replaced by Woodinville's Comprehensive Plan), A Catalog of Washington Streams and Salmon Utilization Volume 1 (Williams et al., 1975), King County's Sensitive Areas Map Folio (King County, 1990). In addition, there is a relatively recent document that appears particularly pertinent, 1999 Habitat Inventory and Assessment of Three Tributaries to the Sammamish River: North, Swamp, and Little Bear Creeks (King County, 2001).

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Other Sources of Information

Other sources of information that do not appear to have been considered and may be appropriate to consider and use in establishing BAS and likely existing functions provided by LBC are identified. Several references that are well recognized and often cited include Bjorn and Reiser, 1991; Groot and Margolis, 1991; Stouder et al., 1997; and Williams et al., 1975. The results of 1999 Habitat Inventory and Assessment of Three Tributaries to the Sammamish River: North, Swamp, and Little Bear Creeks (King County, 2001) appear to be important to the establishment of existing functions in LBC and the measures that are needed to protect them.

Recommendations

Recommendations for strengthening the BAS and better identifying the existing conditions and functions of LBC are presented in this section. Because of the limited resources available to the City, it is impractical to suggest filling data gaps by conducting additional studies. In addition, GMA clearly indicates that this is not required. However, at a minimum, available information must be better integrated into both the Woodinville BAS and the proposed regulations for protecting the existing functions of LBC. Completion of GIS inventories of stream, wetlands, and FWHCA by the City will be helpful. It makes sense to complete these before finalizing revisions to ESA codes.

At a minimum, the BAS should be revised to better reflect existing functions by better integration of existing information. Existing information includes, known distribution and limitations of federally-listed salmonids in LBC and habitat conditions as indicated in DEA, 2002; Williams et al., 1975; and King County, 2001. More emphasis needs to be placed on apparent habitat and water quality degradation caused by existing development. In addition, the productivity of LBC and associated riparian forest must be put in proper context, especially as it pertains to the preservation and recovery of populations of federally-listed fish species. Aerial photo interpretation could be used to better document habitat continuity, linkages, and protective mechanisms (see FWHCA BAS). In addition to those sources mentioned above, other sources of BAS on functions of streams and riparian areas include, Beschta et al., 1987; Spence et al., 1996; FEMAT, 1993; Sheldon et al., 2003; and King County, 2003. See Table 1 for a tabulation of estimated costs for completing reviews and summarizing this information.

WETLAND AND WETLAND BUFFERS

Although the functions attributed to wetlands are somewhat oversimplified, they are generally accurately characterized with one possible exception. There is disagreement among Pacific Northwest wetland scientists whether wetlands provide base flow support to streams. Adolfson suggests that this is an important function in at least some wetlands within the City. However, the recent Draft Synthesis of the Science on Freshwater Wetlands (Sheldon et al., 2003) suggests that this is unlikely given there is little outflow from freshwater wetlands during the summer low-flow period when such base-flow support is most critical.

Like the discussion on streams, there needs to be greater emphasis on the effects of existing development on remaining wetlands in the City. In particular, the amount of impervious area in the LBC watershed and effects on wetland hydrology, vegetation structure, and associated functions must be placed in proper context. Adolfson touches on the presence of invasive species. However, it seems apparent that the abundance and distribution of non-native and invasive plants, such as purple loosestrife, reed canarygrass, and Himalayan blackberry is more widespread than indicated. This may be a reflection of widely fluctuating wetland hydrology, which has significant implications with respect to existing wetland functions. For example, one of the primary functions of existing wetlands may be treatment and retention of pollutants commonly found in urban stormwater runoff, such as suspended solids and associated contaminants. The abundance of invasive species and pollutant loading from stormwater runoff, as well as the fragmented nature of habitat has clear implications on the function of the remaining wetlands and riparian buffers to provide functions, especially habitat. This seems particularly true for wildlife habitat function, which is often the function that drives buffer size. Adolfson correctly identifies the fragmented nature of existing habitat and that it generally appears to support common species of wildlife. However, more emphasis appears appropriate particularly with regard to potential to support self-sustaining populations of these species. It may be that habitats have already been so fragmented and the lack of linkages so few that populations may not now be self-sustaining for less mobile animals (see the discussion on habitat fragmentation in FWHCA).

Buffers provide similar functions to wetlands as they do to streams. Adolfson correctly notes that the effects of buffers on wetlands differ from those on streams. For example, riparian buffers provide shade and contribute to the maintenance of favorable water temperatures, provide an important source of energy (leaf litter and other organic matter) or food to salmonids (terrestrial invertebrates), and a source of large woody debris to streams. These functions may not directly apply or may be less important to wetlands. Water temperature in wetlands may not be as critical or may be moderated by groundwater contributions to wetland hydrology. The trophic structure in wetlands is different than in aquatic ecosystems and does not rely on external contributions as much as streams to support food web dynamics. And LWD can provide invertebrate and wildlife habitat in wetlands but is not as critical to habitat formation (pools) and stability, gravel and organic matter retention, or other functions as it is in streams. Adolfson also acknowledges that buffers are narrow and degraded in many cases. In such cases, the degraded buffers may be providing limited functions.

Adolfson is incorrect in suggesting that McMillan (2000) is the most recent literature review specific to wetland buffers. Washington State Department of Ecology's (Ecology) Draft Synthesis of the Science on Freshwater Wetlands (2003) is the most recent review of wetland buffer functions. Perhaps most importantly, the evaluation of existing buffer functions in the protection of wetland functions, which provides the foundation for identification of required buffers in the proposed ESA revisions, seems lacking. One of the biggest drivers of buffer size is protection of wildlife habitat functions. More emphasis needs to be placed on the sensitivities of existing wildlife habitat functions of wetlands in order to more clearly justify the proposed buffers. Part of this emphasis must be habitat fragmentation and promotion of self-sustaining populations of fish and wildlife.

Most of the documents cited are appropriate and appear to meet the CTED criteria for BAS. There is considerable reliance on Azous and Horner, 2001; Castelle et al., 1992a; and City of Portland, 2001. A rather scathing review of Azous and Horner was published in a recent volume of the Society of Wetland Scientists journal Wetlands in which the reviewer strongly cautioned resource managers' use of this document. Although few would likely argue this document does not meet the BAS criteria specified in the WAC, the critical review does raise some genuine concerns. Having read the precursor to this book, I share at least some of those concerns as may others. Assuming the City of Portland (2001) document was produced by qualified experts and peer reviewed by other qualified experts, it would meet the CTED BAS criteria.

Other Sources of Information

The BAS could benefit from inclusion of findings from more recent studies that clearly satisfies the WAC criteria. Two significant updates and sources of relevant information on BAS pertaining to wetlands are curiously not included. There is no mention of either Ecology's recent Draft Synthesis of the Science on Freshwater Wetlands (Sheldon et al., 2003) or Chapter 9 of King County's BAS (2003). Regional geographic information on wetlands in adjacent jurisdictions particularly King and Snohomish Counties should be included. Both have extensive GIS land use and wetland maps. These should help establish the rarity of wetlands as well as their sensitivity to disturbance both of which are important to the identification of buffers or other measures proposed to protect their functions.

Recommendations

Significant resources have gone into both Ecology's and King County's assessment of BAS. These should be integrated as appropriate. Both of these documents more clearly articulate the range of buffer sizes needed to provide a given function. At a minimum, more emphasis must be included to identify the fact that local conditions dictate the performance of existing functions of the critical area and buffers. This could entail adoption by reference of this information.

FWHCA BAS

As noted by Adolfson, there has been no wildlife habitat inventory in the City. The Wildlife BAS technical memorandum generally accurately characterizes wildlife habitat and known or likely wildlife

use. Like the BAS on streams and wetlands, there seems to be a lack of emphasis on the effects of existing development on FWHCA and potential wildlife use. More emphasis should be placed on the apparent fact that perhaps without exception the wildlife observed is characterized by generalists. This is important because generalists are species with a broad range of tolerances that typically are adaptable to urban environments and thrive in these areas. Some examples given include American crow, house sparrow, opossum, and raccoon. In addition, the apparent lack of habitat complexity could be emphasized. Interspersion of different habitat types creates edges, which are important to some species. The "edge effect" is mentioned by Adolfson, but again the context and emphasis could be clearer. They do a good job of identifying the habitat types but not really elaborating on the quality of these. It seems clear that there is a lack of specialized habitat (e.g., downed logs, large snags, or other

It seems clear that LBC and its associated wetlands and riparian forests are among the most complex and functional habitats remaining in the City. Nonetheless, it also appears clear that remaining habitat is grossly fragmented as pointed out but insufficiently emphasized. There is a considerable amount of scientific literature on the effects of habitat fragmentation, including introduction and spread of invasive plants and animals, predation or harassment of wildlife by domestic animals, and impacts on the sustainability of populations of native plants and animals. Some of these sources deserve more attention and are identified below (see Other Sources of Information). These sources while not specific to the Pacific Northwest clarify both the uncertainty and range of effects of fragmentation. In general, the thrust of these is to reduce the value of existing habitat because of the high level of existing fragmentation and its attendant effects.

The magnitude of this fragmentation and isolation also can be put into clearer perspective by looking at some available existing documentation. King County and Snohomish County both have excellent coverage of existing land uses, open space, and forested areas, which might be used as linkages to habitats in the City. It would likely be quite clear that there are no large intact linkages, which reduces the potential to prevent isolated subpopulations and sustain populations of some species, particularly those with larger home range requirements or any that might be susceptible to disease or high mortality because of existing habitat degradation. It is undeniable that intact riparian forests and other riparian habitats are used by as high as 86% of the terrestrial species known in the state. However, the Washington Department of Fish and Wildlife's (WDFW) own gospel on riparian habitat management (Knutson and Naef, 1997) makes it quite clear that the riparian habitats that support a high diversity of fish and wildlife in intact ecosystems are not the same as those typically found in urban areas. Consequently, the larger recommended buffers needed to maintain the complex mosaic of habitat features found in intact riparian habitats, does not translate to urban areas. It should be stressed more that site-specific conditions influence the quality of riparian habitat.

There is one document that is cited repeatedly throughout the discussion of FWHCA. Johnson and O'Neil (2001) or other contributions in this document are relied upon to a great extent. It seems likely that this document meets the BAS criteria. Another document that may perhaps not be as well summarized as it could is the habitat assessment of LBC completed by David Evans Associates (DEA 2002). Assuming this was completed by a qualified expert and reviewed by a qualified expert, it likely

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meets the BAS criteria. There are many other sources of information that deserve mention (see Other Sources of Information).

Other Sources of Information

As noted above, there are many aerial photos available as well as existing habitat inventory documents that better identify some of the factors limiting habitat. WDFW riparian habitat management recommendations, many of which are available online at http://www.wdfw.wa.gov/hab/phsrecs.htm should be better integrated into the document. WDFWs management recommendations for Washington's Priority Habitats (Knutson and Naef, 1997) is a seminal source of information on riparian habitats. Another document that receives passing reference and documents well the primary and secondary habitat associations of species found in the forests of Washington and Oregon is Brown (1985).

Recommendations

Integrate the WDFW riparian habitat management recommendations into the document and proposed regulations. These will show that many of the specialized habitat features and conditions that contribute to the high diversity of wildlife in intact riparian habitats (a primary FWHCA), such as a mosaic of habitat types, snags, downed wood in various stages of decay, and multiple layers in forested habitats, do not occur in urbanized areas. This is not to suggest that they are completely functionless but again the proper perspective must be emphasized. Urban riparian habitats will likely never function at a high level for many species typically associated with the more complex riparian habitats found in national forests and less disturbed areas. Many of the natural disturbance mechanisms that contribute to the natural complexity and diversity of intact riparian habitats in these areas, forest fire, flooding, channel migration, and landslides, have been removed or dramatically reduced in urban areas.

Focusing on LBC, analysis of the King and Snohomish County wildlife habitat and open space maps combined with the figures or aerial photos will show the magnitude of existing habitat fragmentation. In addition, they should clearly demonstrate the lack of existing habitat linkages or connectivity. This information also will show the limitations of creating habitat linkages that might otherwise be expected to help prevent isolated subpopulations, particularly for less mobile species, and make populations of existing wildlife self-sustaining. See Table 1 for a summary of the estimated costs for completing these recommendations.

OTHER REFERENCES THAT SHOULD BE CONSIDERED

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EVALUATION OF PROPOSED REVISIONS TO CODE

Each of the following sections provides an evaluation of the potential constraints on proposed WMC revisions to the ESA. The potential constraints on development in the LBC corridor is the focus of the review. Potential concerns and recommended modifications are identified where appropriate.

STREAMS

Designation and rating and buffers

LBC is a Type 1 stream, which would have a 150-foot buffer or a 115-foot buffer when the applicant demonstrates the buffer has been significantly degraded and the City approves an enhancement plan that does not reduce stream and buffer functions. While a buffer of 150-feet for a Type 1 stream is common, the proposed BAS does not seem to support such a buffer, especially where conditions are degraded, such as presence of invasive species or landscaping. It is unclear whether this would be applied in cases where there is existing development within the standard buffer. Typically, existing uses would not be considered nonconforming. However, this would clearly seem to potentially greatly reduce future expansion plans for an existing use. Under 21.24.360(b), it appears that the City could reduce the buffer even lower than 115 feet for designated "urban" streams provided. **Recommendations:** 1) Make sure "qualified professional biologist" is clearly defined in the definitions section of WMC. The "urban" designation specifically does not include Type 1 streams per 21.24.360(b)(i). 2) Push to add language that could allow an exception for reaches of Type 1 streams or their buffers are not high functioning as shown by a site specific study done by a qualified biologist. Note that aerial photos and the King County (2001) and possibly the David Evans Associates (2002) LBC habitat studies likely clearly indicate what stream reaches and riparian buffers are lower quality. 3) Make sure that "hazardous substances, pesticides, and fertilizers" are defined in the definitions section of WMC such that they do not constrain reasonable management of your properties. Request adoption of clear criteria under which these might be prohibited, such as ecotoxicological studies that show use of these substances poses probable risks to water quality, listed species, or environmental or human health.

Permitted Alterations

Proposed revisions allow for utilities and stormwater management facilities under certain conditions that appear to be reasonable. If utilities are a concern for the LBC Property Owners Association, provisions WMC 21.24.320 and Comprehensive Plan policy U-1.12 should be reviewed to ensure that these do not appear to unnecessarily constrain potential future development. They also provide for stabilization if structures are threatened. **Recommendations:** 1) Add "prepared by a qualified biologist" to end of the sentence of number (1). 2) Push to include Type 1 streams under (6)(a) based on a study by a qualified biologist that there would be no degradation of existing functions. 3) Check to make sure that compliance with WMC 21.24.220-21.24.260 under subsection (9)(b) does not potentially constrain channel stabilization that "threatens" structures or the only access to properties. Make sure "threaten" is carefully defined in the WMC definitions.

Mitigation Requirements

Restoration or mitigation are required for unauthorized or authorized impacts subject to approved plans. Although none of these appear likely to constrain LBC Property Owners Association members, "basin analysis" is pretty vaguely worded under subsection (2)(b). **Recommendation:** 1) Add language clarifying and stipulating what constitutes basin analysis. Is this modeling? If so, suggest adding language that requires this only if the bed and banks of the stream are being modified or restored.

WETLANDS

Designation and Ranking

The suggested designation and ranking system seems fine provided there are clear definitions and clarifications. See Recommendations for suggested definitions and clarifications. **Recommendations:** 1) In subsection (2)(a)(ii), suggest the language read "Washington State Department of Natural Resources' Natural Heritage Program." 2) In subsection (2)(a)(iii) "sphagnum bogs," "fens," and "natural forest swamps" must be clearly defined in WMC definitions. Suggest replacing sphagnum bogs and fens with "sphagnum-dominated" peatland. This is a clearer and more precise definition. The definition of "natural forest swamps" should exclude red-alder dominated and perhaps conifer-dominated forested wetlands. 3) In subsection (2)(a)(iv), suggest clearly defining "mainstem" to ensure that this does not include small side channels. Also suggest that "influenced" be clearly defined in WMC definitions. All wetlands near LBC could potentially be considered influenced by it. Presumably, this is intended to maintain flood control and attenuation functions of wetlands associated with the river or creek. 4) In subsection (2)(b)(ii), suggest that the word "associated" is clearly defined in the definitions section of WMC. The suggested definition is "Associated wetlands are those that receive surface water contributions from overbank flooding at least periodically, such as once every five years during years of normal, long-term average precipitation." This would exclude anomalous drought conditions. 5) In subsection (2)(b)(iii), suggest adding language "except for wetlands with more than 60 percent areal cover of invasive species, such as reed canarygrass and purple loosestrife." 6) In subsection (2)(b)(iv), suggest revising to read "...or open water in dispersed patches." Also should define open water as "water more than 6.6 feet deep at mean low water during years of normal, long-term average precipitation." This would exclude anomalous drought conditions.

Development Standards

There does not appear to be any clear rationale for expansion of the buffers for the various classes. As indicated in the BAS, buffers should be flexible and allowed to be smaller if site-specific investigations indicate there would be no degradation of wetland function. Presumably the intent is not to make land uses with now larger buffers nonconforming uses through application of larger buffers. Buffer width averaging is allowed subject to a report completed by a professional biologist. **Recommendations:** 1) Request clear language indicating the buffers do not extend across the edge of the built environment, such as roads, parking lots, building, and railroad tracks. 2) In subsection (1)(f), suggest modify to allow increase or decrease of wetland buffers provided site-specific studies prepared by a qualified biologist

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21.06.xxx **Anadromous fish.** Anadromous fish: fish that spawn and rear in freshwater and mature in the marine environment.

21.06.051 **Best Available Science.** Current scientific information used in the process to designate, protect, or restore critical areas, that is derived from a valid scientific process as defined by WAC 375-195-900 through 925. Sources of best available science are included in "Citations of Recommended Sources of Best Available Science for Designated and Protecting Critical Areas" published by the state Office of Community Development.

21.06.058 **Biologist.** Biologist: a person who has earned at least a Bachelor of Science degree in the biological sciences from an accredited college or university or who has equivalent educational training and experience.

21.06.065 **Buffer, critical area.** Buffer, sensitive area: a designated area contiguous to and protective of a critical area that is required for the continued maintenance, functioning, and/or structural stability of a critical area.

21.06.xxx **Critical aquifer recharge area.** Critical aquifer recharge area: Areas designated by Chapter 365-190-080(2) WAC that are determined to have a critical recharging effect on aquifers used for potable water as defined by Chapter 365-190-030(2) WAC.

21.06.207 **Engineering geologist.** Engineering geologist" a practicing engineering geologist licensed in the state of Washington.

21.06.215 **Erosion hazard areas.** Erosion hazard areas: those areas in City of Woodinville underlain by soils, which are subject to severe erosion when disturbed. Such soils include but are not limited to those classified as having a severe to very severe erosion hazard according to the USDA Natural Resource Conservation Service (NRCS), the 1973 King County Soils Survey or any subsequent revisions or addition by or to these sources. These soils include, but are not limited to, any occurrence of River Wash ("Rh") and the following when they occur on slopes fifteen per cent or steeper:

(1) The Alderwood gravely sandy loam ("AgD"),
(2) The Alderwood and Kitsap soils ("AkF"),
(3) The Beausite gravely sandy loam ("BeD" and "BeF"),
(4) The Kitsap silt loam ("KpD"),
(5) The Ovall gravely loam ("OvD" and "OvF"),
(6) The Ragnar fine sandy loam ("RaD"), and
(7) The Ragnar-Indianola Association ("RdE").

21.06.283 **Geologist.** Geologist: a person licensed as a geologist in the state of Washington.

21.06.285 **Geotechnical engineer.** Geotechnical engineer: a practicing geotechnical/civil engineer licensed as a professional civil engineer by the State of Washington.

21.06.303 **Hazardous materials or substance.** Hazardous materials or substance: any hazardous waste, hazardous substance, dangerous waste, or extremely hazardous waste that is a physical or health hazard as defined and classified in Chapter 70.105 RCW and Chapter 1773-303 WAC, whether the materials are in usable or waste condition.

21.06.350 **Landslide.** Landslide: episodic, perceptible movement of a mass, including, but not limited to, soil, rock or snow.

21.06.406 **Native growth protection area (NPGA).** Native growth protection area: an area where native vegetation is preserved for the purpose of preventing harm to property and the environment, including, but not limited to, controlling surface water runoff and erosion, maintaining slope stability, buffering and protecting plants and animal habitat.

21.06.461 **Primary association.** Primary association: use of a habitat area by a species for breeding, nesting, rearing young, roosting, feeding, or foraging on a regular basis.

21.06.xxx **Primary basin.** Primary basin; a stream basin that provides significant fish and wildlife habitat, are largely open channel systems, have the potential for habitat restoration, and have been identified as priority areas for restoration in the Water Resource Inventory Area (WRIA) 8, i.e., Cold Creek and other tributaries to Bear Creek.

21.06.462 **Priority habitat.** Priority habitat: habitat type or elements with unique or significant value to one or more species as classified by the Washington Department of Fish and Wildlife. A priority habitat may consist of a unique vegetation type of dominant plant species, a described successional stage, or a specific structural element.

21.06.xxx **Secondary basin.** Secondary basin: stream basins in which streams are largely piped, have limited opportunities for restoration, and lie within the urban city center, i.e., Woodin Creek.

21.06.535 **Seismic hazard areas.** Seismic hazard areas: those areas in the City of Woodinville subject to severe risk of earthquake damage as a result of earthquake-induced ground shaking, slope failure, settlement, surface rupture, or soil liquefaction.

21.06.614 **Species, endangered.** Endangered species: any fish or wildlife species that is threatened with extinction throughout all or a significant portion of its range and is listed by the state or federal government as an endangered species.

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21.06.xxx **Species or local importance.** Species of local importance: those species of local concern due to their population status or their sensitivity to habitat manipulation.

21.06.xxx **Species, threatened.** Threatened species: any fish or wildlife species that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range without cooperative management or removal of threats, and is listed by the state or federal government as a threatened species.

Streams. Streams: those areas in the City of Woodinville where surface waters produce a defined channel or bed, not including irrigation ditches, canals, storm or surface water run-off devices or other entirely artificial watercourses, unless they are used by salmonids or are used to convey streams naturally occurring prior to construction in such watercourses. For the purpose of this definition, a defined channel or bed is an area which demonstrates clear evidence of the passage of water and includes, but is not limited to, bedrock channels, gravel beds, sand and silt beds and defined-channel swales. The channel or bed need not contain water year-round.

21.06.710 **Wetland.** Wetlands: those areas which are inundated or saturated by ground or surface water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas. Wetlands do not include those artificial wetlands intentionally created from non-wetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentially created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from non-wetland areas to mitigate the conversion of wetlands.

21.06.711 **Wetland classes.** Wetland classes: descriptive classes of the wetlands taxonomic classification system of the U.S. Fish and Wildlife Service (Cowardin et al., 1979).

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21.24.200 Critical aquifer recharge areas: designation and rating

(1) The map entitled King County Critical Recharge Areas, including any authorized updates to this map, attached to this ordinance as Exhibit A is hereby adopted as the designation of critical aquifer recharge areas in the City of Woodinville. The designated critical aquifer recharge areas map may be updated from time to time as new information becomes available pursuant to RCW 21.24.080.

(2) Critical aquifer recharge areas are categorized as follows:

(a) Category I critical aquifer recharge areas include those areas designated on the critical aquifer recharge area map as highly susceptible to groundwater contamination and that are located within a sole source aquifer or wellhead protection area.

(b) Category II critical aquifer recharge areas include those mapped areas designated that:

(i) Have a medium susceptibility to groundwater contamination and are located in a sole source aquifer or wellhead protection area; or

(ii) Are highly susceptible to groundwater contamination and are not located in a sole source aquifer or wellhead protection area.

(3) An applicant can request that the City declassify a specific area included in the map adopted under WMC 21.24.200(1). The application must be supported by a critical areas report that includes a hydrogeologic assessment. The application to declassify an area shall be reviewed by the City following the procedure in WMC 21.24.100.

21.24.210 Critical aquifer recharge areas: development regulations

(1) The following new uses or activities are not allowed in category I critical aquifer recharge areas:

(a) Hazardous liquid transmission pipelines:

(b) Sand and gravel, and hard rock mining on land that is not zoned for mining as of the effective date of this ordinance;

(c) Mining of any type below the groundwater table;

(d) Processing, storage, and disposal of radioactive wastes;

(e) Hydrocarbon extraction;

(f) Commercial wood treatment facilities on permeable surfaces;

(g) Golf courses

(h) Cemeteries

(i) Wrecking yards

(j) Landfills for hazardous waste, municipal solid waste, or special waste, and

(k) On-site septic systems on lots smaller than one acre without a treatment system that results in effluent nitrate-nitrogen concentrations below ten (10) milligrams per liter.

(2) The following new uses and activities are not allowed in a category II critical aquifer recharge area:

(a) Mining of any type below the water table;

(b) Processing, storage, and disposal of radioactive substances;

(c) Hydrocarbon extraction;
(d) Commercial wood treatment facilities on permeable surfaces:
(e) Wrecking yards;
(f) Landfills for hazardous waste, municipal solid waste, or special waste; and
(g) On-site septic systems on lots smaller than one acre without a treatment system that results in effluent nitrate-nitrogen concentrations below ten (10) milligrams per liter.

(3) The following standards apply to any development proposal in a critical aquifer recharge area:
(a) All storage tanks proposed to be located in a critical aquifer recharge area must comply with local building code requirements and must conform to the Uniform Fire Code requirements for secondary containment.
(b) Commercial vehicle repair and servicing must be conducted over impermeable pads and within a covered structure capable of withstanding normally expected weather conditions. Chemicals used in the process of vehicle repair and servicing must be stored in a manner that protects them from weather and provides containment should leaks occur.
(c) No dry wells shall be allowed in critical aquifer recharge areas on sites used for vehicle repair and servicing. Dry wells existing on the site prior to facility development must be abandoned using techniques approved by the Washington State Department of Ecology prior to commencement of the proposed activity.
(d) The uses listed below shall be conditioned in accordance with the applicable state and federal regulations as necessary to protect critical aquifer recharge areas.

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Statutes, Regulations, and Guidance Pertaining to Ground Water Impacting Activities

Activity	Statute - Regulation - Guidance
Above Ground Storage Tanks	Chapter 173-303 -640 WAC
Animal Feedlots	Chapter 173-216 WAC, Chapter 173-220 WAC
Automobile Washers	Chapter 173-216 WAC, Best Management Practices for Vehicle and Equipment Discharges (WDOE WQ-R-95-56)
Chemical Treatment Storage and Disposal Facilities	Chapter 173-303-182 WAC
Hazardous Waste Generator (*Boat Repair Shops, Biological Research Facility, Dry Cleaners, Furniture Stripping, Motor Vehicle Service Garages, Photographic Processing, Printing and Publishing Shops, etc.)*	Chapter 173-303 WAC
Injection Wells	Federal 40 CFR Parts 144 and 146, Chapter 173-218 WAC
Junk Yards and Salvage Yards	Chapter 173-304 WAC, Best Management Practices to Prevent Stormwater Pollution at Vehicles Recycler Facilities (WDOE 94-146)
Oil and Gas Drilling	Chapter 332-12-450 WAC, WAC , Chapter 173-218 WAC
On-Site Sewage Systems (Large Scale)	Chapter 173-240 WAC
On-Site Sewage Systems (< 14,500 gal/day)	Chapter 246-272 WAC, Local Health Ordinances
Pesticide Storage and Use	Chapter 15.54 RCW, Chapter 17.21 RCW
Sawmills	Chapter 173-303 WAC, 173-304 WAC, Best Management Practices to Prevent Stormwater Pollution at Log Yards (WDOE 95-53)
Solid Waste Handling and Recycling Facilities	Chapter 173-304 WAC
Surface Mining	Chapter 332-18-015 WAC
Underground Storage Tanks	Chapter 173-360 WAC
Waste Water Application to Land Surface	Chapter 173-216 WAC, Chapter 173-200 WAC, WDOE Land Application Guidelines, Best Management Practices for Irrigated Agriculture

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21.24.270 Geologically hazardous areas: designation.

(1) Geologically hazardous areas include areas susceptible to erosion, sliding, earthquake, or other geological events. Areas susceptible to one or more of the following types of hazards shall be designated as a geologically hazardous area:

(a) Erosion hazard;

(b) Landslide hazard;

(c) Seismic hazard

(d) Other geological events including mass wasting debris flows, rock falls, and differential settlement.

(2) Designation of specific hazard areas.

(a) Erosion hazard areas. Erosion hazard areas are those areas identified by the U.S. Department of Agriculture's Natural Resources Conservation Service or identified by a critical area special study as having a severe to very severe erosion potential.

(b) Landslide hazard areas. Landslide hazard areas are areas potentially subject to landslides based on a combination of geologic, topographic, and hydrologic factors. They include areas susceptible because of any combination of bedrock, soil, slope (gradient), slope aspect, structure, hydrology, or other factors. Examples of these may include, but are not limited to the following:

i. Areas of historic failures, such as areas designated as quaternary slumps, earthflows, mudflows, lahars, or landslides on maps published by the U.S. Geological Survey or Department of Natural Resources;

ii. Areas with all three of the following characteristics:

1. Slopes steeper than fifteen percent (15%); and
2. Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and
3. Springs or ground water seepage.

iii. Areas that have shown movement during the Holocene epoch (from ten thousand years ago to the present) or that are underlain or covered by mass wastage debris of that epoch;

iv. Areas potentially unstable because of rapid stream incision, stream bank erosion, and undercutting by wave action;

v. Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding; and

vi. Any area with a slope of forty percent (40%) or steeper and with a vertical relief of ten (10) or more feet except areas composed of consolidated rock. A slope is delineated by establishing its toe and top and measured by averaging the inclination over at least ten (10) feet of vertical relief.

c. **Seismic hazard areas.** Seismic hazard areas are areas subject to severe risk of damage as a result of earthquake induced ground shaking, slope failure, settlement, surface rupture, or soil liquefaction.

21.24.290 Development standards: general requirements

(1) Alterations of geologically hazardous areas or associated buffers may only occur for activities that:

(a) Will not increase the threat of the geological hazard to adjacent properties beyond pre-development conditions;

(b) Will not adversely impact other critical areas; and

Are designed so that the hazard to the project is eliminated or mitigated to a level equal to or less than pre-development conditions.

21.24.300 Performance standards – Specific hazards

(1) **Erosion and landslide hazard areas.** Activities on sites containing erosion or landslide hazards shall meet the following requirements:

(a) **Buffer required.** A buffer shall be established from all edges of erosion or landslide hazard areas. The size of the buffer shall be determined by the City to eliminate or minimize the risk of property damage, death or injury resulting from erosion and landslides caused in whole or part by the development, based upon review of and concurrence with a critical area report prepared by a qualified professional.

i. **Minimum buffer.** The minimum buffer shall be fifty (50) feet.

ii. **Buffer reduction.** The buffer may be reduced to a minimum of ten (10) feet when a qualified professional demonstrates to the Planning Directors satisfaction that the reduction will adequately protect the proposed development, adjacent developments and uses and the subject critical area.

iii. **Increased buffer.** The buffer may be increased where the Planning Director determines a larger buffer is necessary to prevent risk of damage to proposed and existing development;

(b) **Alterations.** Alterations of an erosion or landslide hazard area and/or buffer may only occur for activities for which a geotechnical analysis is submitted and certifies that:

i. The development will not increase surface water discharge or sedimentation to adjacent properties beyond pre-development conditions;

ii. The development will not decrease slope stability on adjacent properties; and

iii. Such alterations will not adversely impact other critical areas;

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(c) **Design standards.** Development within an erosion or landslide hazard area and/or buffer shall be designed to meet the following basic requirements unless it can be demonstrated that an alternative design that deviates from one or more of these standards provides greater long-term slope stability while meeting all other provisions of this Title. The requirement for long-term slope stability shall exclude designs that require regular and periodic maintenance to maintain their level of function. The basic development design standards are:

i. The proposed development shall not decrease the factor of safety for landslide occurrences below the limits of 1.5 for static conditions and 1.2 for dynamic conditions. Analysis of dynamic conditions shall be based on a minimum horizontal acceleration as established by the current version of the Uniform Building Code.

ii. Structures and improvements shall be clustered to avoid geologically hazardous areas and other critical areas;

iii. Structures and improvements shall minimize alterations to the natural contour of the slope and foundations shall be tiered where possible to conform to existing topography;

iv. Structures and improvements shall be located to preserve the most critical portion of the site and its natural landforms and vegetation;

v. The proposed development shall not result in greater risk or a need for increased buffers on neighboring properties;

vi. The use of retaining walls that allow the maintenance of existing natural slope area is preferred over graded artificial slopes;

vii. Development shall be designed to minimize impervious lot coverage;

(d) **Vegetation shall be retained.** Unless otherwise provided or as part of an approved alteration, removal of vegetation from an erosion or landslide hazard area or related buffer shall be prohibited;

(e) **Seasonal restriction.** Clearing shall be allowed only from May 1st to October 1st of each year provided that the City may extend or shorten the dry season on a case-by-case basis depending on actual weather conditions, except that timber harvest, not including brush clearing or stump removal, may be allowed pursuant to an approved forest practice permit issued by the City or the Department of Natural Resources;

(f) **Utility lines and pipes.** Utility lines and pipes shall be permitted in erosion and landslide hazard areas only when the applicant demonstrates that no other practical alternative is available. The line or pipe shall be located above ground and properly anchored and/or designed so that it will continue to function in the event of an underlying slide. Stormwater conveyance shall be allowed only through a high-density polyethylene pipe with fuse-welded joints, or similar product that is technically equal or superior.

(g) **Point discharges.** Point discharges from surface water facilities and roof drains onto or upstream from an erosion or landslide hazard area shall be prohibited except as follows:

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i. Conveyed via continuous storm pipe downslope to a point where there are no erosion hazards areas downstream from the discharge;

ii. Discharged at flow durations matching predeveloped conditions, with adequate energy dissipation, into existing channels that previously conveyed stormwater runoff in the predeveloped state; or

iii. Dispersed discharge upslope of the steep slope onto a low-gradient undisturbed buffer demonstrated to be adequate to infiltrate all surface and stormwater runoff, and where it can be demonstrated that such discharge will not increase the saturation of the slope;

(h) **Subdivisions.** The division of land in erosion and landslide hazard areas and associated buffers is subject to the following:

i. Land that is located wholly within an erosion or landslide hazard area or its buffer may not be subdivided. Land that is located partially within an erosion or landslide hazard area or its buffer may be divided provided that each resulting lot has sufficient buildable area outside of, and will not affect, the erosion or landslide hazard or its buffer.

ii. Access roads and utilities may be permitted within the erosion or landslide hazard area and associated buffers if the City determines that no other feasible alternative exists.

(i) **Prohibited development.** On-site sewage disposal systems, including drain fields, shall be prohibited within erosion and landslide hazard areas and related buffers.

(2) **Seismic hazard areas.** Activities proposed to be located in seismic hazard areas shall meet the standards of *Development standards – General requirements* [Section 21.24.290].

(3) **Other hazard areas.** Activities on sites containing or adjacent to volcanic, tsunamis, or other geologically hazardous areas, shall meet the standards of *Development standards – General requirements* [Section 21.24.290].

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sensitivity of the habitat and the type and intensity of human activity proposed to be conducted nearby, and shall be consistent with the management recommendations issued by the state Department of Fish and Wildlife.

(8) Seasonal restrictions. When a species is more susceptible to adverse impacts during specific periods of the year, seasonal restrictions, as determined by the Washington Department of Fish and Wildlife, may apply. Larger buffers may be required and activities may be further restricted during the specified season.

(9) Tree retention. The tree retention provisions of WMC 21.16 shall apply to the protection of Fish and Wildlife Habitat Conservation Areas.

21.24.xxx Fish and wildlife habitat conservation areas: Performance standards for Specific habitats

(1) The following development standards shall apply for areas with endangered or threatened species:

(a) No development shall be allowed without prior review and approval within a fish and wildlife habitat conservation area with which state or federally endangered or threatened species have a primary association.

(b) Whenever activities are proposed abutting a fish and wildlife habitat conservation area with which state or federally endangered or threatened species have a primary association, such area shall be protected through the application of protection measures in accordance with a Habitat Management Plan prepared by a qualified professional biologist and approved by the City. Approval for alteration of land adjacent to the fish and wildlife habitat conservation area or its buffer shall not occur prior to consultation with the Department of Fish and Wildlife and the appropriate federal agency, as applicable.

(2) Bald eagle habitat shall be protected pursuant to the Washington State Bald Eagle Protection Rules (WAC 232-12-292). Whenever activities are proposed adjacent to a verified nest territory or communal roost, a Habitat Management Plan shall be developed by a qualified professional. Activities are adjacent to bald eagle sites when they are within eight hundred (800) feet, or within a quarter mile (2,640 feet) and in a shoreline foraging area. The City shall verify the location of eagle management areas for each proposed activity. Approval of the activity shall not occur prior to approval of the Habitat Management Plan by the City and Department of Fish and Wildlife.

(3) Great blue heron rookery:

(a) A buffer equal to the distance of 820 feet radius measured from the outer most nest tree in the rookery will be established around an active rookery. This area will be maintained in native vegetation.

(b) Between January 1 and July 31, no clearing, grading or land disturbing activity shall be allowed within 900 feet of the rookery, unless approved by the City and WDFW.

(c) Approval of all activities requiring permits shall not occur within 900 feet of a heron rookery prior to the approval of a Habitat Management Plan by the City and WDFW.

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(4) Anadromous fish:

(a) All activities, uses, and alterations proposed to be located in water bodies used by anadromous fish or in areas that affect such water bodies shall give special consideration to the preservation and enhancement of anadromous fish habitat, including, but not limited to, adhering to the following standards:

i Activities shall be timed to occur only during the allowable work window as designated by the Washington Department of Fish and Wildlife for the applicable species;

ii. An alternative alignment or location for the activity is not feasible;

iii. The activity is designed so that it will not degrade the functions or values of the fish habitat or other critical areas; and

iv. Any impacts to the functions or values of the habitat conservation area are mitigated in accordance with an approved critical area report.

(b) Structures that prevent the migration of salmonids shall not be allowed in the portion of water bodies currently or historically used by anadromous fish. Fish bypass facilities shall be provided that allow the upstream migration of adult fish and shall prevent fry and juveniles migrating downstream from being trapped or harmed.

(c) Fills, when authorized by the City of Woodinville's Shoreline Management Master Program, shall not adversely impact anadromous fish or their habitat or shall mitigate any unavoidable impacts, and shall only be allowed for a water-dependent use.

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21.24.xxx Fish and Wildlife Habitat Conservation Areas: designation

(1) Fish and wildlife habitat conservation areas are those habitat areas that meet any of the following criteria:

(a) Documented presence of species listed by the federal government or the State of Washington as endangered or threatened; or

(b) Heron rookeries or active nesting trees; or

(c) Class 1 Wetlands as defined in 21.24.310; or

(d) Type 1 Streams as defined in 21.24.350; or

(e) Native Growth Protection Easements / Native Growth Protection Areas (NGPE / NGPA) and other areas designated by the City.

(f) Sites containing a bald eagle territory as mapped by WDFW. Bald eagle habitat shall be protected pursuant to the Washington State Bald Eagle Protection Rules (Chapter 232-12-292 WAC).

(2) All areas within the City meeting one or more of these criteria, regardless of any formal identification, are hereby designated critical areas and are subject to the provisions of this Title.

21.24.xxx Critical area report

(1) Requirements for critical areas reports for fish and wildlife habitat conservation areas are available from the City.

21.24.xxx Fish and wildlife habitat conservation areas: Performance standards

(1) Habitat Management Plan. A Habitat Management Plan is required when the priority habitats and species maps or natural heritage program maps maintained by the City, or other information, indicate the presence of areas with which species listed as endangered or threatened under federal law have a primary association, or which contain heron nests.

(a) All Habitat Management Plans shall be prepared in consultation with the state Department of Fish and Wildlife. Habitat Management Plans for species listed as endangered or threatened or heron rookeries shall be approved by the Department of Fish and Wildlife.

(b) Habitat Management Plan Content Requirements. Based on the characteristics of the site and information submitted by the applicant, the Director may require that all or a portion of the following be included in a Habitat Management Plan:

i. A map drawn to scale or survey showing the following information:

1. All lakes, ponds, streams, and wetlands on, or adjacent to the subject property, including the name (if named), ordinary high water mark of each, and the stream type or wetland class consistent with the Title.

2. The location and description of the fish and wildlife habitat conservation areas on the subject property, as well as any potential fish and wildlife habitat conservation areas within 200 feet of the subject property as shown on maps maintained by the City, and

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3. The location of any observed evidence of use by a threatened or endangered species.

ii. An analysis of how the proposed development activities will affect the fish and wildlife habit conservation area and listed species;

iii. Provisions to reduce or eliminate the impact of the proposed development activities on any fish and wildlife habitat conservation area and listed species; and

iv. The Habitat Management Plan should also address the following issues:

1. Prohibition or limitation of development activities within the fish and wildlife habitat conservation area,
2. Establishment of a buffer around the fish and wildlife habitat conservation area,
3. Retention of certain vegetation or areas of vegetation critically important to the listed species,
4. Limitation of access to the fish and wildlife habitat conservation area and buffer,
5. Seasonal restrictions on construction activities on the subject property,
6. Clustering of development on the subject property, and
7. Preservation or creation of a habitat area for the listed species.

(2) Fish and wildlife habitat conservation areas may be altered only if the proposed alteration of the habitat or the mitigation proposed does not degrade the quantitative and qualitative functions and values of the habitat. All new structures and land alterations shall be prohibited from habitat conservation areas, except in accordance with this Title.

(3) Introduction of plant, wildlife, or fish species not indigenous to the region into a fish and wildlife habitat conservation areas shall be prohibited unless authorized by a state or federal permit or approval.

(4) Mitigation sites shall be located to achieve contiguous wildlife habitat corridors in accordance with a mitigation plan that is part of an approved critical area report to minimize the isolating effects of development on habitat areas. Mitigation of aquatic habitat shall be located within the same aquatic ecosystem as the area disturbed.

(5) Mitigation of alterations to habitat conservation areas shall achieve equivalent or greater biologic functions. Mitigation shall address each function affected by the alteration in order to achieve functional equivalency or improvement on a per function basis.

(6) Any mitigation for alterations or impacts to a fish and wildlife habitat conservation area shall be supported by the best available science.

(7) Buffers. The Director shall require the establishment of buffer areas for activities in, or adjacent to, fish and wildlife habitat conservation areas, when needed to protect fish and wildlife habitat conservation areas. Buffers shall be established to protect the integrity, functions and values of the affected habitat. Buffers shall either consist of an undisturbed area of native vegetation, or of areas identified for restoration or enhancement. Required buffer widths shall reflect the

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21.24.350 **Streams: designation and rating.** Streams are waterbodies with a defined bed and banks and demonstrable flow of water. Streams shall be designated Type 1, Type 2, Type 3 and Type 4 according to the following criteria:

(1) Type 1 Streams are those streams identified as "Shorelines of the State" under Chapter 90.58 RCW or supporting significant anadromous salmonid use, including the Sammamish River. add LBC

(2) Type 2 Streams are those that have perennial (year-round) or intermittent (seasonal) flow and are used by salmonids.

(3) Type 3 Streams are those that have perennial or intermittent flow and are used by fish other than salmonids.

(4) Type 4 Streams are those natural streams with perennial or intermittent flow that are not used by fish.

21.24.360 **Streams: development standards.** A development proposal on a site containing a stream shall meet the following requirements:

(1) The following standard buffers shall be established from the ordinary high water mark or from the top of the bank if the ordinary high water mark cannot be identified:

TABLE A

Stream Type	Standard Buffer Width (feet)	Reduced Buffer Width with Enhancement (feet)
Type 1	150	100
Type 2	115	100
Type 3	75	50
Type 4	50	35

(a) The standard buffer width will be established unless the existing stream buffer is significantly degraded. If the existing stream buffer is significantly degraded, the applicant may use the reduced buffer as referenced in Table A as long as enhancement measures are implemented to provide a net improvement in overall stream and buffer function and value as determined by a qualified biologist. Enhancement measures shall be conducted in accordance with a plan approved by the City.

(b) The City may allow further decreases to buffer widths on streams designated as "urban" in accordance with the recommendations of a qualified professional biologist and the best available science on a case-by-case basis. A reduced buffer must be sufficient to protect stream functions and values based on site-specific characteristics and must include enhancement measures implemented to provide a net improvement in overall stream and buffer function and value. Stream enhancement measures may be required on-site and/or off-site to improve overall stream function. No buffer shall be reduced on a stream designated as "urban" to less than fifty (50) feet wide unless the stream is not used by fish whereas

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the minimum buffer will be thirty five (35) feet. Streams designated as "urban" are those streams, which meet all of the following criteria:

(i) Streams other than Type 1 streams according to the City's classification system;

~~(ii) Little Bear Creek shall be exempt from the Urban Stream classification.~~

(iii)Streams with degraded channel conditions (i.e., presence of piping, sedimentation, channelization, etc.);

(iv) Streams with buffers that are currently degraded or developed: and

(v) Streams within subbasins where restoration opportunities are limited.

(c) Any stream relocated because of a permitted alteration shall have the minimum buffer required for the stream class involved.

(d) The City shall require increased buffer widths in accordance with the recommendations of a qualified professional biologist and the best available science on a case-by-case basis when a larger buffer is necessary to protect stream functions and values based on site-specific characteristics. This determination shall be based on one or more of the following criteria:

(i) A larger buffer is needed to protect other critical areas:

(ii) The buffer or adjacent uplands has a slope greater than thirty percent (30%) or is susceptible to erosion and standard erosion-control measures will not prevent adverse impacts to the stream; and

(e) Any stream adjoined by a riparian wetland or other contiguous sensitive area shall have the buffer required for the stream class involved or the buffer, which applies to the wetland or other sensitive area, whichever is greater.

(2) Buffer width averaging may be allowed by the Planning Director if it will provide additional natural resource protection, as long as the total area contained in the buffer on the development proposal site does not decrease;

(3) The use of hazardous substances, in the stream corridor and its buffer is prohibited; and

(4) The use of pesticides and fertilizers shall be restricted by type and seasonal use under the discretion of the Planning Director.

(5) The livestock restrictions in WMC 21.24.320 shall also apply to Type 1 and 2 streams and their buffers.

21.24.370 **Streams: permitted alterations.** Alterations to streams and buffers may be allowed only as follows:

(1) Alterations may only be permitted if based upon a special study;

(2) Only plants and wildlife indigenous to the Puget Sound area shall be introduced to any stream or buffer unless authorized by a state or federal permit or approval;

(3) Utilities may be allowed in stream buffers if:

(a) No practical alternative location is available;

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(b) The utility corridor meets any additional requirements set forth in administrative rules including, but not limited to, requirements for installation, replacement of vegetation and maintenance;
(c) The requirements for sewer utility corridors in WMC 21.24.320 shall also apply to streams;
(d) Joint use of an approved sewer utility corridor by other utilities may be allowed; and
(e) The utility corridor meets the provisions of Policy U-1.12 of the City's Comprehensive Plan.

(4) The following surface water management activities and facilities may be allowed in stream buffers as follows:
(a) Surface water discharge to a stream from a detention facility, pre-settlement pond or other surface water management activity or facility may be allowed if the discharge is in compliance with the City of Woodinville Surface Water Design Manual;
(b) Stormwater management facilities. Grass lined swales and dispersal trenches may be located in the outer twenty-five percent (25%) of the buffer area. All other surface water management facilities are not allowed within the buffer area;

(5) Public and private trails, or visual access to the stream, is encouraged in stream buffers provided:
(a) The trail surface shall not be made of impervious materials, except that public multi-purpose trails may be made of impervious materials if they meet all other requirements including water quality; and
(b) Buffers shall be expanded, where possible, equal to the width of the trail corridor including disturbed areas;

(6) Stream crossings may be allowed if:
(a) All crossings use bridges or other construction techniques in accordance with Best Management Practices, which do not disturb the stream bed or bank, except that bottomless culverts or other appropriate methods demonstrated to provide fisheries protection may be used for Type 2 or 3 streams if the applicant demonstrates that such methods and their implementation will pose no harm to the stream or inhibit migration of fish;
(b) All crossings are constructed during the summer low flow and are timed to avoid stream disturbance during periods when use is critical to salmonids;
(c) Crossings do not occur over salmonid spawning areas unless the City of Woodinville determines that no other possible crossing site exists;
(d) Bridge piers or abutments are not placed within the FEMA floodway or the ordinary high water mark;
(e) Crossings do not diminish the flood-carrying capacity of the stream;
(f) Underground utility crossings are laterally drilled and located at a depth of four (4) feet below the maximum depth of scour for the base flood predicted by a civil engineer licensed by the State of Washington; and
(g) Crossings are minimized and serve multiple purposes and properties whenever possible;

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(7) Stream relocations may be allowed for:
(a) All stream types as part of a public road project for which a public agency and utility exception is granted pursuant to WMC 21.24.050; and
(b) Type 3 or 4 streams for the purpose of enhancing resources in the stream if:
(i) Appropriate floodplain protection measures are used; and
(ii) The relocation occurs on the site, except that relocation off the site may be allowed if the applicant demonstrates that any on-site relocation is impracticable, the applicant provides all necessary easements and waivers from affected property owners and the off-site location is in the same drainage sub-basin as the original stream;
(c) Rolocations are constructed during the summer low flow and are timed to avoid stream disturbance during periods when use is critical to salmonids.

(8) For any relocation allowed by this section, the applicant shall demonstrate, based on information provided by a civil engineer and a qualified biologist, that:
(a) The equivalent base flood storage volume and function will be maintained;
(b) There will be no adverse impact to local groundwater;
(c) There will be no increase in velocity;
(d) There will be no increase in transfer of water;
(e) There will be no increase in the sediment load;
(f) Requirements set out in the mitigation plan are met;
(g) The relocation conforms to other applicable laws; and
(h) All work will be carried out under the direct supervision of a qualified biologist;

(9)A stream channel may be stabilized if:
(a) Movement of the stream channel threatens existing residential or commercial structures, public facilities or improvements, unique natural resources or the only existing access to property; and
(b) The stabilization is done in compliance with the requirements of WMC 21.24.220 - 21.24.260 and administrative rules promulgated pursuant to this chapter;

(10)Stream enhancement not associated with any other development proposal may be allowed if accomplished according to a plan for its design, implementation, maintenance and monitoring prepared by a civil engineer and a qualified biologist and carried out under the direct supervision of a qualified biologist pursuant to provisions contained in administrative rules;

(11)A minor stream restoration project for fish habitat enhancement may be allowed if:
(a) The restoration is accomplished by a public agency with a mandate to do such work;
(b) The restoration is unassociated with mitigation of a specific development proposal;

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(c) The restoration is limited to placement of rock weirs, log controls, spawning gravel, culvert replacement and other specific salmonid habitat improvements;
(d) The restoration only involves the use of hand labor and light equipment; and
(e) The restoration is performed under the direct supervision of a qualified biologist;

21.24.380 Streams: mitigation requirements.

(1) Restoration or mitigation shall be required as part of a development proposal whereby impacts, either direct or indirect, to the stream occur. Restoration shall also be required when a stream or its buffer is altered in violation of law or without any specific permission or approval by the Planning Director. A mitigation plan for the restoration or mitigation shall demonstrate that:
(a) The stream has been degraded and will not be further degraded by the restoration or mitigation activity;
(b) The restoration or mitigation will reliably and demonstrably improve the water quality and fish and wildlife habitat of the stream;
(c) The restoration or mitigation will have no lasting significant adverse impact on any stream functions; and
(d) The restoration or mitigation will assist in stabilizing the stream channel.

(2) The following minimum requirements shall be met for the restoration or mitigation of impacts to a stream or its buffer:
(a) All work shall be carried out under the direct supervision of a qualified biologist;
(b) Basin analysis shall be performed to determine hydrologic conditions;
(c) The natural channel dimensions shall be replicated including its depth, width, length and gradient at the original location, and the original horizontal alignment (meander lengths) shall be replaced;
(d) The bottom shall be restored with identical or similar materials;
(e) The bank and buffer configuration shall be restored to its original condition;
(f) The channel, bank and buffer areas shall be replanted with native vegetation which replicates the original vegetation in species, sizes and densities; and
(g) The pre-existing biologic functions of the stream shall be recreated.
(h) Mitigation projects shall be monitored and maintained for a period of five (5) years. A monitoring protocol shall be approved by the City and monitoring reports shall be submitted to the City as required.

(3) The requirements in subsection (2) may be modified if the applicant demonstrates to the satisfaction of the Planning Director that a greater biologic function can otherwise be obtained;

(4) Replacement or enhancement shall be required when a stream or buffer is altered pursuant to an approved development proposal. There shall be no net

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loss of stream functions on a development proposal site and no impact on stream functions above or below the site due to approved alterations.

(5) The requirements, which apply, to the restoration of streams in subsection (2). shall also apply to the relocation of streams, unless the applicant demonstrates to the satisfaction of the Planning Director that a greater biologic function can be obtained by modifying these requirements.

(6) Replacement or enhancement for approved stream or buffer alterations shall be accomplished in streams and on the site unless the applicant demonstrates to the satisfaction of the Planning Director that:

(a) Enhancement or replacement on the site is not possible;

(b) The off-site location is in the same drainage sub-basin as the original stream; and

(c) Greater biologic and hydrologic functions will be achieved.

(7) Surface water management or flood control alterations shall not be considered enhancement unless other functions are simultaneously improved.

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21.24.310 **Wetlands: designation and ranking.** Wetlands are those areas designated in accordance with the *Washington State Wetland Identification and Delineation Manual* (1977), that are inundated or saturated by surface or ground water at a frequency and duration to support, and that under normal circumstances do support, a prevalence of vegetation adapted for life in saturated soil conditions. The goal of the City of Woodinville is to maintain a standard of no net loss in the functions and values of wetlands.

(1) Wetland rating. Wetlands shall be rated similarly to the Department of Ecology wetland rating system found in the Washington State Wetland Rating System document, Western Washington, *Ecology Publication #93-74.* latest ?

(2) Wetland rating categories. Wetlands shall be designated as Class 1, Class 2, and Class 3 according to the criteria in this Section.

(a) Class 1 Wetlands are those wetlands that meet any of the following criteria:

i. Documented habitat for federal or state listed endangered or threatened fish, animal, or plant species: or

ii. Wetlands documented as high quality habitats in the natural Heritage Information System; or

iii. Wetlands of exceptional local significance or irreplaceable ecological functions, including spagnum bogs and fens or natural forest swamps: or

iv. Wetlands proximal to and influenced by the mainstem of the Sammamish River or Little Bear Creek.

(b) Class 2 Wetlands are those wetlands not rated as Class 1 wetlands and meet any of the following criteria:

i. Wetlands that have significant functions that may not be adequately replicated through creation of restoration; or

ii. Wetlands of any size associated with Type 2 or 3 streams; or

iii. Wetlands greater than one (1) acre in size; or

iii. Wetlands equal to or less than one (1) acre having three (3) or more classes of wetland vegetation (as defined in Classification of Wetlands and Deepwater Habitats of the United States (Cowardin, et al. 1979)); or

iv. Wetlands equal to or less than one (1) acre having a forested wetland class or open water habitat.

(c) Class 3 Wetlands are those wetlands not rated as Class 1 or 2 Wetlands.

21.24.320 **Wetlands: development standards.** A development proposal on a site containing a wetland shall meet the following requirements:

(1) The following standard minimum buffers shall be established from the wetland edge:

(a) A class 1 wetland shall have a 150-foot buffer with a 50 ft. reduction with enhancement

(b) A class 2 wetland shall have a 100-foot buffer with a 50 foot reduction with enhancement.

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(c) A class 3 wetland shall have a fifty (50)-foot buffer with a 25 foot buffer reduction with enhancement.

(d) The standard buffer width will be established unless the existing wetland buffer is significantly degraded. If the existing wetland buffer is significantly degraded, the applicant may use a reduced buffer as long as enhancement measures are implemented to provide a net improvement in overall wetland and buffer function and value as determined by a qualified biologist. Enhancement measures shall be conducted in accordance with a plan approved by the City.

(e) Any wetland restored, relocated, replaced or enhanced because of a wetland alteration shall have the minimum buffer required for the highest wetland class involved

(f) Wetland buffers shall be measured from the wetland edge as delineated and marked in the field using the 1997 Washington State Wetland Identification and Delineation Manual (Ecology).

(g) The City shall require increased buffer widths in accordance with a qualified biologist and the best available science on a case-by-case basis when a larger buffer is necessary to protect wetland functions and values based on site-specific characteristics. This determination shall be based on one or more of the following criteria:

i. A larger buffer is needed to protect other critical areas;

ii. The buffer or adjacent uplands has a slope greater than thirty percent (30%) or is susceptible to erosion and standard erosion-control measures will not prevent adverse impacts to the wetland.

(2) Buffer width averaging may be allowed by the City in accordance with an approved critical area report and the best available science on a case-by case basis. Averaging of buffer widths may only be allowed where a qualified professional biologist demonstrates that:

(a) Additional protection to the wetland will be provided through implementation of a buffer enhancement plan:

(b) It will not reduce wetland functions or values;

(c) The wetland contains variations in sensitivity due to existing physical characteristics or the character of the buffer varies in slope, soils, or vegetation, and the wetland would benefit from a wider buffer in places and would not be adversely impacted by a narrower buffer in other places;

(d) The total area contained in the buffer area after averaging is no less than that which would be contained within the standard buffer; and

(e) The buffer width is not reduced by more than twenty percent (20 %) of the standard width or fifty (50) feet, whichever is greater.

Note: Buffer averaging is allowed as an alternative to this method. Only one method shall be implemented.

(3) The use of hazardous substances, pesticides and fertilizers in the wetland and its buffer may be prohibited by the Planning Director;

(4) Unless otherwise provided, the following restrictions shall apply to all development proposals, which include the introduction of livestock:

(a) To prevent damage to class 1 and 2 wetlands:

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i. A plan to protect and enhance the wetland's water quality shall be implemented pursuant to WMC 21.30; or

ii. Fencing located at the buffer edge shall be required; and

(b) Standards pertaining to access to streams for watering purposes, stream crossing requirements and use of natural barriers and vegetative buffering in lieu of fencing shall be included in administrative rules promulgated pursuant to this chapter; and

(5) The livestock restrictions contained in subsection (4) shall not apply to wetlands defined as grazed wet meadows, regardless of their classification.

21.24.330 **Wetlands: permitted alterations.** Alterations to wetlands and buffers may be allowed only as follows:

(1) Alterations may be permitted if the Planning Director determines, based upon its review of special studies completed by qualified professionals, that:

(a) The wetland does not serve any of the valuable functions of wetlands identified in WMC 21.06.710 including, but not limited to, biologic and hydrologic functions; or

(b) The proposed development will protect or enhance the wildlife habitat, natural drainage or other valuable functions of the wetland and will be consistent with the purposes of this chapter;

(2) To establish the conditions in subsection (1), detailed studies may be required as part of the special study on habitat value, hydrology, erosion and deposition and/or water quality. Such detailed studies shall include specific recommendations for mitigation, which may be required as a condition of any development proposal approval. The recommendations may include, but are not limited to, construction techniques or design, drainage or density specifications;

(3) There shall be no introduction of any plant or wildlife, which is not indigenous to the Puget Sound Region into any wetland or buffer unless authorized by a state or federal permit or approval;

(4) Utilities may be allowed in wetland buffers if:

(a) The City of Woodinville determines that no practical alternative location is available;

(b) The utility corridor meets any additional requirements set forth in administrative rules including, but not limited to, requirements for installation, replacement of vegetation and maintenance; and

(c) The utility corridor meets the provisions of Policy U-1.12 of the City's Comprehensive Plan.

(5) Sewer utility corridors may be allowed in wetland buffers only if:

(a) The applicant demonstrates that sewer lines are necessary for gravity flow;

(b) The corridor is not located in a wetland or buffer used by species listed as endangered or threatened by the state or federal government or containing critical or outstanding actual habitat for those species or heron rookeries or raptor nesting trees;

(c) The corridor alignment including, but not limited to, any allowed maintenance roads follows a path beyond a distance equal to seventy-five (75) percent of the buffer width from the wetland edge;

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(d) Corridor construction and maintenance protects the wetland and buffer and is aligned to avoid cutting trees greater than twelve (12) inches in diameter at breast height, when possible, and pesticides, herbicides and other hazardous substances are not used;

(e) An additional, contiguous and undisturbed buffer, equal in width to the proposed corridor including any allowed maintenance roads, is provided to protect the wetland;

(f) The corridor is revegetated with appropriate native vegetation at pre-construction densities or greater immediately upon completion of construction or as soon thereafter as possible, and the sewer utility ensures that such vegetation survives;

(g) Any additional corridor access for maintenance is provided, to the extent possible, at specific points rather than by a parallel road;

(h) The width of any necessary parallel road providing access for maintenance is as small as possible, but not greater than fifteen (15) feet, the road is maintained without the use of herbicides, pesticides or other hazardous substances and the location of the road is contiguous to the utility corridor on the side away from the wetland; and

(i) The utility corridor meets the provisions of Policy U-1.12 of the City's Comprehensive Plan.

(6) Joint use of an approved sewer utility corridor by other utilities may be allowed.

(7) The following surface water management activities and facilities may be allowed in wetland buffers only as follows:

(a) Surface water discharge to a wetland from a detention facility, pre-settlement pond or other surface water management activity or facility may be allowed if the discharge does not increase the rate of flow, change the plant composition in a forested wetland or decrease the water quality of the wetland;

(b) A class 1 or 2 wetland or buffer may be used for a retention/detention facility if:

i. A public agency and utility exception is granted pursuant to WMC 21.24.070;

ii. All requirements of the King County Surface Water Design Manual are met;

iii. The use will not alter the rating or the factors used in rating the wetland;

iv. The proposal is in compliance with the latest adopted findings of the Puget Sound Wetlands Research Project; and

v. There are no significant adverse impacts to the wetland;

(c) A class 3 wetland or buffer which has as its major function the storage of water may be used as a retention/detention facility if a pre-settlement pond is required and all requirements of the King County Surface Water Design Manual are met; and

(d) Use of a wetland buffer for a surface water management activity or facility, other than a retention/detention facility, such as an energy

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dissipater and associated pipes, may be allowed only if the applicant demonstrates, to the satisfaction of the City of Woodinville, that:

i. No practicable alternative exists; and

ii. The functions of the buffer or the wetland are not adversely affected;

(8) Public and private trails, or visual access to the sensitive area, are encouraged in wetland buffers provided:

(a) The trail surface shall not be made of impervious materials, except that public multi-purpose trails may be made of impervious materials if they meet all other requirements including water quality; and

(b) Buffers shall be expanded, where possible, equal to the width of the trail corridor including disturbed areas.

(9) Wetland road crossings may be allowed if:

(a) The City of Woodinville determines that no alternative access is practical;

(b) All crossings minimize impact to the wetland and provide mitigation for unavoidable impacts through restoration, enhancement or replacement of disturbed areas;

(c) Crossings do not change the overall wetland hydrology;

(d) Crossings do not diminish the flood storage capacity of the wetland; and

(e) All crossings are constructed during summer low water periods.

21.24.340 Wetlands: mitigation requirements.

(1) **Mitigation shall achieve equivalent or greater biological functions.** Mitigation for alterations to wetlands shall achieve equivalent or greater biologic functions. Mitigation plans shall be consistent with the Department of Ecology *Guidelines for Developing Freshwater Wetlands Mitigation Plans and Proposals*, 1994, as revised.

(2) **Mitigation for lost functions and values.** Mitigation actions shall address functions affected by the alteration to achieve functional equivalency or improvement, and shall provide similar wetland functions as those lost except when:

(a) The lost wetland provides minimal functions as determined by a site-specific function assessment and the proposed mitigation action(s) will provide equal or greater functions or will provide functions shown to be limiting within a watershed through a formal watershed assessment plan or protocol; or

(b) Out-of-kind replacement will best meet formally identified regional goals, such as replacement of historically diminished wetland types.

(3) **Preference of mitigation actions.** Mitigation actions that require compensation by replacing, enhancing, or substitution, shall occur in the following order of preference:

(a) Restoring wetlands on upland sites that were formerly wetlands.

(b) Enhancing significantly degraded wetlands.

(c) Preserving high-quality wetlands that are under imminent threat.

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(4) **Type and location of mitigation.** Mitigation actions shall be conducted within the same sub-drainage basin and on the site as the alteration except when the all of the following apply:

(a) There are no reasonable on-site or in subdrainage basin opportunities or on-site and in subdrainage basin opportunities do not have a high likelihood of success due to development pressures, adjacent land uses, or on-site buffers or connectivity are inadequate;

(b) Off-site mitigation has a greater likelihood of providing equal or improved wetland functions than the impacted wetland; and

(c) Off-site locations shall be in the same sub-drainage basin and the same Water Resource Inventory Area (WRIA) unless established regional or watershed goals for water quality, flood or conveyance, habitat or other wetland functions have been established and strongly justify location of mitigation at another site.

(5) **Mitigation timing.** Where feasible, mitigation projects shall be completed prior to activities that will disturb wetlands. In all other cases, mitigation shall be completed immediately following disturbance and prior to use or occupancy of the activity or development. Construction of mitigation projects shall be timed to reduce impacts to existing wildlife and flora.

(6) **Mitigation monitoring and maintenance.** Mitigation projects shall be monitored and maintained for a period of five (5) years. A monitoring protocol shall be approved by the City and monitoring reports shall be submitted to the City as required.

(7) **Mitigation ratios**

(a) **Acreage replacement ratios.** The following ratios shall apply to creation or restoration that is in-kind, on-site, the same category, timed prior to or concurrent with alteration, and has a high probability of success. These ratios do not apply to remedial actions resulting from unauthorized alterations; greater ratios shall apply in those cases. These ratios do not apply to the use of credits from a state certified wetland mitigation bank. When credits from a certified bank are used, replacement ratios should be consistent with the requirements of the bank's certification. The first number specifies the acreage of replacement wetlands and the second specifies the acreage of wetlands altered.

Class I	4 to 1
Class II	2 to 1
Class III	1.5 to 1

(b) **Increased replacement ratio.** The City may increase the ratios under the following circumstances:

i. Uncertainty exists as to the probable success of the proposed restoration or creation; or

ii. A significant period of time will elapse between impact and replication of wetland functions; or

iii. Proposed mitigation will result in a lower category wetland or reduced functions relative to the wetland being impacted; or

iv. The impact was an unauthorized impact.

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(c) **Wetland mitigation banks**

i. Credits from a wetland mitigation bank may be approved for use as compensation for unavoidable impacts to wetlands when:

1. The bank is certified under Chapter 173-700 WAC;
2. The City determines that the wetland mitigation bank provides appropriate compensation for the authorized impacts; and
3. The proposed use of credits is consistent with the terms and conditions of the bank's certification.

(d) Replacement ratios for projects using bank credits shall be consistent with replacement ratios specified in the bank's certification.

21.24.340 Wetlands: limited exemption. Class 3 wetlands less than 1,000 square feet may be exempted from the provisions of WMC 21.24.310 to 21.24.330 and may be altered by filling or dredging if the City of Woodinville determines that the cumulative impacts do not unduly counteract the purposes of this chapter and are mitigated pursuant to an approved mitigation plan.

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21.24.350 **Streams: designation and rating.** Streams are waterbodies with a defined bed and banks and demonstrable flow of water. Streams shall be designated Type 1, Type 2, Type 3 and Type 4 according to the following criteria:

(1) Type 1 Streams are those streams identified as "Shorelines of the State" under Chapter 90.58 RCW or supporting significant anadromous salmonid use, including the Sammamish River and Little Bear Creek.

(2) Type 2 Streams are those that have perennial (year-round) or intermittent (seasonal) flow and are used by salmonids.

(3) Type 3 Streams are those that have perennial or intermittent flow and are used by fish other than salmonids.

(4) Type 4 Streams are those natural streams with perennial or intermittent flow that are not used by fish.

21.24.360 **Streams: development standards.** A development proposal on a site containing a stream shall meet the following requirements:

(1) The following standard~~minimum~~ buffers shall be established from the ordinary high water mark or from the top of the bank if the ordinary high water mark cannot be identified:

Stream Type	Standard Buffer Width (feet)	Reduced Buffer Width with Enhancement (feet)
Type 1	150	115
Type 2	115	100
Type 3	75	50
Type 4	50	35

~~(a) A class 1 stream shall have a 100-foot buffer;~~

~~(b) A class 2 stream used by salmonids shall have a 100-foot buffer;~~

~~(c) A class 2 stream shall have a fifty (50) foot buffer;~~

~~(d) A class 3 stream shall have a twenty-five (25) foot buffer;~~

(a) The standard buffer width will be established unless the existing stream buffer is significantly degraded. If the existing stream buffer is significantly degraded, the applicant may use a reduced buffer as long as enhancement measures are implemented to provide a net improvement in overall stream and buffer function and value as determined by a qualified biologist. Enhancement measures shall be conducted in accordance with a plan approved by the City.

(b~~e~~)The City may allow further decreases to buffer widths on streams designated as "urban" in accordance with the recommendations of a qualified professional biologist and the best available science on a case-by-case basis. A reduced buffer must be sufficient to protect stream functions and values based on site-specific characteristics and must include enhancement measures implemented to provide a net improvement in overall stream and buffer function and value. Stream enhancement

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measures may be required on-site and/or off-site to improve overall stream function. ~~No~~ No buffer shall be reduced on ~~an urban~~ stream designated as "urban" to less than fifty (50) feet wide unless the stream is not used by fish whereas the minimum buffer will be thirty five (35) feet. Streams designated as "urban" are those streams-, which meet all of the following criteria:

(i) Streams other than Type 1 streams according to the City's classification system;

(ii) Streams with degraded channel conditions (i.e., presence of piping, sedimentation, channelization, etc.);

(iii) Streams with buffers that are currently degraded or developed: and

(iv) Streams within subbasins where restoration opportunities are limited.

(c) Any stream relocated because of a permitted alteration shall have the minimum buffer required for the stream class involved.

(d) The City shall require increased buffer widths in accordance with the recommendations of a qualified professional biologist and the best available science on a case-by-case basis when a larger buffer is necessary to protect stream functions and values based on site-specific characteristics. This determination shall be based on one or more of the following criteria:

(i) A larger buffer is needed to protect other critical areas:

(ii) The buffer or adjacent uplands has a slope greater than thirty percent (30%) or is susceptible to erosion and standard erosion-control measures will not prevent adverse impacts to the stream; and

~~(f) Any stream with an ordinary high water mark within twenty five (25) feet of the toe of a slope thirty (30) percent or steeper, but less than forty (40) percent, shall have:~~

~~(i) The minimum buffer required for the stream class involved or a twenty five (25) foot buffer beyond the top of the slope, whichever is greater, if the horizontal length of the slope including small benches and terraces is within the buffer for that stream class; or~~

~~(ii) A twenty five (25) foot buffer beyond the minimum buffer required for the stream class involved if the horizontal length of the slope including small benches and terraces extends beyond the buffer for that stream class; and~~

(~~g~~e) Any stream adjoined by a riparian wetland or other contiguous sensitive area shall have the buffer required for the stream class involved or the buffer, which applies to the wetland or other sensitive area, whichever is greater.~~;~~

~~(2) Buffer width averaging may be allowed by the Planning Director if it will provide additional natural resource protection, as long as the total area contained in the buffer on the development proposal site does not decrease;~~

~~(3) Increased buffer widths shall be required by the Planning Director when necessary to protect streams. Provisions for additional buffer widths shall be contained in administrative rules promulgated pursuant to this chapter~~

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~~including, but not limited to, critical drainage areas, location of hazardous substances, critical fish and wildlife habitat, landslide or erosion hazard areas contiguous to streams, groundwater recharge and discharge and the location of trail or utility corridors;~~

(~~4~~2) The use of hazardous substances, pesticides and fertilizers in the stream corridor and its buffer may be prohibited by the Planning Director; and

(~~5~~3) The livestock restrictions in WMC 21.24.32~~1~~0 shall also apply to Type~~class~~ 1 and 2 streams and their buffers.

21.24.37~~6~~0 Streams: permitted alterations. Alterations to streams and buffers may be allowed only as follows:

(1) Alterations may only be permitted if based upon a special study;

~~(2) The applicant shall notify affected communities and native tribes of proposed alterations prior to any alteration if a stream is in a flood hazard area and shall submit evidence of such notification to the Federal Insurance Administration;~~

(2~~3~~) There shall be no introduction of any plant or wildlife, which is not indigenous to the Puget Sound Region into any stream or buffer unless authorized by a state or federal permit or approval;

(3~~4~~) Utilities may be allowed in stream buffers if:

(a) No practical alternative location is available;

(b) The utility corridor meets any additional requirements set forth in administrative rules including, but not limited to, requirements for installation, replacement of vegetation and maintenance;

(c) The requirements for sewer utility corridors in WMC 21.24.320 shall also apply to streams;

(d) Joint use of an approved sewer utility corridor by other utilities may be allowed; and

(e) The utility corridor meets the provisions of Policy U-1.12 of the City's Comprehensive Plan.

(4~~5~~) The following surface water management activities and facilities may be allowed in stream buffers as follows:

(a) Surface water discharge to a stream from a detention facility, pre-settlement pond or other surface water management activity or facility may be allowed if the discharge is in compliance with the City of Woodinville~~King County~~ Surface Water Design Manual;

(b) Stormwater management facilities. Grass lined swales and dispersal trenches may be located in the outer twenty-five percent (25%) of the buffer area. All other surface water management facilities are not allowed within the buffer area;

~~Class 1 and Class 2 streams or buffer may be used for a retention/detention facility if:~~

~~(i) A public agency and utility exception is granted pursuant to WMC 21.24.070;~~

~~(ii) All requirements of the King County Surface Water Design Manual are met;~~

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~~(iii)The use will not alter the rating or the factors used in rating the stream; and~~

~~(iv)There are no significant adverse impacts to the stream.~~

~~(c) A class 3 stream or buffer may be used as a retention/detention facility if the alteration will have no lasting adverse impact on any stream and all requirements of the King County Surface Water Design Manual are met;~~

(5~~6~~) Public and private trails, or visual access to the stream, is encouraged in stream buffers provided:

(a) The trail surface shall not be made of impervious materials, except that public multi-purpose trails may be made of impervious materials if they meet all other requirements including water quality; and

(b) Buffers shall be expanded, where possible, equal to the width of the trail corridor including disturbed areas;

(~~7~~6) Stream crossings may be allowed if:

(a) All crossings use bridges or other construction techniques which do not disturb the stream bed or bank, except that bottomless culverts or other appropriate methods demonstrated to provide fisheries protection may be used for Type~~class~~ 2 or 3 streams if the applicant demonstrates that such methods and their implementation will pose no harm to the stream or inhibit migration of fish;

(b) All crossings are constructed during the summer low flow and are timed to avoid stream disturbance during periods when use is critical to salmonids;

(c) Crossings do not occur over salmonid spawning areas unless the City of Woodinville determines that no other possible crossing site exists;

(d) Bridge piers or abutments are not placed within the FEMA floodway or the ordinary high water mark;

(e) Crossings do not diminish the flood-carrying capacity of the stream;

(f) Underground utility crossings are laterally drilled and located at a depth of four (4) feet below the maximum depth of scour for the base flood predicted by a civil engineer licensed by the State of Washington; and

(g) Crossings are minimized and serve multiple purposes and properties whenever possible;

(~~8~~7) Stream relocations may be allowed only for:

(a) All stream types~~Class 2 streams~~ as part of a public road project for which a public agency and utility exception is granted pursuant to WMC 21.24.050; and

(b) Type~~Class~~ 3 or 4 streams for the purpose of enhancing resources in the stream if:

(i) Appropriate floodplain protection measures are used; and

(ii) The relocation occurs on the site, except that relocation off the site may be allowed if the applicant demonstrates that any on-site relocation is impracticable, the applicant provides all necessary easements and waivers from affected property owners and the off-site location is in the same drainage sub-basin as the original stream;

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(~~9~~8) For any relocation allowed by this section, the applicant shall demonstrate, based on information provided by a civil engineer and a qualified biologist, that:

(a) The equivalent base flood storage volume and function will be maintained;
(b) There will be no adverse impact to local groundwater;
(c) There will be no increase in velocity;
(d) There will be no increase in transfer of water;
(e) There will be no increase in the sediment load;
(f) Requirements set out in the mitigation plan are met;
(g) The relocation conforms to other applicable laws; and
(h) All work will be carried out under the direct supervision of a qualified biologist;

(9~~10~~)A stream channel may be stabilized if:

(a) Movement of the stream channel threatens existing residential or commercial structures, public facilities or improvements, unique natural resources or the only existing access to property; and
(b) The stabilization is done in compliance with the requirements of WMC 21.24.220 - 21.24.260 and administrative rules promulgated pursuant to this chapter;

(10~~11~~)Stream enhancement not associated with any other development proposal may be allowed if accomplished according to a plan for its design, implementation, maintenance and monitoring prepared by a civil engineer and a qualified biologist and carried out under the direct supervision of a qualified biologist pursuant to provisions contained in administrative rules;

(11~~12~~)A minor stream restoration project for fish habitat enhancement may be allowed if:

(a) The restoration is accomplished by a public agency with a mandate to do such work;
(b) The restoration is unassociated with mitigation of a specific development proposal;
~~(c) The restoration does not cost more than $25,000;~~
(~~d~~c) The restoration is limited to placement of rock weirs, log controls, spawning gravel, culvert replacement and other specific salmonid habitat improvements;
(~~e~~d) The restoration only involves the use of hand labor and light equipment; and
(~~f~~e)The restoration is performed under the direct supervision of a qualified biologist;

~~(12~~13)~~Roadside and agricultural drainage ditches which carry streams with salmonids may be maintained through use of best management practices developed in consultation with relevant city, county, state and federal agencies. These practices shall be adopted as administrative rules; and~~

~~(14)Subject to the Planning Director's approval, the cutting of up to one cord of firewood may be permitted in buffers of five acres or larger in any year if the overall function of the buffer is not adversely affected. Removal of brush may~~

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~~also be permitted for the purpose of enhancing tree growth if the area of removal is limited to the diameter of the tree canopy at the time of planting.~~

21.24.38~~70~~ Streams: mitigation requirements.

(1) Restoration shall be required when a stream or its buffer is altered in violation of law or without any specific permission or approval by the Planning Director. Restoration or mitigation shall also be required as part of a development proposal whereby impacts, either direct or indirect, to the stream result. A mitigation plan for the restoration or mitigation shall demonstrate that:

(a) The stream has been degraded and will not be further degraded by the restoration or mitigation activity;

(b) The restoration or mitigation will reliably and demonstrably improve the water quality and fish and wildlife habitat of the stream;

(c) The restoration or mitigation will have no lasting significant adverse impact on any stream functions; and

(d) The restoration or mitigation will assist in stabilizing the stream channel.

(2) The following minimum requirements shall be met for the restoration or mitigation of impacts to ~~of~~ a stream or its buffer:

(a) All work shall be carried out under the direct supervision of a qualified biologist;

(b) Basin analysis shall be performed to determine hydrologic conditions;

(c) The natural channel dimensions shall be replicated including its depth, width, length and gradient at the original location, and the original horizontal alignment (meander lengths) shall be replaced;

(d) The bottom shall be restored with identical or similar materials;

(e) The bank and buffer configuration shall be restored to its original condition;

(f) The channel, bank and buffer areas shall be replanted with native vegetation which replicates the original vegetation in species, sizes and densities; and

(g) The pre-existing~~original~~ biologic functions of the stream shall be recreated.

(h) Mitigation projects shall be monitored and maintained for a period of five (5) years. A monitoring protocol shall be approved by the City and monitoring reports shall be submitted to the City as required.

(3) The requirements in subsection (2) may be modified if the applicant demonstrates to the satisfaction of the Planning Director that a greater biologic function can otherwise be obtained;

(4) Replacement or enhancement shall be required when a stream or buffer is altered pursuant to an approved development proposal. There shall be no net loss of stream functions on a development proposal site and no impact on stream functions above or below the site due to approved alterations.

(5) The requirements, which apply, to the restoration of streams in subsection (2). shall also apply to the relocation of streams, unless the applicant demonstrates

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to the satisfaction of the Planning Director that a greater biologic function can be obtained by modifying these requirements.

(6) Replacement or enhancement for approved stream or buffer alterations shall be accomplished in streams and on the site unless the applicant demonstrates to the satisfaction of the Planning Director that:

(a) Enhancement or replacement on the site is not possible;

(b) The off-site location is in the same drainage sub-basin as the original stream; and

(c) Greater biologic and hydrologic functions will be achieved.

(7) Surface water management or flood control alterations shall not be considered enhancement unless other functions are simultaneously improved.

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LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT

Woodinville, Washington

Prepared for:

THE CITY OF WOODINVILLE
17301 133rd Avenue NE
Woodinville, Washington 98072-8534

WOOD0000-0010

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July 2002

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EXECUTIVE SUMMARY

The City of Woodinville is bisected by several creeks, the largest of which is Little Bear Creek. Little Bear Creek is recognized as an important salmon-bearing stream within the Lake Washington – Cedar – Sammamish Basin (Water Resource Inventory Area 8). With the listing of chinook salmon as a threatened species under the Endangered Species Act (ESA), numerous cities, including the City of Woodinville, have undergone stream inventories to document existing habitat conditions in streams within their jurisdiction. The City of Woodinville contracted with David Evans and Associates, Inc. (DEA) to prepare this Little Bear Creek Corridor Habitat Assessment. The project goals were to document existing fish and wildlife habitat conditions and utilization, and identify potential restoration opportunities along Little Bear Creek within the City of Woodinville. This assessment provides a detailed analysis of stream and riparian habitat conditions, fish and wildlife utilization, and includes data that assisted in the determination of limiting factors as they relate to ESA listed salmon.

Because of project specific goals, and a desire to have the results comparable to other on-going stream inventory efforts, DEA utilized the *Inventory Methods for Wadable Streams in King County* (King County, 2001a) as the primary methodology. Both the King County 1991 (Appendix B) and 2001a (Appendix C) protocols are based on the methods defined in the *USDA Forest Service Stream Habitat Classification and Inventory Procedures for Northern California* (McCain et al., 1990) as modified by King County staff. Additional data as outlined in the United States Forest Service (USFS) – *Stream Inventory Handbook for Region 6, Version 2.1* (USFS, 2001) was included.

Existing stream and watershed conditions were quantified by using watershed and habitat parameters as defined by the "Matrix of Pathways and Indicators" developed by the National Marine Fisheries Service (NMFS) (Table S-1). The "Matrix of Pathways and Indicators" summarizes important parameters for six major pathways that are vital for the continued survival of salmon including:

- Water Quality;
- Habitat Access;
- Habitat Elements;
- Channel Condition and Dynamics;
- Flow/Hydrology; and
- Watershed Conditions.

These six major pathways are further broken down into a total of 18 "indicators." As an example, the water quality pathway is composed of three indicators: temperature, sediment/turbidity, and chemical contamination/nutrients. Scientifically sound data was collected during this assessment to accurately assign the appropriate "condition" to each indicator as defined by the NMFS. The indicator conditions are classified as either: "properly functioning," "at risk," or "not properly functioning." Criteria for each condition is defined by a range or goal based on the best available scientific data available, but criteria are not absolute, and may be adjusted for unique watersheds (NMFS, 1996). Within this report, definitions and determinations of an indicators status are distinguishable by font. Definitions are italicized and determinations are in bold font. Existing conditions were documented to a level of detail that would allow for future trend analysis. Should

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the criteria for the Matrix of Pathways and Indicators change, an appropriate condition for each indicator could be assigned based on the results presented in this report.

This report has also consolidated numerous supporting references such as salmon spawning survey data from the Washington Department of Fish and Wildlife (WDFW), and presents all the raw data for ease of record keeping and as an aid to future researchers. Furthermore, opportunities for restoration have been listed and prioritized based on the findings present within this report.

Little Bear Creek is currently utilized by at least nine species of fish including resident, adfluvial, and anadromous species. Resident fish spend their entire life in a specific stream. Adfluvial fish spawn and sometimes rear in a stream, but migrate to a lake to mature before returning to a stream to spawn. Anadromous fish spawn and rear in freshwater, but reach maturity at sea prior to returning to freshwater to start the process over again. Resident species documented in Little Bear Creek include coast range sculpins (*Cottus aleuticus*), western brook lampreys (*Lampretra richardsoni*), and cutthroat trout (*Oncorhynchus clarki*). Cutthroat trout are somewhat unique in that resident, adfluvial, and anadromous forms may utilize the same stream depending upon watershed conditions, life history type, and access to the ocean. Species that utilize the adfluvial life history include cutthroat trout and kokanee salmon (*O. nerka* [freshwater sockeye]). Anadromous species documented in Little Bear Creek include chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), and sockeye salmon (*O. nerka*). Some species such as pink (*O. gorbuscha*) and chum (*O. keta*) salmon have rarely been observed in Little Bear Creek. However, due to their scarcity, they are not part of an established population, rather, they are strays from another watershed. Undocumented species such as steelhead trout (*O. mykiss*) could potentially utilize Little Bear Creek.

The results of this assessment indicate that Little Bear Creek is very similar to most urbanized Puget Sound lowland streams in that it has been severely impacted by past and current land-use activities. The percentage of total impervious surface has increased to about 37 percent and road density to 5.9 kilometers per square kilometer (km/km^2) (2.28 mi/mi^2) in the past 12 years (Purser and Simmonds, Snohomish County Surface Water Management, unpublished data as reported by Kerwin, 2001). Out of the 18 indicators examined, one was found to be partially **properly functioning** (temperature). Three were found to range from **not properly functioning** to **at risk** (varied by reach), three were **at risk**, while the remaining 11 were **not properly functioning**. The results are summarized below.

Although the existing habitat conditions reflect those frequently associated with an urbanized basin, Little Bear Creek is still an important salmon-bearing stream. Little Bear Creek possess numerous opportunities for enhancement and restoration that could significantly improve conditions for salmonids. The City of Woodinville is currently undertaking several stream restoration projects along the Little Bear Creek Corridor. Appendix R outlines current habitat enhancement projects along the corridor.

Little Bear Creek was segmented into three reaches based on land use and permanent landmarks. Reach 1 is defined as extending from the mouth to the SR 202 culvert crossing. Reach 2 is defined as extending from the SR 202 culvert crossing to the SR 522 culvert crossing. Reach 3 is defined as extending from the SR 522 culvert crossing to the NE 205th Street culvert crossing.

The majority of Reach 1 is developed up to the banks. The banks are armored with riprap and there are signs of localized erosion. This riprap should be removed. It is recommended that the banks be restored and stabilized using bioengineering methods. Improvements to the mouth such as the installation of large woody debris and create scour pools would also improve existing habitat conditions.

The amount of bank armoring (riprap) in Reach 2 is significantly less than in Reach 1. However, there are opportunities for riprap removal, and bank restoration and stabilization using bioengineering methods. There are areas of riparian habitat between Little Bear Creek and SR 522 that are candidates for acquisition. Connectivity between these areas and Little Bear Creek could be improved. In this reach there are culverted outfalls from regional and private storm drainage systems, and tributaries that could be used to create off-channel habitat.

There are similar opportunities in Reach 3, especially in the lowermost section. Riprap removal, bank restoration and stabilization using bioengineering methods, installation of large woody debris, and improved connectivity between remaining riparian habitat would improve existing conditions in Reach 3.

The majority of the Little Bear Creek corridor is privately owned. The City has acquired four parcels along the corridor. The Washington State Department of Transportation owns one parcel, and the SR 522 right-of-way through which segments of Little Bear Creek flow. It is recommended that the City look for opportunities to partner with residents, property owners, business owners, and other agencies on habitat enhancement projects. As redevelopment occurs along this corridor, an evaluation of potential habitat improvement opportunities should be undertaken to determine what could be done to restore and enhance the habitat. Potential improvements are outlined later in this report.

The following properties are outside the Little Bear Creek corridor, but within the watershed, that the City should evaluate for possible acquisition to preserve undeveloped upland forest habitat:

- North of Woodinville High School and west of 136th Avenue NE
- Northeast of 144th Avenue NE and NE 195th Street
- Southwest of North Woodinville Way and NE Woodinville Duvall Road

Purchase of these properties would help to maintain the amount of impervious area within the watershed, provide areas for groundwater recharge, and provide water quality benefits.

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Table S-1:
Matrix of Pathway and Indicators Summary

PATHWAY	INDICATORS	BASELINE CONDITIONS
Water Quality	Temperature	Juvenile Migration and Rearing = Not Properly Functioning to At Risk Adult Migration and Spawning = Properly Functioning
	Sediment	Not Properly Functioning
	Chemical Contamination & Nutrients	Not Properly Functioning
Habitat Access	Physical Barriers	At Risk
Habitat Elements	Substrate	At Risk
	Large Woody Debris	Not Properly Functioning
	Pool Frequency	Not Properly Functioning
	Pool Quality/Depth	At Risk (not properly functioning in Reach 1)
	Off-Channel Habitat	Not Properly Functioning
	Refugia	Not Properly Functioning
Channel Conditions and Dynamics	Width/Depth Ratio	Reach 1: Not Properly Functioning Reach 2 and 3: At Risk
	Streambank Condition	Not Properly Functioning
	Floodplain Connectivity	Not Properly Functioning
Flow/Hydrology	Change in Peak/Base Flows	At Risk
	Increase in Drainage Network	Not Properly Functioning
Watershed Conditions	Road Density and Location	Not Properly Functioning
	Disturbance History	Not Properly Functioning
	Riparian Reserve/Conservation Areas	Not Properly Functioning (at risk in Reach 3)

Based on the results of this assessment, several additional actions have been outlined that could potentially improve existing habitat conditions in Little Bear Creek. These recommended actions include:

1. Obtain, preserve, and enhance land along Little Bear Creek to minimize further habitat degradation from continued development along the Little Bear Creek corridor. Undeveloped properties along the corridor with quality riparian habitat should be high priority acquisitions, such as, the properties to the north of the City's "Lumpkin" property (east of 134th Avenue NE crossing). Another area to consider would be the properties to the west of 134th Avenue NE as described in item 7.
2. Immediately initiate a program to reestablish conifers within the riparian zone throughout the Little Bear Creek corridor.
3. Restore hardened rip/rap banks along Little Bear Creek. Include creation of pool, and addition of large woody debris as part of the restoration plan.
4. Retrofit potential pollution-generating sites such as large parking lots and roadways with pollution prevention and storm flow retention facilities where such facilities are presently absent.
5. Reforest upland areas dominated by introduced species such as reed canarygrass and Himalayan blackberry.

6. Create off-channel habitat at each culverted tributary confluence with Little Bear Creek. This can be accomplished by daylighting the maximum extent of culverted tributary possible at each confluence.
7. The City of Woodinville should investigate the feasibility of purchasing the wrecking yard on 134th Avenue NE along the west side of Little Bear Creek. If this lot could be purchased several stream enhancement opportunities could occur. The first goals would be to remove soil contaminants within the lot and remove all structures. The second goal would be to use this crossing for enhancement efforts between Little Bear Creek and Highway 522 within Reach 2. Once these actions were completed the 134th Avenue NE crossing could be permanently removed, or replaced with a bridge.
8. The newly purchased city property immediately upstream of NE 195th Street is an ideal site for intensive in-stream, riparian, and upland habitat restoration activities. Actions that would benefit Little Bear Creek at this site include removal of bank armoring, creation of pool habitat, removal of impervious surface (pavement) and non-native vegetation, and installation of large woody debris, and riparian and upland vegetation.
9. Maintain regular street sweeping, storm drainage system cleaning, and add sediment traps where feasible. This will reduce the amount of sediment entering Little Bear Creek.

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1.0 INTRODUCTION

At the request of the City of Woodinville, David Evans and Associates, Inc. (DEA) conducted a Corridor Habitat Assessment along Little Bear Creek in King County during 2001. This assessment was carried out by accomplishing several tasks including: existing data collection and review, habitat and presence surveys for fish and wildlife, and documentation of findings.

The project goals were to document existing fish and wildlife habitat conditions and utilization, and identify potential restoration opportunities along Little Bear Creek within the City of Woodinville (Figures 1 and 2). DEA initially focused on collecting existing data for review and determination of data gaps. Once all readily available information was obtained and reviewed, the specific parameters and methods to be documented by DEA biologists were finalized. Fieldwork began during the spring of 2001 and continued through October 2001.

DEA biologists surveyed the entire stretch of Little Bear Creek that occurs within the City of Woodinville from June 25, through August 1, 2001. A total of 3,484.1 meters (2.2 miles) of stream was surveyed from the mouth of Little Bear Creek at the Sammamish River to the crossing under NE 205th Street along the City of Woodinville and Snohomish County line. Little Bear Creek was segmented into three reaches based on current land use and location of permanent landmarks (Figures 2 and 3). Reach 1 began at the mouth of Little Bear Creek and extended to the downstream end of the culverts under State Route (SR) 202. Reach 1 is composed of primarily industrial and commercial development. Reach 2 began at the downstream side of the culverts under SR 202 and extended to the upstream side of the culverts under Highway 522. Reach 2 is composed of primarily commercial development and public park/open space. Reach 3 began at the upstream side of Highway 522 and ended at NE 205th Street, which follows the City of Woodinville and Snohomish County line. Reach 3 is composed primarily of residential development.

Because Endangered Species Act (ESA) considerations are an important facet of current stream-related surveys, DEA also focused on collecting data that would assist in the determination of limiting factors as they relate to ESA listed salmonids. This included data required to address the Matrix of Pathways and Indicators developed by the National Marine Fisheries Service (NMFS). DEA utilized two versions of the Matrix. The original version was developed by the NMFS in 1996 and encompasses the entire Pacific Northwest (Appendix L-1). The Mt. Baker – Snoqualmie National Forest modified several of the indicators as originally outlined by the NMFS (Appendix L-2). In each case where the modified NMFS version is used it is cited as "NMFS as modified by the Mt. Baker – Snoqualmie National Forest." If the original NMFS version is used it is cited as "NMFS, 1996." A definition of *properly functioning*, *at risk*, and *not properly functioning* is provided for each condition, and a copy of the modified version is provided as an appendix.

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2.0 METHODOLOGY

A Little Bear Creek Corridor Habitat Assessment was conducted between June 25, 2001, and September 1, 2001, to evaluate existing habitat conditions of Little Bear Creek within the City of Woodinville, King County, Washington. The methodology utilized was an enhanced combination of several protocols that results in collecting data for 16 general tasks. DEA used aspects of two King County protocols (1991 and 2001a), and the U.S. Forest Service (USFS) protocol (USFS, 2001). The combining of aspects from all three methodologies results in a comprehensive habitat analysis that is compatible and comparable with other data collected using any of these methodologies. The stream survey included the following tasks:

1. Measure temperature, dissolved oxygen, conductivity, turbidity, and pH at the beginning and end of each project stream utilizing a Horiba U-10 water quality meter.
2. Measure stream flow with a Swoffer flow meter.
3. Measure stream gradient in each reach.
4. Document condition, type, and size of every culvert encountered within each stream to include sediment accumulation, fish passage, and photo documentation.
5. Categorize each habitat type into one of the 22 channel geomorphic types as outlined by McCain et al., 1990.
6. Measure the length, average depth, and average width of each habitat type.
7. Measure the length, tailout depth, maximum depth, average depth, and width of each pool encountered.
8. Measure bankfull width at several representative riffles within each reach.
9. Document the length, diameter, species, decay class, and zone of influence for each piece of woody debris longer than 2 meters (6.6 feet) and wider than 10 centimeters (3.9 inches) encountered within the stream channel.
10. Conduct a Wolman Pebble count in at least two representative riffles per reach. Increase the number of measures as reach length and complexity increase.
11. Document substrate composition visually throughout the stream.
12. Document riparian species composition and age.
13. Document the species and location of any fish or wildlife observed during the survey.
14. Document the location of all side channels or tributaries encountered.
15. Document the degree of bank armoring and severe erosion along each stream reach.
16. Photo document representative stream reaches and features of note encountered during the survey.

2.1 EXISTING DATA

A listing of initial existing data collected on fish and wildlife habitat, species presence and abundance, water quality and hydrology, and land use along Little Bear Creek was previously presented to the City of Woodinville (Appendix A). Additional literature collected after the initial review of existing data is cited within the text and reference section as appropriate.

2.2 FISHERIES RELATED DATA

2.2.1 In-stream Habitat

DEA utilized the *Inventory Methods for Wadable Streams in King County* (King County, 2001a) as the primary methodology. Both the King County 1991 (Appendix B) and 2001a (Appendix C) protocols are based on the methods defined in the *USDA Forest Service Stream Habitat Classification and Inventory Procedures for Northern California* (McCain et al., 1990) as modified by King County staff. Habitat units are defined as one of 22 habitat types listed in Table 1 below. Additional data as outlined in the USFS – *Stream Inventory Handbook for Region 6, Version 2.1* (USFS, 2001) was included.

Table 1:
Stream Habitat Types

1.	Low gradient riffle	12.	Lateral scour pool - bedrock formed
2.	High gradient riffle	13.	Dammed pool
3.	Cascade	14.	Glide
4.	Secondary channel pool	15.	Run
5.	Backwater pool - boulder formed	16.	Step run
6.	Backwater pool – rootwad formed	17.	Mid-channel pool
7.	Backwater pool – log formed	18.	Edgewater
8.	Trench/chute	19.	Channel confluence pool
9.	Plunge pool	20.	Lateral scour pool - boulder formed
10.	Lateral scour pool - log formed	21.	Pocket water
11.	Lateral scour pool - rootwad formed	22.	Corner pool

Source: McCain et al., 1990.

King County surveyed most of the entire length of Little Bear Creek in 1999 (King County, 2001b). Because of variations in project goals and methodologies only select results from their previous survey were incorporated into this report. Specifically, DEA used their bankfull width to depth ratio, scour, and bank stability data.

A hip-chain was used to measure habitat lengths and create station numbers. The hip-chain was zeroed at the lowermost starting point at each stream reach and utilized to document the location of each feature or action taken along the stream reach. Each habitat unit was defined as occupying only the area actually wetted at the time of the survey. Habitat width was measured with a 22.9-meter (75-foot) tape, habitat length with a hip chain, and habitat depth with a 1.2-meter (4-foot) stick graduated in centimeters. DEA biologists used the U.S. Geological Survey (USGS) standard of defining "left bank" (LB) and "right bank" (RB) as when facing downstream.

2.2.2 Fish Abundance and Distribution

Data collected by the Washington State Department of Fish and Wildlife (WDFW) and King County was used to document the presence, abundance, and distribution of salmonids in Little Bear Creek (WDFW, 2001a). Additional data was collected through field investigations.

DEA biologists electrofished four locations along the mainstem of Little Bear Creek on August 24 and 31, 2001, prior to the arrival of returning adult salmon. Sites electrofished included

immediately upstream of the mouth, upstream of SR 202, downstream and upstream of 134th Avenue NE, upstream of NE 195th Street, downstream of NE 205th Street (Figure 2), and several sites in one unnamed tributary (Figure 3 – Unnamed Tributary D). DEA utilized a Smith-Root Model 12 electrofisher with a frequency setting of 60 Hz and output voltage of 500 volts. All fish captured were first placed in a bucket of water containing a "pinch" of Tricaine Methanesulfonate prior to species identification and measurement of total length. Tricaine Methanesulfonate relaxes the fish for ease of handling, and reduces injuries and oxygen consumption. After handling, all fish were placed in a second bucket with fresh water to recuperate prior to release.

All fish observed during the habitat survey from June 25, 2001, to September 1, 2001, were identified to the species level when possible. Additional surveys directed at encountering returning/spawning adult salmonids were conducted between September 20, and October 18, 2001. The number and location of redds, and whether spawning behavior was occurring was also noted. Accessible points such as trail and road crossings were surveyed. DEA biologists also surveyed extended sections of various reaches to document the upper extent of spawning and potential presence of barriers.

2.2.3 Riparian Habitat

DEA biologists used aerial photo interpretation and ground truthing to document riparian scale and composition. The width of potential riparian habitat analyzed incorporated 61 meters (200 feet) from the stream edge along each side of the stream for a total corridor width of 122 meters (400 feet). The amount of riparian habitat and impervious surface within the 122-meter (400-foot) corridor was then calculated. DEA used aerial photographs from 1999 that were expanded to a scale of 2.54-centimeter (1-inch) equaling 31.40 meters (103 feet). The amount of forest, shrub/grass, gravel, and impervious area within 60.96 meters (200 feet) of each side of the stream was then calculated with a PLANIX 7 – Tamaya digital planimeter. The species composition, age, and structure were then listed and documented by ground truthing. The stream side vegetation was also classified as coniferous, deciduous, or mixed. Plant species were identified according to Cooke (1997), Pojar and MacKinnon (1994), and Hitchcock and Cronquist (1973).

2.2.4 Water Quality and Hydrology

2.2.4.1 Water Quality

Existing water quality data for Little Bear Creek was obtained from both King and Snohomish counties. Published water quality data for Little Bear Creek as it flows through the City of Woodinville is available in *Water Quality of Small Streams – Western King County 1990 – 1993* (King County, 1994).

Published water quality data for Little Bear Creek in Snohomish County is available in *The State of the Waters: Water Quality in Snohomish County's Rivers, Streams, and Lakes – 2000 Assessment* (Snohomish County, 2000). Additional water quality data for Little Bear Creek in Snohomish County was obtained by contacting the Snohomish County Public Works – Surface Water Management (Thornburgh, personal communication, 2001).

Additional water quality data was collected by DEA. A Horiba U-10 water quality meter was used on several occasions to document temperature, pH, conductivity, dissolved oxygen, and turbidity.

Furthermore, two temperature monitors were deployed in Little Bear Creek between June 15, and October 18, 2001, to document stream temperature on an hourly basis. DEA utilized two 32K waterproof Stowaway Tidbit monitors set to collect hourly readings. One was installed in Little Bear Creek near its confluence with the Sammamish River, and the other was installed near the King and Snohomish county line immediately downstream of NE 205th Street.

2.2.4.2 Hydrology

Hydrology data for Little Bear Creek was obtained from King County (2001c). Hydrology data is collected in King County at the SR 202 crossing of Little Bear Creek in the City of Woodinville (Station #30). DEA biologists also used a Swoffer Model 2100 flow meter on two occasions to document site specific conditions. The first measurement was made on June 25, 2001, at the beginning of the in-stream habitat survey near the confluence of Little Bear Creek and the Sammamish River. The second event occurred on August 29, 2001, to document variation of flow at Little Bear Creek as it enters Woodinville at NE 205th Street, and near its confluence with the Sammamish River.

2.3 WILDLIFE RELATED DATA

2.3.1 Habitat Availability

DEA biologists mapped plant communities by interpreting aerial photographs and ground-truthing. DEA translated plant communities into habitat types. Biologists established 17 circular plots with a 10-meter (32.8-foot) radius in representative locations between the creek and the nearest development in all habitat types. DEA identified dominant, common, and infrequent plant species; estimated tree diameter at breast height (DBH); counted snags, stumps, and logs; observed trees for raptor nests; and assessed overall condition of each habitat area.

2.3.2 Wildlife Presence

2.3.2.1 Birds

DEA biologists surveyed birds on May 18, May 31, and June 18, 2001, using the variable circular-plot method (Reynolds et al., 1980). Surveys began at sunrise and ended by 9:15 AM (Robbins, 1981). DEA established 20-meter (65.6-foot) radius plots in all habitat types and surveyed for 10 minutes in each plot, recording species observed visually and aurally both in and outside of the plots. Biologists surveyed 16 plots on May 18, and 13 plots on subsequent survey days.

2.3.2.2 Bats and Owls

DEA biologists surveyed for owls at seven stations on June 19, and July 7, 2001, by soliciting birds with amplified taped recordings and listening for a response with the unaided ear. At each of 7 stations, located in each habitat type in the study area, biologists broadcast calls for approximately 1 minute and listened for a period of approximately 3 minutes. DEA repeated this procedure 3 times at each station. Although there was no standard distance between stations, we chose stations that were far enough apart to avoid double counting while still covering the entire study area. Biologists scanned each station and the surrounding areas with a 20 to 160 kHz bat detector at 1- to 2-minute intervals for approximately 10 minutes and recorded all frequencies of all detections.

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2.3.2.3 Mammals

DEA biologists recorded all mammal species observed during all visits to the study area. Biologists searched for, examined, and recorded all mammal sign, including tracks, scats (wildlife excrement), and runways (animal trails). In addition to the site visits conducted for the wildlife and habitat analyses, DEA biologists also documented mammal observations while conducting the stream survey.

2.3.2.4 Reptiles and Amphibians

DEA biologists conducted reptile and amphibian surveys on May 31, and conducted searches during stream surveys. Biologists overturned logs and debris and searched at the bases of plants and along Little Bear Creek. DEA biologists identified and recorded all individuals observed. All captured specimens were returned to the point of capture unharmed and all overturned logs and debris were placed back in their original location.

3.0 HISTORIC CONDITIONS

To better understand existing conditions and possible future trends, historic conditions must be considered. The focus of this report is on fish, wildlife, habitat, and restoration potential along the Little Bear Creek corridor through the City of Woodinville. Although very little site-specific information on the historic conditions of Little Bear Creek as they relate to fish and wildlife is known, some data is available. The "historic conditions" defined as that time from the retreat of the Vashon Glacier approximately 14,000 years ago to the present can be segmented into pre European settlement and post European settlement time periods. The transition between pre and post European settlement time period near Woodinville occurred during the early 1870s. A brief overview is provided below.

3.1 PRE EUROPEAN SETTLEMENT

For the purposes of this report the pre European time period began approximately 14,000 years ago with the retreat of the glaciers and lasted until the arrival of the European settlers in 1870. The Sammamish River Valley was historically dominated primarily by giant western red cedar trees (*Thuja plicata*). Other conifers such as Douglas fir (*Pseudotsuga menziesii*) and Sitka spruce (*Picea sitchensis*) were also present. Several stumps of these remnant trees were observed along the banks of Little Bear Creek during the 2001 survey conducted by DEA. They often had burn marks and "spring board" notches where planks were used by loggers to reach the desired cut location above the tree buttress. Furthermore, old cedar tree stump fragments were also encountered during the in-stream habitat survey and classified as woody debris when they met or exceeded the length and width parameters.

Lake Washington was larger and deeper than at present, and the Sammamish River was longer, and contained numerous meanders and oxbows. The Sammamish River was about 30 miles long, heavily forested to its banks, and very difficult to navigate due to the abundance of fallen trees (King County, 2001d). Besides being lined with large trees, "swamp land" abutted both banks especially near its mouth. The Sammamish River was previously known as Squak Slough, and while the local Indians

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were also known as the Squaks, they were really part of the Simump tribe (Stickney and McDonald, 1977). The native Americans lived primarily near Lake Sammamish, but traveled and camped along the Sammamish River. The Sammamish River corridor was also likely utilized by several other tribes as an east-west route.

3.2 ARRIVAL OF EUROPEAN SETTLERS

One of the first Europeans known to have traveled up the Sammamish River was Sam Hancock, who in 1850 explored for coal in the region (Stickney and McDonald, 1977). The earliest land claims in the Woodinville area were by George Wilson and Columbus Greenleaf in 1870 (King County, 2001d). In 1871 the Woodins became the first settlers after rowing across Lake Washington with all their goods and building a log cabin along the bank of the Sammamish River. They passed a couple other homesteads on their journey up the Sammamish River. Other families slowly moved into the area to log the local forests and establish homesteads. By 1897 four families owned most of the land along Little Bear Creek in Township 26 North, Range 5 East (Appendix E). Each of these landholders owned approximately one-quarter section along Little Bear Creek in what today is known as the City of Woodinville. The City of Woodinville was given its name in honor of the first pioneers, Ira and Susan Woodin sometime around 1887. The railway network grew rapidly in the area from 1877 through 1888 and was used extensively for both timber and coal transport. The railroad reached Woodinville in 1877 and Issaquah in 1888. By the 1890s several stores, hotels, saw mills, meat markets, and other enterprises became established.

Logging the old-growth forest was the primary occupation during this period. The local rivers played an important role in the transport of timber prior to the arrival of railroad. However, as the land was cleared and large first-growth trees became more distant, farming became more prevalent. The Sammamish River valley had been mostly cleared of giant western red cedar trees by the early 1920s. What was referred to as "stump farms" dotted the landscape during this time, but were gradually being cleared. Because heavy equipment was scarce and consisted primarily of horse drawn devices, the most common method of stump removal was by dynamiting and then burning the stump. As the stumps were removed, farming the rich river valley became the primary occupation in the area and the local population grew.

Other events related to logging and navigation that would result in changes to Little Bear Creek were occurring closer to Seattle during this same time period. In the 1880s a small channel and lock was built at Montlake to carry logs to mills. Lake Washington originally drained into the Black River that flowed into the Duwamish River prior to reaching Elliott Bay. In 1912 the Cedar River was diverted from the Black River into Lake Washington. This resulted in the replacement of the Black River as Lake Washington's outlet with the Cedar River as a new inlet. The Hiram M. Chittenden Locks and a fish ladder were completed by 1916 resulting in Lake Washington being lowered 2.7 meters (9 feet). In the early 1920's the historically slow and meandering Sammamish River was straightened, narrowed, and later dredged. By the 1930s stocks of chum and pink salmon had been extirpated, but three new stocks including Baker River sockeye, Green River coho and chinook salmon had been introduced (Goetz, proceedings from Conference, 2000).

Little is known about the composition and distribution of fish and wildlife during the early days of Little Bear Creek. Early accounts say the land was occupied by deer, cougar, bear, and migratory

waterfowl (Stickney and McDonald, 1977). Additional stories mention settlers being confined to their cabins during bad weather and hearing the howling of wolves, and others mention trapping bear, otter, raccoon, muskrat, and mink. Waterfowl were apparently abundant in the adjacent marshes since hunters would travel from Seattle to hunt the area, and Indians used the area extensively to hunt ducks. Duck clubs were present along the river that catered to wealthy Seattle residents. They hunted mallards, teal, and widgeon using decoys and feed to attract them within the marshy areas. Many of the adjacent marshes were drained as a result of the lowering of Lake Washington.

Settlers make no mention of salmon in the early accounts. Although it was noted that the local Indians hunted ducks along the marshy land adjacent to the Sammamish River, no reference to salmon is made. According to one resident, fishing in the Sammamish River during the early 1920s was not very good (Repman, personal communication, 2001). Mr. Repman recalled catching bullheads, chub, and an occasional chum salmon as a youth. It is likely that native populations of anadromous salmonids had drastically declined by this time. However, populations of resident kokanee (land-locked sockeye) were very abundant in the Lake Washington System during this time period (King County, 2000a). Mr. Repman was also an avid hunter who targeted grouse, quail, and pheasant (introduced). Between 1925 and 1970 he did not see any bear, cougar, or deer. According to Mr. Repman, deer showed-up later, after the surrounding uplands had been logged, and were more prevalent after the 1970s.

Based on a review of the first aerial photographs of Little Bear Creek during 1936 (Appendix F), riparian vegetation had been cleared from much of the stream by this time. The lower most reach downstream of what would become SR 202 was totally devoid of riparian vegetation by this time. Further upstream, thin segments of riparian vegetation lined some sections of the stream. The stream banks became more forested upstream of what would become NE 195th Street during 1936.

The local population around Woodinville began to expand rapidly after World War II. The City of Woodinville had been agricultural and very rural until a large influx of people began arriving from the 1950s through the 1970s. The creation of Interstate 405 in the 1960s and Highway 522 allowed for the exponential expansion of the area as developers began building and selling entire neighborhoods. By the 1980s, rural Woodinville had completely changed into its current suburban landscape. Woodinville was part of unincorporated King County until 1993.

4.0 EXISTING CONDITIONS

4.1 LITTLE BEAR CREEK WATERSHED

Little Bear Creek is a 12.4-kilometer (7.7-mile) long second order stream that drains a 3,885-hectare (9,600-acre) watershed in both Snohomish and King counties, Washington. Approximately 3,108 hectares (7,680 acres) (80 percent) of the upper watershed are located in Snohomish County while 777 hectares (1,920 acres) (20 percent) are in King County. While in King County, Little Bear Creek flows through the City of Woodinville for approximately 3.5 kilometers (2.2 miles) from NE 205th Street to its mouth on the Sammamish River at River Mile (RM) 5.4 (Figure 4). The headwaters of Little Bear

Creek are located in a peat bog 2.4 kilometers (1.5 miles) west of Clearview in Snohomish County. The elevation along Little Bear Creek varies from 76 meters (250 feet) near its headwaters to 6 meters (20 feet) at its confluence with the Sammamish River. Based on these elevations, the overall gradient of Little Bear Creek is about 0.6 percent. Other reports state the overall gradient is about 0.8 percent based on an elevation of 94.50 meters (310 feet) near Clearview (Kerwin, 2001).

4.2 CITY OF WOODINVILLE

The City of Woodinville currently covers 1,461 hectares (3,610 acres) and has a population of 9,294 people. The population is expected to reach 13,400 people by the year 2010 based on 1990 census data. Land use within the city is composed of residential (59.0 percent), commercial (9.2 percent), industrial (13.4 percent), park/open space (1.2 percent), public right-of-way (11.8 percent) and other (5.4 percent) designations.

4.3 FISHERIES

Little Bear Creek has been utilized by at least nine resident and anadromous species of fish. This includes anadromous, adfluvial, and resident salmonids, and sculpins and lampreys. Table 2 below lists the common name, scientific name, and documentation source for each species known to have utilized Little Bear Creek. Some species such as chum and pink salmon have been documented only once. Chinook salmon occur seasonally in low numbers, while other species such as sockeye and coho salmon, and cutthroat trout can be very abundant. Undocumented species could also occasionally utilize Little Bear Creek as well. An example of undocumented species that could be present includes steelhead trout (*Oncorhynchus mykiss*) and other species of sculpin (*Cottus* spp.). Native char (bull trout/Dolly varden) were not considered in this report due to a lack of documentation and absence of suitable habitat. Native char have never been documented in Little Bear Creek, and although it is theoretically possible that if they were to enter the Sammamish River they could investigate Little Bear Creek, the downstream limit of successful char spawning is always upstream of the winter snow line (WDFW, 1999). Because the headwaters of Little Bear Creek originate at an elevation of about 94.50 meters (310 feet), suitable char spawning habitat is not present in Little Bear Creek due to elevated stream temperatures throughout the basin. If bull trout were to ever be present in Little Bear Creek, it would likely be foraging adults or sub-adults, or possibly wayward adults searching for suitable spawning habitat.

Table 2:
Fish Species Documented in Little Bear Creek

#	Common Name	Scientific Name	Source
1.	Coast Range Sculpin	*Cottus aleuticus*	DEA
2.	Western Brook Lamprey	*Lampretra richardsoni*	DEA
3.	Cutthroat Trout	*Oncorhynchus clarki*	DEA
4.	Pink Salmon	*Oncorhynchus gorbuscha*	WDFW
5.	Chum Salmon	*Oncorhynchus keta*	WDFW
6.	Coho Salmon	*Oncorhynchus kisutch*	WDFW, King County, & DEA.
7.	Sockeye Salmon	*Oncorhynchus nerka*	WDFW & King County, & DEA
8.	Kokanee	*Oncorhynchus nerka*	WDFW & King County, & DEA
9.	Chinook Salmon	*Oncorhynchus tshawytscha*	WDFW, NMFS, & King County.

At least 40 different non-native species of fish have been introduced into the Lake Washington watershed since the arrival of the first European settlers. However, many of these introduced species did not survive and today approximately 24 species remain (Kerwin, 2001). A listing of 21 species of native and non-native fish that have been documented within the greater Lake Washington watershed are included in Table 3 below. Introduced species have become prevalent in both Lake Washington and Lake Sammamish, and continue to adversely impact native salmonids. Although the list presented in Table 3 below is not all-inclusive, it provides evidence of the shear abundance of non-native species of fish that still inhabit the Lake Washington watershed. Some of these species listed in Table 3 likely utilize the Sammamish River and therefore potentially the lowermost reach of Little Bear Creek. The likelihood of any of these additional undocumented species being present in Little Bear Creek varies by species.

Table 3:
Additional Fish Species Documented in the Greater Lake Washington Watershed

#	Common Name	Scientific Name	Native or Introduced	Resident or Anadromous	Status
1.	White sturgeon	*Acipenser transmontanus*	Locks created access	Anadromous	Rare visitor
2.	Largescale sucker	*Catostomus macrocheilus*	Native	Resident	Unknown
3.	Lake whitefish	*Coregonus clupeaformis*	Introduced in 1899	Resident	No longer present
4.	Prickly sculpin	*Cottus asper*	Native	Resident	Abundant
5.	Shorthead sculpin	*Cottus confusus*	Native	Resident	Abundant
6.	Carp	*Cyprinus carpio*	Introduced	Resident	Locally abundant
7.	Three-spine stickleback	*Gasterosteus aculeatus*	Native	Both	Unknown
8.	Brown bullhead	*Ictalurus nebulosus*	Introduced	Resident	Unknown
9.	Pumpkinseed	*Lepomis gibbosus*	Introduced	Resident	Sparse
10.	Pacific staghorn sculpin	*Leptocottus armatus*	Native	Both	Sparse
11.	Smallmouth bass	*Micropterus dolomieui*	Introduced	Resident	Abundant
12.	Largemouth bass	*Micropterus salmoides*	Introduced	Resident	Abundant
13.	Peamouth	*Mylocheilus caurinus*	Native	Resident	Unknown
14.	Olympic mudminnow	*Novumbra hubbsi*	Unknown	Resident	Rare: one siting
15.	Steelhead trout	*Oncorhynchus mykiss*	Native	Both	Stock depressed
16.	Yellow perch	*Perca flavescens*	Introduced	Resident	Abundant
17.	Black crappie	*Pomoxis nigromaculatus*	Introduced	Resident	Sparse
18.	Northern Squawfish	*Ptychocheilus oregonensis*	Native	Resident	Unknown
19.	Bull trout	*Salvelinus confluentus*	Native	Both	Rare
20.	Longfin smelt	*Spirinchus thaleichthys*	Native	Resident	Unknown
21	Tench	*Tinca tinca*	Introduced	Resident	Unknown

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4.3.1 Chinook Salmon

The Puget Sound chinook salmon evolutionarily significant unit (ESU) was designated as threatened on March 24, 1999 (64 FR 14308). This ESU includes all naturally spawned spring, summer, and fall runs of chinook salmon in the Puget Sound region. Puget Sound chinook salmon critical habitat was designated on February 16, 2000 (65 FR 7777). Critical habitat is designated to include all marine, estuarine and river reaches that could be utilized by chinook salmon in the Puget Sound region. This incorporates the riverbed, bank, and riparian zone in all rivers currently or historically utilized by Puget Sound chinook salmon. Based on the fact that fall run chinook salmon utilize Little Bear Creek, the stream and shoreline are designated critical habitat.

Salmon spawning ground survey data from the WDFW from 1952 through 2000 indicates that chinook salmon utilization of Little Bear Creek is typically limited to less than 8 individuals (Table 4). The maximum daily count was 28 chinook salmon on October 21, 1981, but was typically between 1 and 5 (Appendix J). The highest yearly count occurred in 1981 when a total of 62 chinook salmon were counted (Table 4). The majority of higher counts occurred between RM 4.4 and 5.5. Sightings were made as early as September 29, and live fish were observed as late as November 3. Although the WDFW has surveyed Little Bear Creek since 1952, the first documented adult chinook salmon did not occur in Little Bear Creek until 1971 when one carcass was found on November 11 between RM 4.4 and 5.4.

Table 4:
Chinook Salmon Summary for Little Bear Creek based on WDFW Salmon Spawning Ground Survey Data

Year	Live Count	Dead Count	Total Count
1971	0	1	1
1972	0	1	1
1973	0	1	1
1974	3	3	6
1975	4	1	5
1976	13	12	25
1977	2	16	18
1978	11	40	51
1979	0	1	1
1980	0	2	2
1981	20	42	62
1982	0	3	3
1983	0	3	3
1984	0	4	4
1985	11	4	15
1986	0	5	5
1987	7	3	10
1988	0	6	6
1989	1	3	4
1990	0	0	0
1991	0	0	0
1992	0	0	0

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Table 4 continued

Year	Live Count	Dead Count	Total Count
1993	0	0	0
1994	0	7	7
1995	0	0	0
1996	1	4	5
1997	0	0	0
1998	0	0	0
1999	0	0	0
2000	0	0	0
Total	73	162	235
Average	2.4	5.4	7.8

During the King County surveys from 1996 to 1999, year to year sightings have varied from zero to 12 observations. These numbers represent the minimum number of fish present since the entire stream was not surveyed. However, it does further indicate that Little Bear Creek is not heavily utilized by chinook salmon.

The origin of chinook salmon in Little Bear Creek is uncertain. Straying from either Bear Creek and/or the Issaquah Creek Hatchery is highly probable. Plants of fry and fingerling chinook salmon directly into Little Bear Creek totaled 1,083,300 from 1983 through 1992 (Appendix H). These were all fall chinook from the Issaquah Hatchery. No more plants by the WDFW are currently planned for Little Bear Creek (Foley, personal communication, 2001). In May of 2001, the Issaquah Creek Hatchery released 2,194,773 juvenile chinook salmon into Issaquah Creek. Some of the juveniles from the Issaquah Creek Hatchery and from naturally produced spawners in Bear Creek may utilize the lower segment of Reach 1 during their outmigration through the Sammamish River.

Juvenile chinook salmon typically exhibit either ocean-type or stream-type life history strategies. The primary difference between these strategies is residence time and growth rates. For the purposes of this report, residence time is important. Juvenile chinook salmon within the Lake Washington watershed exhibit the ocean-type strategy which means they rapidly exit their natal stream after emergence from the gravel (Fresh, personal communication, 2000). Data collected and analyzed by the WDFW indicate that the majority of the total juvenile out-migration in Bear Creek (immediately east of Little Bear Creek) occurred after mid-April, but varied between years (Seiler, 2001). The overall out-migration period ranges from mid-January through late June, but spikes between March and June. These trends can be expected to be "similar" to what occurs in Little Bear Creek.

4.3.2 Coho Salmon

Puget Sound/Strait of Georgia coho salmon was designated as a candidate for listing under the ESA on July 25, 1995 (60 FR 38011). If its status is changed to either threatened or endangered in the future, critical habitat may be designated at that time.

Salmon spawning ground survey data from the WDFW from 1952 through 2000 indicates "fair" numbers of coho salmon consistently spawn in Little Bear Creek, but during some years they are very abundant. The average total number of coho salmon observed each year in Little Bear Creek is

approximately 380 (1952 through 2000 excluding 1962 and 1969 [no data]). However, from 1976 to 1978 when the WDFW conducted intensive salmon spawning surveys at Little Bear Creek an average of approximately 2,700 coho were observed per year (range = 1,448 to 4,852). The abundance of coho salmon in Little Bear Creek appears to have dropped in the late 1980s to early 1990s. Prior to 1991 the yearly average total number of observations was approximately 460, after 1991 the yearly average was 68 with a high of 168 in 1995.

The two highest single day counts included 197 on December 14, 1979, and 191 on December 11, 1987 (Appendix J). Both of these daily counts only represent the adults observed between RM 4.4 and 5.5 on a specific day, and therefore, do not represent the total number of spawning adults in Little Bear Creek. From 1988 through 2000, the highest daily counts have been 40, 45, 46, 36, 9, 26, 4, 48, 38, 68, 25, 12, and 36, respectively. As previously stated, these numbers are not absolute in that they can only be used as an indicator of abundance. Numerous factors such as time of year, observer bias, survey effort, survey timing, flow, water clarity, and weather can all play a role in the total number of observations.

Unlike chinook salmon, coho juveniles spend from 1 to 2 years in freshwater before heading to sea. Their extended period of rearing in freshwater makes them especially vulnerable to changes in habitat, water quality, and hydrology. Following this period of freshwater residence, the juveniles migrate downstream to Lake Washington and then the ocean. They then spend about 18 months at sea before returning to their stream of origin for spawning (Wydoski and Whitney, 1979). Returning adult coho salmon stray within a watershed, and between watersheds.

Low numbers of juvenile coho salmon were captured in Reach 1, 2, and 3 during our electrofishing survey on August 24, and 31, 2001 (Appendix K). The total coho catch in Reach 1 was three juveniles during 110 seconds of effort, or one per 36.7 seconds. Juvenile coho represented 8.3 percent of the catch in Reach 1. One of the three coho had a clipped adipose fin and was therefore likely from the Issaquah Hatchery. The hatchery coho was much larger than the others with a total length of 10.7 centimeters (4.2 inches) versus an average length of 8.6 centimeters (3.4 inches) for the naturally produced coho (range: 8.4 to 8.9 centimeters [3.3 to 3.5 inches]). Two coho were captured in Reach 2 during 320 seconds of effort.

Electrofishing in Reach 3 produced the most coho, except that all the captures occurred in the upper-most section downstream of NE 205th Street. A total of nine juvenile coho were captured in the upper section of Reach 3 during 141 seconds of effort. This equates to one coho per 15.7 seconds of effort. Juvenile coho represented 20.4 percent of the salmonid catch in the upper section of Reach 3. Juvenile coho in the upper section of Reach 3 were smaller than those captured in Reach 1 with an average length of 7.8 centimeters (3.08 inches) ranging from 7.6 to 8.3 centimeters (3 to 3.25 inches). Overall, juvenile coho represented 7.7 percent of the total catch in Little Bear Creek. No coho were captured immediately upstream of NE 195th Street although 29 cutthroat trout and six sculpins were caught. No hatchery coho were captured in any section of Reach 2 or Reach 3.

The WDFW has planted 2,927,707 emergent, fingerling, fry, pre-smolt, and smolt coho salmon into Little Bear Creek between 1952 and 1978, and 1,161,763 between 1984 and 1997 (Appendix H). This does not include additional plants by the tribes, schools, or other organizations. During March of 2001, the Issaquah Creek Hatchery released two different size classes into Issaquah Creek totaling

2,250,549 (Appendix I). One of these juvenile coho was captured in Reach 1 of Little Bear Creek on August 24, 2001.

4.3.3 Sockeye Salmon

Sockeye salmon differ from other species of salmon in that juveniles require a lake environment to exist, where they spend 12 to 15 months maturing prior to going to sea (Wydoski and Whitney, 1979). Returning adult sockeye enter Lake Washington in late June and July, reside in Lake Washington until late August, and then spawn in numerous tributaries between September through early December (peaking in mid-October). An average female will produce approximately 4,000 eggs that hatch in 6 to 9 weeks, and then reside within the substrate for another 2 to 3 weeks. The newly hatched juveniles migrate from the tributaries into Lake Washington between January and April, but typically peak during March. These fish are the progeny of transplants from Baker River around the 1930s.

Kokanee are sockeye salmon that spend their entire life in freshwater. They are segmented into early-run and late-run races. Early-run kokanee spawn from August through September while the late-run spawns from October through December (King County, 2000a). The early-run variance is native to the Lake Washington system and has received much notice lately due to a decline in abundance. The late-run are the progeny of hatchery fish from Lake Whatcom planted in Big Bear Creek in the 1930s and 3.5 million planted in Lake Sammamish between 1976 and 1979 (King County, 2000a). However, the total number of kokanee planted in the Lake Washington system was approximately 35 million fry and fingerlings.

Several organizations have petitioned the United States Fish and Wildlife Service (USFWS) to list the early-run kokanee as an endangered species. To date, the USFWS has not responded to these petitions despite the population crash that occurred in the 1980s. During 2000, efforts were initiated to capture, rear, and then release early-run kokanee in order to increase the egg-to-fry survival rate. As of yet, these efforts have failed due to a lack of captured adult spawners.

Kokanee have been documented in Little Bear Creek (King County, 2000a). According to King County, up to 221 kokanee spawned in the lower most section of Reach 1 between September 27, through November 8, 1999. Kokanee were observed spawning in Little Bear Creek by DEA biologists during a water quality-monitoring event on September 20, 2001. Between 6 and 10 kokanee ranging from 17.8 to 35.6 centimeters (7 to 14 inches) long were observed immediately below the NE 178th Street culvert. The exact number is uncertain due to a lack of visibility under the overhanging cluster of Japanese knotweed where several more were hiding. One female between 17.8 to 20.3 centimeters (7 and 8 inches) long was observed digging a redd immediately under the downstream culvert edge in the center of a low-gradient riffle. Several others, suspected to be males, would occasionally be by her side, but dart between the redd and the cluster of Japanese knotweed along the left-bank. A minimum of four were observed, and several others were under the overhanging cluster of Japanese knotweed, and "thrashing/splashing noises" were emanating from under the cluster of knotweed. One additional redd was identified immediately downstream of the railroad crossing near the mouth (upstream of the Sammamish River trail crossing). The timing of these observations does not conclusively categorize them as either early or late-run kokanee, but leads to the possibility that they could be either. Some researchers have stated that during 1996, the timing of the early-run in Issaquah Creek extended from August 14, through September 16 (Ostergaard 1988 as reported by King County, 2000). Due to yearly

variations in-water temperature and run timing, these dates are not absolute. However, due to the closeness between the observed spawning of kokanee in Little Bear Creek on September 20th, it is possible that these fish were a component of the early-run race.

Sockeye salmon are occasionally the most abundant spawning anadromous salmonid in Little Bear Creek. Based on salmon spawning ground data from the WDFW, adult sockeye salmon were first observed in Little Bear Creek in 1970 (WDFW, 2001). Low numbers (n) were observed in 1970 (n = 14), 1975 (n = 1), 1976 (n = 8), 1977 (n = 2), 1978 (n = 34), 1979 (n = 91), but began to increase substantially during 1987 when over 2,000 spawning adults were observed (Appendix J). Exceptionally large numbers of sockeye salmon spawned in Little Bear Creek in 1996 when 4,716 were recorded. Based on observations during field visits this year, 2001 will be another productive year for sockeye in Little Bear Creek.

4.3.4 Chum Salmon

Chum salmon often spawn near tidewater and begin to migrate back to the ocean soon after emergence. Spawning primarily occurs between October through December, and outmigration between March and June (Wydoski and Whitney, 1979). Chum salmon were considered extirpated from Lake Washington by the early 1930s (Goetz, proceedings from Conference, 2000). However, they are occasionally observed in tributaries to both Lake Washington and Lake Sammamish. Only two chum salmon have been observed in Little Bear Creek during the WDFW annual salmon spawning ground surveys from 1952 through 2000. These two adults were observed between RM 4.4 and 5.5 on November 6, 1976 (Appendix J). Based on the low number of observations of chum salmon in Little Bear Creek, these adults likely strayed from either the Cedar River or other Puget Sound watersheds.

4.3.5 Pink Salmon

Pink and chum salmon are similar in that they have a short residence time in freshwater as both adults and juveniles. Spawning occurs primarily between August and September (Wydoski and Whitney, 1979). Pink salmon were also considered extirpated from Lake Washington by the early 1930s (Goetz, proceedings from Conference, 2000). Only one adult pink salmon has been observed in Little Bear Creek (WDFW, 2001). The single adult was observed dead between RM 0.0 and 1.1 on November 1, 1977 (Appendix J). Based on the single observation of a pink salmon in Little Bear Creek, this adult was likely a strayed from a different Puget Sound watershed.

4.3.6 Cutthroat Trout

The life history of cutthroat trout is very diverse. Sea-run, adfluvial, and resident forms utilize the Lake Washington system. The resident form is likely the most abundant trout and the only resident salmonid in Little Bear Creek. During our electrofishing survey on August 24 and 31, 2001, cutthroat trout increased in abundance as we progressed upstream. They represented 8.6 percent of the catch in Reach 1 (n = 3), 50.8 percent in Reach 2 (n = 32), and 76.2 percent in Reach 3 (n = 64). Overall, cutthroat trout represented 54.4 percent of the total catch in Little Bear Creek. The largest specimen captured was in Reach 3 and was 21.6 centimeters (8.5 inches) long (Appendix K).

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4.3.7 Western Brook Lamprey

Three species of lamprey have been documented in the State of Washington including the western brook lamprey (*Lampetra richardsoni*), Pacific lamprey (*Entosphenus tridentatus*), and river lamprey (*Lampetra ayresi*). Of these, only the western brook lamprey was documented in Little Bear Creek by DEA.

Adult western brook lampreys are the smallest of the lamprey family by being usually less than 17.8 centimeters (7 inches) in length (Wydoski and Whitney, 1979). They are slender, have dull/ nonfunctional teeth, may live for up to 6 years, and spend their entire life in freshwater. Unlike other species of lampreys, the brook lamprey does not attach themselves to other fish. Spawning occurs in small-excavated "nests" from April to July. Up to 12 adults may use a single nest and die soon after spawning. Juveniles are called ammocoetes and are non-parasitic filter feeders that consume primarily microscopic plant and animal matter such as diatoms, algae, and detritus.

Western brook lampreys were observed in Reaches 2 and 3, and in Tributary D as depicted on Figure 3 immediately downstream of 140th Place NE. Spawning behavior in the form of nest building and quivering was noted in the large pool immediately downstream of NE 205th Street and in a low-gradient riffle in Reach 2. In Reach 3 approximately 12 spawning lampreys were observed on June 15, 2001, at the NE 205th Street site. It is interesting to note that the same site along the edge (RB) of the pool near the tailout was later used by sockeye salmon for spawning. Numerous other sightings of lampreys occurred throughout Reaches 2 and 3 during the survey.

4.3.8 Coastrange Sculpin

The coastrange sculpin inhabits medium to large streams along the West Coast from California to Alaska. They grow to 7.6 to 10.2 centimeters (3 to 4 inches) long depending on geographic location, and spawn from mid-February to June (Wydoski and Whitney, 1979). They feed primarily on aquatic insects but will eat stray salmonid eggs when available. Large adult sculpins may feed on salmonid fry but are in-turn eaten by larger salmon and trout.

Sculpins are the most difficult fish in Washington to identify to species because of their morphological variations and small size (Wydoski and Whitney, 1979). At least 11 species occur in Washington State, some of which may hybridize and result in similar characteristics that further complicates species identification. Some of the characteristics that distinguish the coastrange sculpin from other species include its non-contiguous dorsal fin (separated to base), distinct tubular nostril, lack of palatine teeth, and absence of prickles and dark vertical bars (Wydoski and Whitney, 1979).

DEA documented coastrange sculpins throughout Little Bear Creek (Appendix K). Sculpins represented 82.9 percent of the catch in Reach 1 (n = 29), 46 percent in Reach 2 (n = 29), and 13.1 percent in Reach 3 (n = 23). The overall catch in Little Bear Creek was 37.9 percent. Although the majority of specimens captured were coastrange sculpins, some differed and may have been reticulated sculpins. The variation included the presence of a slightly contiguous dorsal fin on larger specimens.

4.3.9 Mollusks and Crawfish

Other aquatic species observed in Little Bear Creek include mollusks, crawfish, and macroinvertebrates. The western pearlshell (*Margaritifera falcata*) has been documented within

upper Little Bear Creek within Snohomish County. Several shells were observed in Little Bear Creek within King County, but no live specimens were documented during the DEA stream survey. These shells likely floated downstream during flood events. Another mollusk referred to as the Asian clam (*Coricula fluminea*) was observed in the Sammamish River near the mouth of Little Bear Creek during the DEA stream survey. The Asian clam is an introduced species known to be present in the Colombia River, but never previously documented in the Sammamish River. Crawfish are also present in the Sammamish River and Little Bear Creek. However, their presence in Little Bear Creek appears to be limited to the lowermost section of Reach 1.

4.4 STREAM HABITAT

DEA biologists surveyed the entire section of Little Bear Creek within the City of Woodinville between its mouth to NE 205th Street from June 25, through August 1, 2001. A total of 3,484.1 meters (2.2 miles) of stream was surveyed from the mouth of Little Bear Creek at the Sammamish River to the crossing under NE 205th Street along the City of Woodinville and Snohomish County line (Table 5). Little Bear Creek was segmented into three reaches. Reach 1 began at the mouth of Little Bear Creek and extended to the downstream end of the culverts under SR 202. Reach 2 started at the downstream side of the culverts under SR 202 and extended to the upstream side of the culverts under Highway 522. Reach 3 began at the upstream side of Highway 522 and ended at NE 205th Street, which follows the City of Woodinville and Snohomish County line.

Table 5:
Survey Summary for Reach 1, 2, and 3 of Little Bear Creek in Woodinville, Washington (WDFW Stream Number 08-0080)

	Reach 1	Reach 2	Reach 3
Date Surveyed	6/25/01	6/26/01 – 7/6/01	7/19/01 – 8/1/01
Total Length Surveyed	388.2 meters (0.24 mile)	1,725.7 meters (1.07 miles)	1,370.2 meters (0.85 mile)
Bank Full Width	4.5 – 6.6, x[1] = 5.8 meters	3.1 – 8.8, x = 6.2 meters	5.6 – 8.2, x = 6.9 meters
Total # of Habitat Units (NSOs)	14	105	94
Total Habitat Area	1,773.58 m²	9,267.05 m²	7,379.52 m²
Percent Pool by Area	13.74%	34.01%	36.57%
Percent Glide by Area	15.04%	20.48%	21.34%
Percent Riffle by Area	71.22%	47.67%	42.09%
# Hardened Crossings	3	4	3
Percent Armoring	98.3%	13.7%	15.5%
Placed Structures	6 log weirs	0	5 rip/rap weirs
Gradient	0.25 – 1.25%	0.56 – 1.2%	0.31 - 0.87%
Sinuosity	1.01	1.15	1.08
Number Wolman Measurements	2	5	4
% Fines < 6 mm	19 – 40%, x = 29.5%	15 – 41%, x = 27%	13 – 31%, x = 21.5%
Wolman Pebble Count D-50	x = 20.6 mm	x = 21.9 mm	x = 29.6 mm
Dominant Substrate Type	Coarse gravel	Coarse gravel	Coarse gravel
Flow Measurement (8/24/01)	15.02 cfs	Not measured	13.77 cfs

Note #1: X = mean measurement.

4.4.1 Pool/Riffle Habitat

Pools and riffles are the basic components of stream habitat. The percentage and quality of these basic components help define the overall health of a stream. They are also key parameters that help

support both resident and anadromous populations of salmonids as well as other aquatic species that depend on a "healthy" stream.

Pool Habitat: Pools are used by adult salmonids for cover and resting, and pool tailouts are key spawning sites for many species. Juveniles depend on pools for cover, feeding, and refuge during extremes in stream flow. As the quantity and quality of pool habitat decreases, so does the abundance of aquatic life (salmonids, insects, mollusks, etc.). The importance of pool habitat and their associated tailouts can not be overstated. All spawning sockeye in Little Bear Creek observed during our studies were spawning in pool tailouts or the transition between the pool and their associated tailout. Although riffle habitat is also used in streams such as Little Bear Creek, riffles tend to be too shallow to be used consistently by most salmonids.

Pools are typically formed by stationary features such as large woody debris and boulders, abrupt changes in elevation, and changes in the direction of flow and substrate. The loss of large conifers within the riparian zone that contribute to in-stream woody debris and removal of in-stream wood has reduced the abundance and quality of pool habitat. Additional factors such as reduction in sinuosity, increased sedimentation, and changes in hydroperiod have further reduced habitat complexity.

In order to rate a stream within an urbanized environment, comparisons are made to more natural streams that have not been as heavily impacted by anthropogenic factors. Several researchers as well as state and federal agencies have suggested some basic standards upon which to rate a stream. Because of the wide variation in streams, bankfull width (BFW) and gradient are typically used as the parameters to which the standards are based. This is done so that comparisons are made to similar sized streams. Regardless of size, the overall area of pool habitat in a stream is typically expected to be about 40 percent to 60 percent to be considered optimum (Peterson et al., 1992).

Pool Frequency: The NMFS (1996) utilizes channel width (BFW) to develop a desired pool frequency (# pools/mile). Since the average BFW varied by reach, the desired pool frequency also varies. A stream is considered *properly functioning* if it meets the desired pool frequency and the large woody debris standards for properly functioning is also met (NMFS, 1996). A stream is considered *at risk* if it meets the desired pool frequency but large woody debris recruitment is inadequate to maintain pools overtime. A stream is considered to be *not properly functioning* if it does not meet the pool frequency standards. A comparison of the NMFS pool frequency standards and results of the DEA survey are presented below in Table 6.

Table 6:
Pool Frequency Data for Little Bear Creek, Woodinville

Reach	BFW	NMFS Match	NMFS Goal	Actual
Reach 1	19.0 ft.	20 ft.	56 pools/mile	21 pools/mile
Reach 2	20.3 ft.	20 ft.	56 pools/mile	43 pools/mile
Reach 3	22.6 ft.	25 ft.	47 pools/mile	41 pools/mile
Average	20.7 ft.	20 ft.	56 pools/mile	40 pools/mile

Based on the results presented in Table 6, pool frequency in Little Bear Creek is **not properly functioning**. This conclusion is strengthened by the fact that large woody debris recruitment is not sufficient to maintain existing pools over time due to the absence of large mature conifers within most of the riparian zone. Furthermore, the overall number of pools per kilometer in Little Bear Creek as it

flows through the City of Woodinville is 24.7 (40/mile), and the overall percentage of pool habitat is 33.1 percent. This further indicates that the frequency of pool habitat is below optimum levels.

Pool Quality: Although the number of pools is very important, another important factor is the residual depth, which is defined as the maximum depth minus tailout depth. The premise of residual depth is that deeper pools provide more cover, are more stable, and can be utilized by larger salmonids such as chinook. Shallow pools provide less cover, can be rapidly filled by sediment, and do not provide good refugia for salmonids.

The NMFS (1996) considers that pool quality is *properly functioning* when they contain pools >1 meter (3.3 feet) deep with good cover and cool water, and minor reduction of pool volume by fine sediment. Pool quality is *at risk* when few pools >1 meter (3.3 feet) are present or have inadequate cover/temperature, and only a moderate reduction in pool volume by fine sediment. Pool quality is *not properly functioning* when no pools are >1 meter (3.3 feet) deep and have inadequate cover/temperature, and there is a major reduction of pool volume by fine sediment. The NMFS Matrix of Pathways and Indicators does not mention "residual depth," therefore maximum depth will be used.

Within Reach 1, none of the five pools had a maximum depth >0.90 meter (2.9 feet). The maximum pool depth was 0.90 meter (2.9 feet), average pool depth was 0.60 meter (2 feet), average maximum depth was 0.85 meter (2.8 feet), average residual depth was 0.55 meter (1.8 feet), and maximum residual depth was 0.70 meter (2.3 feet). These pools also lacked "good" cover and "cool" water. Therefore, pool quality in Reach 1 is **not properly functioning**.

Reach 2 contained 46 pools, but only eight (17.4 percent) had a maximum depth equal to or >1 meter (3.3 feet). The maximum pool depth was 1.1 meter (3.6 feet), average pool depth was 0.43 meter (1.4 feet), average maximum depth was 0.73 meter (2.4 feet), average residual depth was 0.55 meter (1.8 feet), and maximum residual depth was 0.90 meter (2.9 feet). Although some of the pools contained good cover, most did not. Therefore, pool quality in Reach 2 is considered **at risk**.

Pool quality increased in Reach 3 due to the presence of deeper pools. Reach 3 contained 35 pools, nine (25.7 percent) of which had a maximum depth equal to or greater than 1 meter (3.3 feet). The maximum pool depth was 1.71 meter (5.6 feet), average pool depth was 0.39 meter (1.3 feet), average maximum depth was 0.75 meter (2.5 feet), average residual depth was 0.54 meter (1.8 feet), and maximum residual depth was 1.51 meter (4.9 feet). Compared to Reaches 1 and 2, the percentage of deeper pools increased and overall water temperature decreased, but few pools were considered to provide adequate cover. A reduction in pool volume due to fines was observed. Although conditions improved in Reach 3, pool quality is considered **at risk**. The overall pool quality in Little Bear Creek as it flows through the City of Woodinville is considered also **at risk** because few pools are greater than 1 meter (3.3 feet) deep.

Riffle Habitat: Riffles are also important spawning areas in many streams, and support a myriad of macroinvertebrates that provide the primary food source for juvenile salmonids as well as other species of fish. Gradient and water depth dictates the suitability for salmonid spawning while embeddedness and overall abundance of fines influence productivity. The NMFS (1996) states that gravel or cobble should be the dominant substrate, with embeddedness being less than 20 percent to be *properly functioning*. In other words, the interstitial spaces between the gravel or cobble should not be filled with more than 20 percent fines, and the gravel should not be compacted. Although

salmonids can and do spawn in gravel containing excess fines, the egg-to-fry ratio may be low. This could result in few, if any eggs surviving to the fry stage due to suffocation and entrapment.

Table 7 below summarizes the pool, riffle, and glide habitat parameters quantified by this survey. The raw data are provided in Appendix M. Table 7 is segmented by reach in order to capture trends as Little Bear Creek flows through the City of Woodinville. Overall, Reach 1 near the mouth of Little Bear Creek has been severely degraded while Reach 2 and 3 still contain "fair" habitat. Although pool habitat is **not properly functioning** based on NMFS standards, Reaches 2 and 3 of Little Bear Creek do contain a fair amount of suitable habitat (although somewhat degraded). The primary factors that have degraded pool habitat in Little Bear Creek are the lack of in-stream large woody debris, and relatively heavy sediment load.

Table 7:
Pool, Riffle, and Glide Habitat Summary for Reach 1, 2, and 3 of Little Bear Creek

	Reach 1	Reach 2	Reach 3
Total Habitat Area	1,773.58 m²	9,267.05 m²	7,379.52 m²
Total Pool Area	243.66 m²	3,151.51 m²	2,698.64 m²
Total Glide Area	266.81 m²	1,898.24 m²	1,574.86 m²
Total Riffle Area	1,263.11 m²	4,417.305 m²	3,106.02 m²
Percent Pool by Area	13.74%	34.01%	36.57%
Percent Glide by Area	15.04%	20.48%	21.34%
Percent Riffle by Area	71.22%	47.67%	42.09%
Number of Pools	5 (4 of 5 man made)	46	35
Pools per Kilometer	12.88	26.66	25.54
Total Length of Pool Habitat	74.8 meters	548.2 meters	421.9 meters
Dominant Pool Type	Plunge	Scour	Scour
Average Length of Pools	14.96 meters	11.92 meters	12.05 meters
Average Residual Pool Depth	0.55 meter	0.55 meter	0.54 meter
Maximum Residual Depth	0.70 meter	0.90 meter	1.51 meter
Maximum Pool Depth	0.90 meter	1.1 meter	1.71 meter
Average Maximum Pool Depth	0.85 meter	0.73 meter	0.75 meter
Average Pool Depth	0.60 meter	0.43 meter	0.39 meter
Average Pool Width	4.02 meters	6.10 meters	6.19 meters
Number of Riffles	4	43	40
Total Length of Riffle Habitat	246.80 meters	841.4 meters	634.28 meters
Average Length of Riffles	61.70 meters	19.57 meters	15.86 meters
Average Width of Riffles	5.35 meters	4.80 meters	4.81 meters
Average Depth of Riffles	0.34 meter	0.20 meter	0.16 meter
Number of Glides	5	16	19
Total Length of Glides	66.60 meters	336.1 meters	313.98 meters
Average Length of Glide Habitat	13.32 meters	19.57 meters	16.53 meters
Average Width of Glides	4.1 meters	4.75 meters	5.09 meters
Average Depth of Glides	0.43 meter	0.34 meter	0.25 meter

4.4.2 Large Woody Debris

Large woody debris (LWD) is a critical component of stream habitat because it creates pools, structure, and habitat diversity. Large pieces of coniferous trees provide the best habitat since they

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are long-lived and will not decay as rapidly as deciduous trees. Large pieces will also stay stationary during high flows and scour out pool habitat as water velocity is redirected around them.

The USFS protocol for LWD west of the Cascades segments wood into three size categories based on length and diameter (USFS, 2001). Small LWD must have a diameter >30.5 centimeters (12 inches) at a length of 7.62 meter (25 feet) from the large end. Medium LWD must have a diameter >61 centimeters (24 inches) at a length of 15.24 meter (50 feet) from the large end. Large LWD must have a diameter >0.91 meter (36 inches) at a length of 15.24 meter (50 feet) from the large end. The NMFS recommends that streams should have a minimum of 80 pieces of LWD per 1.61 km (1 mile) that are at least 15.24 meter (50 feet) long with a diameter of at least 61 centimeters (24 inches) to be *properly functioning*.

Both the USFS and NMFS standards are larger than what is now typically found in Puget Sound lowland streams. Although present in some streams in low numbers, LWD of this size are more appropriately categorized as remnant key pieces. Because of their scarcity, the new standard of measuring and categorizing pieces >2 meters (6.6 feet) long and wider than 10 centimeters (3.9 inches) has been adopted by several jurisdictions. Although these smaller pieces are not as influential as the key pieces, they do provide some function. By measuring and categorizing their size, abundance, and species, a more accurate account of existing habitat conditions can be obtained. Appendix N contains all the specific details of each piece of wood >2 meters (6.6 feet) long and 10 centimeters (4 inches) wide encountered in Little Bear Creek as it flows through the City of Woodinville.

Only 5 pieces large enough to meet the NMFS standard were recorded throughout the 3.48 kilometers (2.2 miles) of stream surveyed within the City of Woodinville. Researchers have documented that the occurrence of smaller pieces of wood such as those inventoried during this survey in natural streams occur at a rate of 150 to 460 pieces per kilometer (0.62 mile) (Peterson et al., 1992). The total number of pieces of LWD greater than 2 meters (6.6 feet) long per kilometer (0.62 mile) in Little Bear Creek is 110.5. Based on the NMFS criteria, large woody debris is **not properly functioning** in Little Bear Creek. Table 8 below summarizes our findings by reach, and the raw data are presented in Appendix N.

Table 8:
Woody Debris Summary for Reach 1, 2, and 3 of Little Bear Creek

	Reach 1	Reach 2	Reach 3
Total Wood Inventoried	16 pieces	217 pieces	152 pieces
# NMFS Woody Debris	0	4	1
Pieces (> 2 m long) per Meter	0.04	0.13	0.11
Pieces (> 2 m long) per kilometer	47.31	125.75	110.93
Distance between Pieces	24.26 meters	7.95 meters	9.01 meters
% Coniferous Woody Debris	66.7% (weirs)	23.6%	34.5%
% Deciduous Woody Debris	33.3%	76.4%	65.5%
Dominant Conifer Species	Cedar	Cedar	Cedar
Dominant Deciduous Species	Alder	Alder	Alder
Average Length	3.66 meters	3.31 meters	3.74 meters
Average Diameter	32.5 cm	29.2 cm	27 cm
# Stumps	0	18	10
# Log Jams	0	4	3

Note: The results for Reach 1 were skewed due to the presence of log weirs.

4.4.3 Sediment and Substrate

Stream substrate varies significantly on all scales, and no survey method is perfect at documenting substrate composition on the reach scale. DEA utilized the Wolman (1954) pebble count due to its ease of use, comparability with existing data, and acceptance by both King County and the USFS. However, the Wolman pebble count method focuses on riffle habitat and hence does document substrate composition in pool tailouts. Pool tailouts are often extensively used for spawning.

Variation in substrate occurs by watershed, stream, reach, and habitat type. The substrate also varies on the site-specific scale when analyzing either lateral or longitudinal change. This variation in conjunction with the numerous methods of assessing substrate composition has created difficulties in adequately documenting and interpreting the results of sampling efforts. However, the variation in substrate composition on the watershed scale is one of the many factors that allows for a diverse benthic community to exist such as macroinvertebrates, mollusks, and numerous species of fish that reside within the substrate during their larval stage. A few of the factors that influence substrate composition include flow, gradient, sediment load, and location within the watershed.

Sediment: The focus of most stream substrate assessments is to determine the percentage of fines in potential salmonid spawning habitat. The percentage of fines is then used to infer the quality of spawning habitat because too many fines can degrade in-stream habitat and adversely impact salmonid spawning success. Streams in urbanized watersheds "tend" to have a larger percentage of smaller particles (May, 1996). The NMFS Matrix, as modified by the Mt. Baker/Snoqualmie National Forest, uses percent fines as an indicator of the quality of potential spawning and rearing habitat. Percent fines is used for assessing both spawning and incubation habitat. However, the size range depends on if the field data is collected from the stream surface (<6 millimeters [0.24 inch]) or from within the substrate (<0.85 millimeter [0.03 inch]). The Wolman pebble count collects stream substrate surface data. Therefore, based on NMFS Matrix values as modified by the Mt. Baker/Snoqualmie National Forest that includes surface fines: ≤20 percent fines (<6 millimeters [0.24 inch]) and low turbidity is considered *properly functioning* in most watersheds, 12 percent to 20 percent fines and moderate turbidity is considered *at risk*, and >20 percent fines and high turbidity is considered *not properly functioning* (Appendix L-2).

The results of the Wolman pebble count data collected in Little Bear Creek highlights the variability of fines (Table 9). Data was collected at 11 riffles, the percent fines <6 millimeter (0.24 inch) ranged from 13 percent to 41 percent, with an overall average of 25.45 percent. Based on these results, the sediment indicator at the local level ranges from **properly functioning** to **not properly functioning**, but averages in the **at risk** range. Assuming this data is representative and enough samples were collected to identify possible trends, an overall general trend of fewer fines per reach occurred as sampling progressed upstream. The average percent fines in Reach 1 was 29.5 percent, Reach 2 was 27 percent, and Reach 3 was 21.5 percent. These reach averages are all greater than 20 percent, and therefore indicates that the overall sediment indicator for Little Bear Creek is **not properly functioning**.

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Table 9:
Substrate Composition Based on Wolman Pebble Counts in Little Bear Creek, Woodinville

#	Reach #	NSO	Location	Fines <6 mm	D35	D50	D84	D95
1.	1	1	R1: Station 18.4	40%	1.9 mm	16.0 mm	175.8 mm	299.3 mm
2.	1	14	R8: Imm. D. stream SR 202	19%	14.2 mm	25.1 mm	132.4 mm	203.4 mm
3.	2	2	Imm. U. stream SR 202	21%	19.2 mm	29.6 mm	64.9 mm	99.5 mm
4.	2	15	R9	41%	1.9 mm	10.1 mm	30.7 mm	44.0 mm
5.	2	27	Station 558.9, UW Bug site	26%	9.6 mm	16.5 mm	35.0 mm	50.7 mm
6.	2	56	R26: Station 1015	32%	8.0 mm	17.9 mm	30.9 mm	43.2 mm
7.	2	76	NSO 76	15%	27.0 mm	35.5 mm	67.5 mm	93.8 mm
8.	3	3	R2	13%	22.9 mm	30.6 mm	57.1 mm	78.1 mm
9.	3	38	R23	24%	20.1 mm	48.7 mm	48.7 mm	61.1 mm
10.	3	50	R30	18%	16.1 mm	22.7 mm	58.4 mm	87.5 mm
11.	3	81	R49	31%	7.4 mm	16.2 mm	41.9 mm	63.9 mm

Wolman pebble count data also documents larger particle size distribution (D35 – D95). The "D" represents distribution, while the adjoining number represents the percentile of interest. The D35 equates to the distribution of the 35 percentile of the particle size distribution. Whereas the D50 is the median particle size of a distribution that divides the distribution in two equal parts (mid-point/median). Another way of expressing this concept is that a percentile is a sediment size indicated by the cumulative distribution curve for a particle "percent finer" value. Therefore, D35 means 35 percent of the sample was smaller than the cumulative particle size (diameter in millimeters) documented at the riffle. In the case of the first sample site, 35 percent of the pebbles measured were smaller than 1.9 millimeter (0.075 inch) in diameter. The data in the form of a cumulative distribution curve from each of the sample sites is provided in Appendix O.

Substrate: The NMFS utilizes both embeddedness and substrate composition as the indicators for substrate quality. The percentage embeddedness is obtained visually and is extremely subjective. The NMFS criteria for *properly functioning* is a dominance of gravel or cobble (interstitial spaces clear) and embeddedness <20 percent, *at risk* is gravel and cobble subdominant or if dominant embeddedness is between 20 percent and 30 percent, and *not properly functioning* if bedrock, sand, silt or small gravel dominant or if gravel and cobble dominant embeddedness is >30 percent.

Based on the D50 results, the median gravel size in riffles throughout Little Bear Creek in the City of Woodinville ranged from medium to very coarse gravel. The D50 in Reach 1 ranged from 16 to 25.1 millimeters (0.63 to 0.99 inch) with the average being 20.55 millimeters (0.81 inch) (coarse gravel). The D50 in Reach 2 ranged from 10.1 to 35.5 millimeters (0.40 to 1.4 inches) with the average being 21.92 millimeters (0.86 inch) (coarse gravel). The D50 in Reach 3 ranged from 16.2 to 48.7 millimeters (0.64 to 1.92 inches) with the average being 29.55 millimeters (1.16 inches) (coarse gravel). Although more samples should be taken to increase confidence levels, there appears to be a trend of increasing D50 results as the upstream distance from Reach 1 increases. Although coarse gravel was dominant, interstitial spaces were not clear, and embeddedness averaged from 20 percent to 30 percent (sometimes >30 percent). Based on these results, the Habitat Element Pathway – Substrate Indicator is **at risk**.

4.4.4 Off-Channel Habitat/Refugia

The availability of "adequate" off-channel habitat and refugia are indicators of a stream's ability to provide a safe haven for primarily juvenile fish during high flow events. These are generally areas of lower stream velocity that can be accessed during flood events, but also includes low energy areas during normal stream flows such as backwater areas with cover, ponds, and oxbows.

Few side-channels, oxbows, or other types of potential off-channel habitat/refugia exist along Little Bear Creek. Although a few potential off-channel habitat and refugia sites were noted, they were not adequately abundant or distributed in Little Bear Creek. It appears that hydromodifications in the form of rip/rap armoring throughout Reach 1, and sections of Reaches 2 and 3 in conjunction with the loss of adjacent wetlands and tributaries that are culverted into Little Bear Creek, the indicator for off-channel habitat and refugia are **not properly functioning**.

4.4.5 Channel Condition and Dynamics

The channel condition and dynamics pathway includes three primary indicators assessed by the NMFS. These include: (1) width/depth ratio, (2) streambank condition, and (3) floodplain connectivity. Additional parameters not included in the Matrix of Pathways and Indicators developed by the NMFS (1996) that also provide insight into channel conditions and dynamics of a stream include: channel sinuosity and percent armoring. Although no specific percentages have been defined by the federal agencies for these last two indicators, they provide insight into the degree of anthropogenic influences that have been placed upon a stream. Both channel sinuosity and percent armoring are often closely associated with each other in that as the percentage of armoring increases the overall sinuosity decreases.

Width/Depth Ratio: The width/depth ratio concept relies on the premise that a stream channel will incise when banks are armored. This channel down cutting is created as high-flows that would normally spill-out into and over the adjacent stream banks are forced to stay within the defined channel by the presence of armoring (typically large rip/rap). The hydrologic impacts of urbanization typically widen and/or deepen a stream channel when the banks are not armored, but streamside development will often have the opposite effect (May et al., 1997).

The NMFS (1996) states that a *properly functioning* stream has a width/depth ratio of <10, an *at risk* stream has a ratio between 10 to 12, and the ratio for a *not properly functioning* stream is >12 (Appendix L-1). Based on the results of King County (2001b), the width/depth ratio for Reaches 1 through 3 is 5.8, 5.3, and 8.0, respectively. Based on their data, this indicator is **properly functioning** throughout Reaches 1 through 3. Although this could possibly be true for Reaches 2 and 3, it does not seem possible that Reach 1 could be properly functioning given that 98.3 percent is armored close to the bankfull line. Based on this, and that May et al., (1997) found varying results, this indicator as currently defined does not appear to be suited for urbanized streams in Puget Sound. Considering these issues, the width/depth ratio in Reach 1 is considered by DEA to be **not properly functioning**, and **at risk** in Reaches 2 and 3.

Streambank Condition: Streambank condition refers to the percentage of the bank that is stable and the percentage that is actively eroding. The NMFS (1996) defines a *properly functioning* streambank as being >90 percent stable with <10 percent actively eroding, 80 percent to 90 percent stable when *at risk*, and <80 percent stable when *not properly functioning*. This indicator also appears at least

partially flawed since a streambank that is completely armored would be considered stable using this approach and would be categorized as properly functioning. If the banks contain a predominance of gravels and not fines, the addition of new gravels to a stream channel can be beneficial. King County (2001b) reported that Reach 1 was 32 percent armored, 32 percent full scour, 33 percent low scour, and zero percent stable. Reach 2 was 9 percent armored, 18 percent full scour, 46 percent low scour, and 27 percent stable (King County, 2001b). Reach 3 was 6 percent armored, 16 percent full scour, 26 percent low scour, and 52 percent stable (King County, 2001b).

DEA biologists documented 98.3 percent armoring in Reach 1 distributed equally between the left and right banks. The percent armoring in Reach 2 varied depending upon bank (Table 10). The right bank (RB) was armored for a distance of 185.6 meters (608.9 feet) or 10.7 percent, while the left bank (LB) was armored for 288.4 meters (946.2 feet) or 16.7 percent. This discrepancy is due to the abundance of businesses along the left bank, and the relatively long distance between the right bank and Highway 522. Several sites along the left bank were experiencing localized sloughing as a result of streambank encroachment and absence of riparian vegetation (Appendix D – Reach 2 Photo 7). The percent armoring in Reach 3 also varied depending upon bank. The right bank was armored for a distance of 225.6 meters (740.2 feet) or 16.5 percent, while the left bank was armored for a distance of 198.5 meters (651.2 feet) or 14.5 percent. Based on these results, the streambank condition indicator is **not properly functioning**.

Table 10:
Bank Armoring Along Little Bear Creek in Woodinville

#	Reach	Bank	Downstream Station (m)	Upstream Station (m)	Length	Comment
1.	1	RB	6.6	388.2	381.6 meters	Rip/rap +
2.	1	LB	6.6	388.2	381.6 meters	Rip/rap +
3.	2	RB	0.0	39.7	39.7 meters	SR 202 culvert
4.	2	LB	0.0	39.7	39.7 meters	SR 202 culvert
5.	2	LB	128.6	138.2	9.6 meters	Rip/rap
6.	2	RB	196.0	226.5	30.5 meters	132nd Ave culvert
7.	2	LB	196.0	226.5	30.5 meters	132nd Ave culvert
8.	2	LB	254.5	274	19.5 meters	Rip/rap
9.	2	LB	311.4	315.2	3.8 meters	Rip/rap
10.	2	RB	487.1	498.6	11.5 meters	134th Ave culvert
11.	2	LB	487.1	498.6	11.5 meters	134th Ave culvert
12.	2	LB	778.4	786.0	7.6 meters	Gabion weir
13.	2	LB	839	846.1	7.1 meters	Rip/rap
14.	2	LB	870.9	898.5	27.6 meters	Rip/rap
15.	2	LB	1262.7	1274.2	11.5 meters	Rip/rap
16.	2	LB	1281.2	1286.3	5.1 meters	Rip/rap
17.	2	LB	1380.7	1390.2	9.5 meters	CMP discharge
18.	2	RB	1595.7	1637.1	41.4 meters	Old crossing +
19.	2	LB	1595.7	1615.6	19.9 meters	Old crossing +
20.	2	LB	1651.7	1666.7	15.0 meters	Rip/rap
21.	2	RB	1666.7	1725.7	62.5 meters	Hwy 522 culvert
22.	2	LB	1666.7	1725.7	62.5 meters	Hwy 522 culvert
23.	3	RB	0.0	17.1	17.1 meters	Rip/rap deflector
24.	3	LB	135.3	155.4	20.1 meters	Rip/rap - On-ramp

Table 10 continued

#	Reach	Bank	Downstream Station (m)	Upstream Station (m)	Length	Comment
25.	3	LB	267.6	273.1	5.5 meters	Rip/rap - On-ramp
26.	3	RB	277.7	313.6	35.9 meters	Rip/rap - House
27.	3	LB	271.3	313.6	42.3 meters	Rip/Rap - On-ramp
28.	3	RB	313.6	350.2	36.6 meters	NE 195th Street culvert
29.	3	LB	313.6	350.2	36.6 meters	NE 195th Street culvert
30.	3	RB	350.2	396.0	45.8 meters	Old business
31.	3	LB	350.2	396.0	45.8 meters	Old business
32.	3	LB	616.9	634.9	18.0 meters	Hwy 522 edge
33.	3	RB	915.3	1005.5	90.2 meters	Old Bridge + yards
34.	3	LB	915.3	934.5	19.2 meters	Old Bridge
35.	3	LB	1297.5	1308.5	11.0 meters	House

Floodplain Connectivity: The floodplain indicator as defined by the NMFS (1996) includes hydrologic linkage between adjacent off-channel areas, wetlands, and riparian vegetation and succession. This indicator does not specify quantifiable measurements, but relies on subjective inferences of frequently linked, reduced linkage, and severe reduction in linkage. Based on the lack of off-channel habitat, adjacent wetlands, and greater than 10 percent armoring along all three reaches, this indicator is **not properly functioning**.

4.4.6 Riparian Habitat

Riparian habitat is defined as the land adjoining the stream that influences stream habitat and its processes. The composition and quantity of riparian habitat directly influences temperature, sedimentation, productivity, habitat complexity, and the streams disturbance regime. An "intact" riparian zone buffers the stream from outside elements. One issue today is how large does a buffer have to be to protect a stream from anthropogenic influences. A buffer of 30.5 meters (100 feet) is often used for salmonid-bearing streams. However, many researchers have documented that a 30.5-meter (100-foot) buffer is not sufficient in protecting a stream and its processes from all anthropogenic influences, especially when the quality of the existing buffer is low. Some researchers have suggested that if the goal is to truly protect a valuable resource, than buffer width should be at least 100 meters (328 feet). However, this width can be adjusted downward depending on the maturity and overall percentage of the existing riparian habitat. Furthermore, it is also recognized that the composition of the entire watershed plays a vital role in a stream's overall health. On the watershed scale, the percent or fraction of total impervious area has been found to have a direct correlation with a stream's productivity (May et al., 1997).

This report will focus on a linear corridor adjacent to the stream, 61 meters (200 feet) from each bank or 122 meters (400 feet) total width. Site specific conditions within the City of Woodinville based on aerial photographs from 1999 indicate the width of the Little Bear Creek vegetated riparian buffer varies considerably by reach (Appendix G).

The width of the vegetated riparian buffer in Reach 1 averages about 7.6 meters (25 feet) wide and is abutted by development along both banks. The overall 121.9-meter (400-foot) wide corridor

within Reach 1 was composed of 64.36 percent impervious surface, 27.97 percent shrub/grass habitat, 5.11 percent forest habitat, and 2.59 percent gravel area.

The width of the vegetated buffer in Reach 2 varied between the left and right banks. The left bank ranges from 7.6 to 22.9 meters (25 to 75 feet) wide (average width about 7.6 meters [25 feet]) and is abutted by businesses. The right bank ranges from 15.2 to >61 meters (50 to >200 feet) wide (average width about 45.7 meters [150 feet]) and is abutted by Highway 522. The overall 122-meter (400-foot) wide corridor within Reach 2 was composed of 19.38 percent impervious surface, 46.46 percent shrub/grass habitat, 21.63 percent forest habitat, and 12.52 percent gravel area.

The width of the vegetated riparian buffer along both banks of Reach 3 varies from 15.2 to >61 meters (50 to >200 feet). The right bank is relatively unconstrained while the left bank is defined by Highway 522. The overall 122-meter (400-foot) corridor in Reach 3 was composed of 17.12 percent impervious surface, 1.55 percent gravel area, 45.76 percent forested habitat, and 35.56 percent shrub/grass habitat (Table 11).

Table 11:
Land Use Based on 1999 Aerial Photograph
Along Little Bear Creek, Woodinville

Land Use	Reach 1	Reach 2	Reach 3	Total
Developed Impervious	64.36%	19.38%	17.12%	24.05%
Gravel - cleared impervious	2.59%	12.52%	1.55%	6.56%
Forested Habitat	5.11%	21.63%	45.76%	29.94%
Shrub/Grass Habitat	27.97%	46.46%	35.56%	39.45%

Based on the photo interpretation of the 1999 aerial photographs (Appendix G), two trends are apparent. The percentage of developed impervious (developed and gravel [cleared impervious]) surface is significantly higher along the lower reaches while the percentage of forested habitat significantly decreases. The high percentage (12.52 percent) of cleared gravel area along Reach 2 may be an indicator that more development is planned and that the percentage of developed impervious surface will continue to increase within potential buffer habitat.

The remaining riparian buffer and upland forest habitat is of vital importance to the continued functionality of Little Bear Creek. However, the composition of the buffer along Little Bear Creek is varied, and typically dominated by deciduous trees and non-native species of grasses and shrubs. Red alder (*Alnus rubra*), Himalayan blackberry (*Rubus procerus*), bittersweet nightshade (*Solanum dulcamara*), and reed canarygrass (*Phalaris arundinacea*) are abundant throughout Reaches 1 and 2, and the lowermost section of Reach 3. Japanese knotweed (*Polyonum cuspidatum*), another introduced species is also present and locally abundant, but not as widespread as the other aforementioned invasive species.

A continuous 61-meter (200-foot) riparian buffer along each bank composed of mature coniferous forest with numerous adjoining wetlands should be the goal along the Little Bear Creek corridor. Based on our survey results, these target conditions are absent, but scattered sections along the left bank of Reach 3 do possess some of the desired traits.

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The remaining buffer is composed of primarily deciduous trees, shrubs, and grasses. A detailed list of the species observed along Little Bear Creek is contained in Tables 12, 13, 14, and 15 below. As mentioned previously, red alder is the most abundant tree species along Little Bear Creek, followed by black cottonwood (*Populus balsamifera*), big-leaf maple (*Acer macrophyllum*), and willow (*Salix* spp). Other species such as Douglas fir and western red-cedar become more prevalent in Reach 3. Two Pacific yew (*Taxus brevifolia*) trees were observed along Reach 2. These are long-lived small conifer trees that were used extensively by native Americans and are a source of the cancer fighting drug taxol. The two observed along Little Bear Creek are remnants from pre-settlement. Once gone, Pacific yews will likely not become reestablished because of the absence of mature coniferous forest.

Table 12:
Tree Composition Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	Comment
1.	2, 3.	Vine maple	*Acer circinatum*	Native.
2.	1, 2, 3.	Big-leaf maple	*Acer macrophyllum*	Native.
3.	1, 2, 3.	Red alder	*Alnus rubra*	Native.
4.	2, 3.	Black hawthorne	*Crataegus douglasii*	Native.
5.	1, 3.	Oregon ash	*Fraxinus latifolia*	Native.
6.	1, 2, 3.	Sitka spruce	*Picea sitchensis*	Native.
7.	1	Shore pine	*Pinus contorta*	Native.
8.	1, 2, 3.	Black cottonwood	*Populas balsamifera*	Native.
9.	1, 2, 3.	Bitter cherry	*Prunus emarginata*	Native.
10.	1, 2, 3.	Douglas fir	*Pseudotsuga menziesii*	Native.
11.	2, 3.	Cascara buckthorn	*Rhamnus purshiana*	Native.
12.	1, 2, 3.	Pacific willow	*Salix lasiandra*	Native.
13.	2, 3.	Scouler willow	*Salix scouleriana*	Native.
14.	1, 2, 3.	Sitka willow	*Salix sitchensis*	Native.
15.	2.	Pacific yew	*Taxus brevifolia*	Native.
16.	2, 3.	Western red cedar	*Thuja plicata*	Native.
17.	2, 3.	Western hemlock	*Tsuga heterophylla*	Native.

Shrubs and vines are abundant along Little Bear Creek. The most common along the stream bank include Himalayan blackberry, bittersweet nightshade, and Pacific ninebark (*Physocarpus capitatus*). Others such as Scotch broom (*Cytisus scoparius*) are also abundant, but typically occur beyond the riparian zone, especially within the disturbed areas between Little Bear Creek and Highway 522 along Reaches 2 and 3.

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Table 13:
Shrub and Vine Composition Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	Comment
1.	1, 2, 3.	Red-twig dogwood	*Cornus sericea*	Native.
2.	2	Beaked hazelnut	*Corylus cornuta*	Native.
3.	1, 2, 3.	Scotch broom	*Cytisus scoparius*	Introduced, invasive
4.	2	Salal	*Gaultheria shallon*	Native.
5.	3.	Black twinberry	*Lonicera involucrata*	Native.
6.	2, 3.	Indian plum	*Oemieria cerasiformis*	Native.
7.	3.	Devil's club	*Oplopanax horridus*	Native.
8.	1, 2, 3.	Pacific ninebark	*Physocarpus capitatus*	Native.
9.	2, 3.	Sword fern	*Polysticum munitum*	Native.
10.	3.	Stink currant	*Ribes bracteosum*	Native.
11.	2	Wild rose	*Rosa* spp.	Native.
12.	1, 2, 3.	Evergreen blackberry	*Rubus laciniatus*	Introduced, invasive.
13.	2, 3.	Thimble berry	*Rubus parviflorus*	Native.
14.	1, 2, 3.	Himalayan blackberry	*Rubus procera*	Introduced, invasive.
15.	1, 2	Salmonberry	*Rubus spectabilis*	Native.
16.	2, 3.	Trailing blackberry	*Rubus ursinus*	Native.
17.	2	Red elderberry	*Sambucus racemosa*	Native.
18.	2, 3.	Douglas spirea	*Spiraea douglasii*	Native.
19.	3.	Highbush-cranberry	*Viburnum edule*	Native.

Herbs represent the most diverse subset of plants encountered along Little Bear Creek. The most common groups include the grasses and weeds. The herb category also contains the largest percentage of introduced species, many of which are invasive. They typically are the first group of species to colonize disturbed areas and once present are difficult to remove. Some of these species such as reed canarygrass and bittersweet nightshade can be extremely abundant, and have established extensive monocultures within the riparian zone. Others such as purple loosestrife and yellow flag iris are present but sparse.

Table 14:
Herb Composition Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	Comment
1.	2	Creeping bentgrass	*Agrostis stolonifera*	Introduced.
2.	3.	Pearly everlasting	*Anaphalis margaritacea*	Native.
3.	1, 2, 3.	Lady fern	*Athyrium felix-femina*	Native.
4.	2, 3.	Canada thistle	*Cirsium arvense*	Introduced, invasive.
5.	3	Poison hemlock	*Conium maculatum*	Introduced.
6.	1, 2, 3.	Morning glory	*Convolvulus arvensis*	Introduced, invasive.
7.	2	Bristly hawksbeard	*Crepis setosa 'Haller'*	Introduced.
8.	2	Orchard grass	*Dactylis glomerata*	Introduced.
9.	2	Bleeding heart	*Dicentra formosa*	Native.
10.	1, 2	Fireweed	*Epilobium* sp.	Introduced.
11.	2	Field horsetail	*Equisetum arvense*	Native.
12.	1, 2	Giant horsetail	*Equisetum telmateia*	Native.

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Table 14 continued

#	Reach #	Common Name	Scientific Name	Comment
13.	2	Tall fescue	*Festuca arundinacea*	Introduced.
14.	2, 3.	Bedstraw	*Galium aparine*	Native.
15.	2, 3.	Robert geranium	*Geranium robertianum*	Introduced, invasive.
16.	3.	Big-leaf avens	*Geum macrophyllum*	Native.
17.	1	St. John's-wort	*Hypericum perforatum*	Introduced, invasive, noxious.
18.	1, 2	Yellow touch-me-not	*Impatiens noli-tangere*	Introduced.
19.	1, 2	Yellow-flag iris	*Iris pseudacorus*	Introduced, invasive.
20.	1, 2,	Soft rush	*Juncus effusus*	Native.
21.	2	Daggerleaf rush	*Juncus ensifolius*	Native.
22.	3	Duck weed	*Lemna minor*	Native.
23.	2, 3.	Birdsfoot trefoil	*Lotus corniculatus*	Introduced, invasive.
24.	3	Skunk cabbage	*Lysichitum americanum*	Native.
25.	2, 3.	Purple loosestrife	*Lythrum salicaria*	Introduced, invasive.
26.	2	False lily-of-the-valley	*Maianthemum dilatatum*	Native.
27.	2, 3.	Small water forget-me-not	*Myosotis laxa*	Native.
28.	2	Common evening primrose	*Oenothera biennis*	Introduced – N.E. USA.
29.	1, 2, 3.	Reed canarygrass	*Phalaris arundinacea*	Introduced, invasive.
30.	1	English plantain	*Plantago major*	Introduced.
31.	1, 2, 3.	Japanese knotweed	*Polygonum cuspidatum*	Introduced, invasive.
32.	2, 3.	Bracken fern	*Pteridium aquilinum*	Native.
33.	2, 3.	Creeping buttercup	*Ranunculus repens*	Introduced, invasive.
34.	2	Water cress	*Rorippa nasturtium-aquaticum*	Introduced.
35.	2	Red sorrel	*Rumex acetosella*	Introduced.
36.	2, 3.	Curly dock	*Rumex crispus*	Introduced.
37.	2, 3.	Bitter dock	*Rumex obtusifolius*	Introduced.
38.	1, 2, 3.	Small-fruited bulrush	*Scirpus microcarpus*	Native.
39.	1, 2, 3.	Bittersweet nightshade	*Solanum dulcamara*	Introduced, invasive.
40.	2, 3.	Hedge nettle	*Stachys cooleyae*	Native.
41.	1	Tansy	*Tanacetum vulgare*	Introduced, invasive.
42.	1	Dandelion	*Taraxacum officinale*	Introduced, invasive.
43.	2, 3.	Piggy-back plant	*Tolmeia menziesii*	Native.
44.	2	White clover	*Trifolium repens*	Introduced.
45.	2, 3.	Stinging nettle	*Urtica dioica*	Introduced.

Ornamentals represent introduced species that were typically planted in private yards or businesses. They are usually not invasive, except for English ivy (*Hedera helix*), which can choke trees. Most do not represent a threat and are unable to naturally propagate. Others such as English holly (*Liex aquifolium*) are distributed by bird droppings, but are not problematic.

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Table 15:
Ornamental Composition Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	Comment
1.	3	Norway maple	*Acer platanoides*	Introduced.
2.	3	Red maple	*Acer rubrum*	Introduced.
3.	1	Butterfly bush	*Buddleia davidii*	Introduced.
4.	3	Parneyi cotoneaster	*Cotoneaster lacteus*	Introduced.
5.	3	Crocosmia	*Crocosmia* sp.	Introduced.
6.	1	Buning bush	*Euonymus alaalatus*	Introduced.
7.	1, 2	English ivy	*Hedera helix*	Introduced, invasive.
8.	3	Blue star juniper	*Juniperus squamata*	Introduced.
9.	2	English holly	*Liex aquifolium*	Introduced.
10.	1	Apple fruit tree	*Malus* sp.	Introduced.
11.	1	Scotch pine	*Pinus sylvestris*	Introduced.
12.	3	Thundercloud plum tree	*Prunus cerasifera*	Introduced.
13.	1	Otto-luyken laurel	*Prunus laurocerasus*	Introduced.
14.	1	Plum fruit tree	*Prunus* sp.	Introduced.
15.	3	Flowering cherry tree	*Prunus* sp.	Introduced.
16.	1	Rhododendron species	*Rhododendron* sp.	Introduced.
17.	1, 2, 3.	Locust tree	*Robinia* sp.	Introduced.
18.	1	Weeping willow	*Salix babylonica*	Introduced.
19.	2	European mountain ash	*Sorbus acuparia*	Introduced.

The NMFS (1996) indicator for riparian reserves includes several factors that must be assessed in order to determine its existing state. These factors include: adequate shade, large woody debris recruitment, habitat protection, connectivity, and percent similarity of riparian vegetation to the potential natural community/composition. The functionality of the riparian reserve decreases as loss and fragmentation increase, and as the percent similarity of the existing riparian vegetation to the potential natural community/composition drops from >50 percent (*properly functioning*), to 25 percent to 50 percent (*at risk*), and finally <25 percent (*not properly functioning*). The percent "intact" can also be quantified in that >80 percent is considered *properly functioning*, 70 percent to 80 percent is considered *at risk*, and <70 percent is considered *not properly functioning*. Based on the analysis of aerial photographs, ground truthing, and detailed stream survey, the results indicate the riparian reserves vary by reach.

The riparian reserve in Reach 1 is **not properly functioning** due to only 5.11 percent being forested habitat within the 122-meter (400-foot) wide corridor. Furthermore, the limited amount of riparian reserves along Reach 1 are dominated by deciduous trees and introduced invasive species.

The functionality of the riparian reserve in Reach 2 is not as clear as Reach 1. Although the percent forested increased to 21.63 percent, it is also composed of primarily deciduous trees, introduced invasive species are abundant, and shrubs and grasses (46.46 percent) dominate large tracts. The riparian reserve in this reach is also confined between Highway 522 to the west and commercial businesses to the east. Furthermore, the ability of the reserve to provide large woody debris and

adequate shading has been extremely compromised. Therefore, based on these facts, the riparian reserve in Reach 2 is also **not properly functioning**.

The functionality of the riparian reserve in Reach 3 increases as the percent forested habitat increased to 45.76 percent, and overall shading increased (except immediately upstream of NE 195th Street). Although the potential for future large woody debris recruitment is still unacceptably low, and much of the forest has a high deciduous component, conifers become much more prevalent. Because of these factors, the riparian reserve is considered **at risk** in Reach 3.

The overall rating for the riparian reserve in Little Bear Creek as it flows through the City of Woodinville is considered **not properly functioning**. Although conditions improve in the upper reaches, the overall dominance of deciduous trees, poor potential for future large woody debris recruitment and lack of shade in Reaches 1 and 2 indicate that overall the riparian reserve is **not properly functioning**.

4.4.7 Water Quality

The NMFS (1996) considers temperature, sediment, and chemical contamination/nutrients in their Matrix of Diagnostics/Pathways and Indicators criteria. Of these, sediment was previously discussed in Section 4.4.3, Substrate.

Temperature: Water temperature is a key factor controlling the ability of salmonids to survive in a stream. It will also influence species composition in that some species such as bull trout require exceptionally colder water to successfully reproduce. Water temperatures rising above a 7-day average maximum of 7.8°C (46°F) is reported to limit spawning and rearing success of bull trout.

The following temperatures are average 7-day maximums. The NMFS (1996) considers 10 to 13.9°C (50 to 57°F) or less to be *properly functioning*. At risk temperatures depend on time of year or life cycle (spawning or migration and rearing). Water temperature is considered *at risk* for spawning adults when between 13.9 to 15.6°C (57 to 60°F), and for migration and rearing when 13.9 to 17.8°C (57 to 64°F). Stream temperatures above 15.6°C (>60°F) for spawning and above 17.8°C (>64°F) for migration and rearing are considered *not properly functioning*. The Washington State Department of Ecology reported that temperatures from 21 to 22°C (69.8 to 71.6°F) are lethal to chinook salmon while temperatures from 20 to 21°C (68 to 69.8°F) create thermal barriers (Hicks, 2000 as reported by Kerwin, 2001).

DEA biologists monitored two Hobo temperature data loggers in Little Bear Creek between June 16 and October 17, 2001 (4 months). The lowermost data logger was installed near the mouth of Little Bear Creek while the uppermost was installed downstream of NE 205th Street crossing near the King/Snohomish County line. Each data logger was set to collect hourly readings. The City of Woodinville is continuing the monitoring effort beyond the period of analysis documented in this report (Monzaki, personal communication, 2001).

Table 16 below presents the consolidated stream temperature data in the NMFS 7-day average maximum temperature format for Little Bear Creek from June 16 through October 17, 2001. Juvenile

life cycle data is for chinook salmon as defined by Kerwin (2001) as adapted by Myers et al., 1998. The outmigration period lasts from early March through late July, peaking in June. Adult migration and spawning life cycle data was determined by reviewing the WDFW salmon spawning ground survey data from 1952 through 2000. The earliest observation of an adult chinook in Little Bear Creek occurred on September 29 while the latest live sighting occurred on November 5th, peaking in October. Although this analysis is focused on chinook salmon it is important to note that some species such as juvenile coho salmon, resident cutthroat trout, coastrange sculpins, and western brook lampreys are present in Little Bear Creek throughout the year.

Table 16:
7-day Average Maximum Stream Temperatures for Little Bear Creek, Woodinville

Week	Reach 1 Mouth	Reach 3 205th	Chinook Salmon Life Cycle	NMFS Indicator Status
6/16 – 6/22	15.3°C	14.9°C	Peak Juvenile Migration and Rearing	At Risk
6/23 – 6/29	14.8°C	14.5°C	Peak Juvenile Migration and Rearing	At Risk
6/30 – 7/6	16.4°C	16.1°C	Peak Juvenile Migration and Rearing	Not Properly Functioning
7/7 – 7/13	17.0°C	16.6°C	Juvenile Migration and Rearing	Not Properly Functioning
7/14 – 7/20	15.1°C	14.7°C	Juvenile Migration and Rearing – Adults in Lake Wa.	At Risk
7/21 – 7/27	16.1°C	15.6°C	Juvenile Migration and Rearing – Adults in Lake Wa.	Not Properly Functioning
7/28 – 8/3	15.0°C	14.7°C	Juvenile Migration and Rearing – Adults in Lake Wa.	At Risk
8/4 – 8/10	16.8°C	16.3°C	Juvenile Chinook now absent – Adults in Lake Wa.	Not Properly Functioning
8/11 – 8/17	17.2°C	16.5°C	Adults in Lake Washington	Not Properly Functioning
8/18 – 8/24	15.6°C	15.0°C	Adults in Lake Washington	Not Properly Functioning/At Risk
8/25 – 8/31	16.3°C	15.8°C	Adults in Lake Washington	Not Properly Functioning
9/1 – 9/7	14.8°C	14.4°C	Adults in Lake Washington	At Risk
9/8 – 9/14	14.7°C	14.2°C	Adults in Lake Washington	At Risk
9/15 – 9/21	13.7°C	13.3°C	Adults possibly present in Little Bear Creek	High-end of Properly Functioning
9/22 – 9/28	13.7°C	13.1°C	Adult Chinook likely present Little Bear Creek	High-end of Properly Functioning
9/29 – 10/5	12.0°C	11.6°C	Adult Chinook present – spawning in Little Bear Creek	Properly Functioning
10/6 – 10/12	11.1°C	10.6°C	Adult Chinook present – spawning in Little Bear Creek	Properly Functioning
10/13 – 10/17	11.0°C	10.6°C	Adult Chinook present – spawning in Little Bear Creek	Properly Functioning

Notes: *Properly Functioning* = 10 to 13.9° C.
At Risk = 13.9 to 15.6° C for migrating adults, and 13.9 to 17.8° C for migration and rearing.
Not Properly Functioning = >15.6° C for spawning, and >17.8° C for migration and rearing.

Based on the stream temperature data collected by DEA between June 16, through October 17, 2001, this parameter ranges from **at risk** to **not properly functioning** during juvenile migration and rearing, and **properly functioning** during adult migration and spawning. However, between September 15, 2001, through September 28, 2001, temperatures were at the upper end of **properly functioning** and will likely shift to **at risk** during warmer years.

The stream temperature data collected during this study is presented in Appendix P (Reach 1) and Appendix Q (Reach 3). It is interesting to note that daily stream temperatures fluctuated from 0.46 to 4.68 degrees and that on average, Reach 1 was approximately 0.4 degree warmer than Reach 3. The greatest daily fluctuations "typically" occurred on days when the maximum hourly temperature

was higher than average, and as stream temperature decreased so did the degree of fluctuation. Stream temperature was typically the coolest from 0700 to 0900 hours, and warmest from 1600 to 1800 hours. However, these "typical" time periods would shift substantially during cooling events. The highest hourly stream temperature reading occurred in Reach 1 measuring 18.16°C (64.69°F) for a 1-hour period between 1700 and 1800 hours on August 12, 2001.

Stream temperature data collected by Snohomish County Public Works – Surface Water Management (SWM) in the upper reaches of Little Bear Creek reported only one monthly measurement above 16°C (60.8°F) (SWM, 2000). However, these were spot checks during water quality sampling events utilizing hand held thermometers, and likely occurred prior to the daily peak. Snohomish County also reported that mean fecal coliform levels have violated Class AA standards, nitrate levels are some of the highest in the county, and dissolved oxygen levels violated standards about 8 percent of the time (SWM, 2000). Furthermore, the SWM reported that sediment samples collected near the mouth contained chromium, copper, lead, nickel, and zinc, although exact levels were not reported (SWM, 2000). Some of the peak water quality measurements during the year 2000 include 8,600 colonies/100 mL for fecal coliform, 0.00812 mg/L for copper, 0.000624 mg/L for lead, and 0.00691 mg/L for zinc collected on July 12, 2000 near the headwaters of Little Bear Creek (Thornburgh, personal communication, 2001).

Water quality data is collected by King County in Little Bear Creek at Station No. 0478 located in Reach 1 near the mouth. Stream temperature data collected by King County from 1990 through 1993 ranged from a low of 1.0°C (33.8°F) on February 16, 1993, to a high of 16.2°C (61.2°F) on July 20, 1992 (King County, 1994). Dissolved oxygen levels were generally good, with a low of 9.2 mg/L on August 19, 1991, when the stream temperature was 16.0°C (60.8°F), and a high of 14 mg/L on a couple of dates during the winter when stream temperatures were extremely low at 1.0 to 1.5°C (33.8 to 34.7°F). There is an inverse relationship of stream temperature and dissolved oxygen in that as stream temperature increases dissolved oxygen decreases.

Additional parameters analyzed by King County indicate turbidity fluctuates widely from 0.3 to 42 nephelometric turbidity units (NTU). The highest measurements recorded for various parameters were pH = 8.30, turbidity = 42.0 NTUs, suspended solids = 87.00 mg/L, fecal coliform = 1,700 organisms/100mL, nitrate + nitrite = 1.600 mg/L, ortho-phosphorus = 0.190 mg/L, and total phosphorus = 0.570 mg/L. Stormwater metal levels were below detection levels for cadmium, lead, and nickel, but averaged 0.006 mg/L copper, and 0.023 mg/L zinc (King County, 1994). Levels of copper and zinc in Little Bear Creek were higher than in Swamp, North, Bear-Evans, Issaquah, and Tibbetts creeks.

Chemical Contamination/Nutrients: The NMFS (1996) reports that for the chemical contamination/nutrients indicator, a *properly functioning* stream has low levels of chemical contamination from agricultural, industrial, and other sources, no excess nutrients, and no Clean Water Act (CWA) 303d designated reaches. An *at risk* stream has moderate levels of chemical contamination from agricultural, industrial, and other sources, some excess nutrients, and one CWA 303d designated reach. A *not properly functioning* stream contains high levels of chemical contamination, high levels of excess nutrients, and more than one Clean Water Act 303d designated reach. The Washington Department of Ecology has reported that Little Bear Creek does not support designated uses, and contains three 303(d) listed stream reaches due to elevated fecal

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coliform levels (Kerwin, 2001). Furthermore, a recent King County small streams toxicity/pesticide study indicates a variety of pesticides are present in Little Bear Creek at levels high enough to be "toxic" to test species (Kerwin, 2001). Based on the data presented by Kerwin (2001), and reports by SWM (2000) and King County (1994), the water quality pathway and associated chemical contamination/nutrients are **not properly functioning** in Little Bear Creek.

Additional Water Quality Data: Water quality data was collected in the field with a Horiba U-10 water quality meter during this survey. The goal was to document change by reach, and compare Little Bear Creek with the Sammamish River utilizing data collected on the same day. Based on this effort, the following data in Table 17 is presented. On September 25, 2001, pH, turbidity, and dissolved oxygen levels were noticeably lower in the Sammamish River, while temperature was elevated (Table 17). Based on the results, water quality is generally better in Little Bear Creek than in the Sammamish River due to lower water temperature and higher dissolved oxygen levels in Little Bear Creek. Within Little Bear Creek, conductivity and turbidity increased, and temperature decreased from Reach 1 to 3. Dissolved oxygen and pH fluctuated little between reaches.

Table 17:
Water Quality Data on 9/25/01 for Little Bear Creek, Woodinville

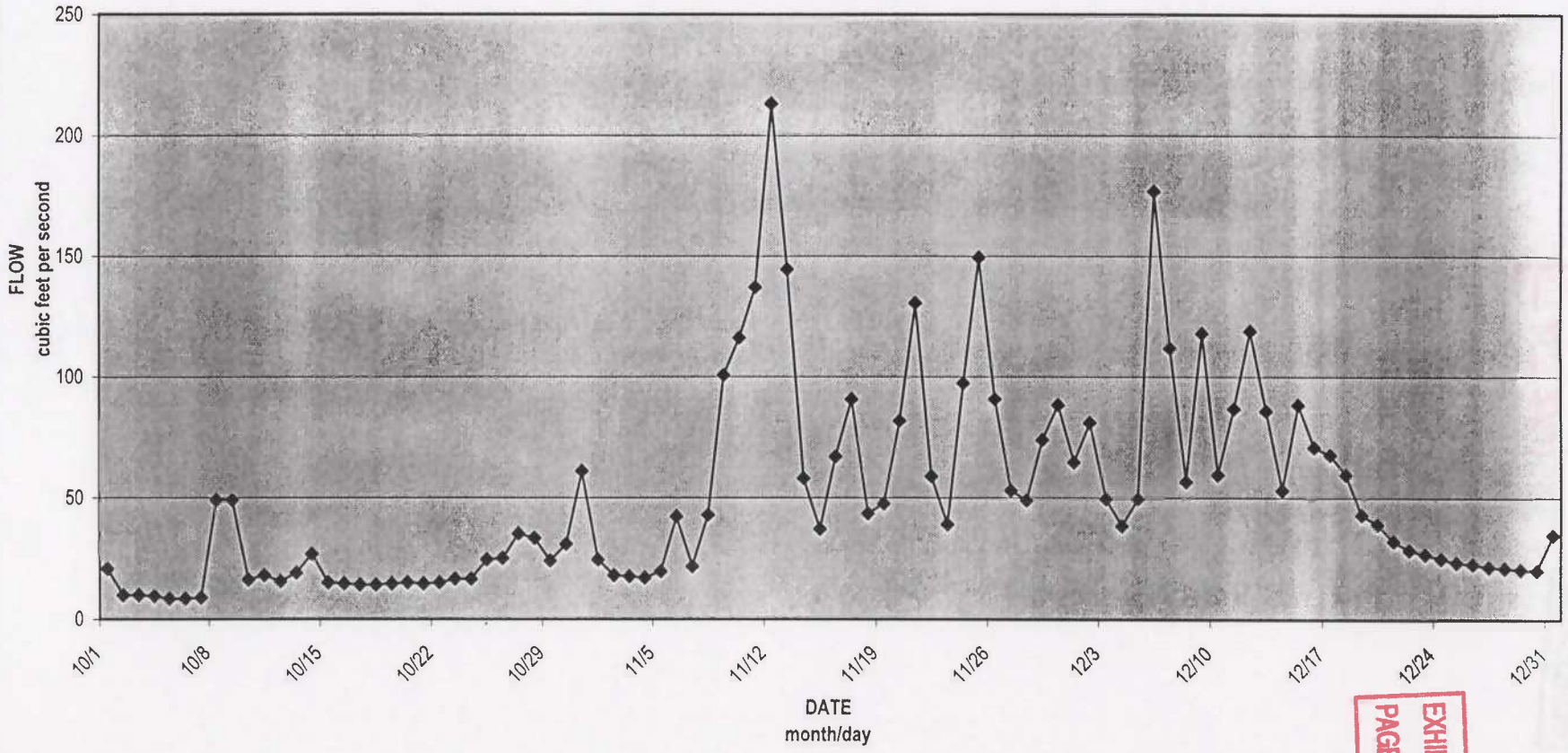
#	Parameter	Sammamish River	Reach 1 Mouth	Reach 2 134th	Reach 3 205th
1.	pH	6.85	7.70	7.89	7.72
2.	Conductivity (mS/cm)	0.145	0.144	0.147	0.148
3.	Temperature (C)	16.0	13.2	13.3	13.0
4.	Turbidity (NTU)	1	7	10	12
5.	Dissolved oxygen (mg/L)	6.90	9.40	8.65	8.95

4.4.8 Flow/Hydrology

The flow/hydrology pathway contains two indicators: change in peak/base flow and increase in drainage network. Increased urbanization results in increased flood frequency and streamflow variability (May et al., 1997). The result is that flow levels change frequently and extreme flow events occur more often. This condition is exasperated by an increase in the drainage network. Elements of the drainage network include ditches, road crossings, and stormwater outfalls. The overall result is that rainwater reaches the stream channel exponentially faster then what would occur naturally.

Peak/Base Flow: The NMFS (1996) Matrix of Diagnostics/Pathways and Indicators utilizes watershed hydrographs to document changes in peak/base flow. A *properly functioning* stream's hydrograph would indicate peak, base, and flow timing is comparable to a similar undisturbed watershed. An *at risk* stream shows some evidence of change. A *not properly functioning* stream's hydrograph indicates pronounced change in peak, base, and flow timing. Based on the following hydrographs (Figures 5a through 5c), the peak/base flow indicator is **at risk** due to evidence of change when compared with hydrographs from minimally disturbed watersheds.

Figure 5a: 1999 Hydrograph, October through December
Little Bear Creek



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o:/project/w/wood0000-0010/0500 deliverables/Figure 5a 5b 5c.xls/5a, 1999

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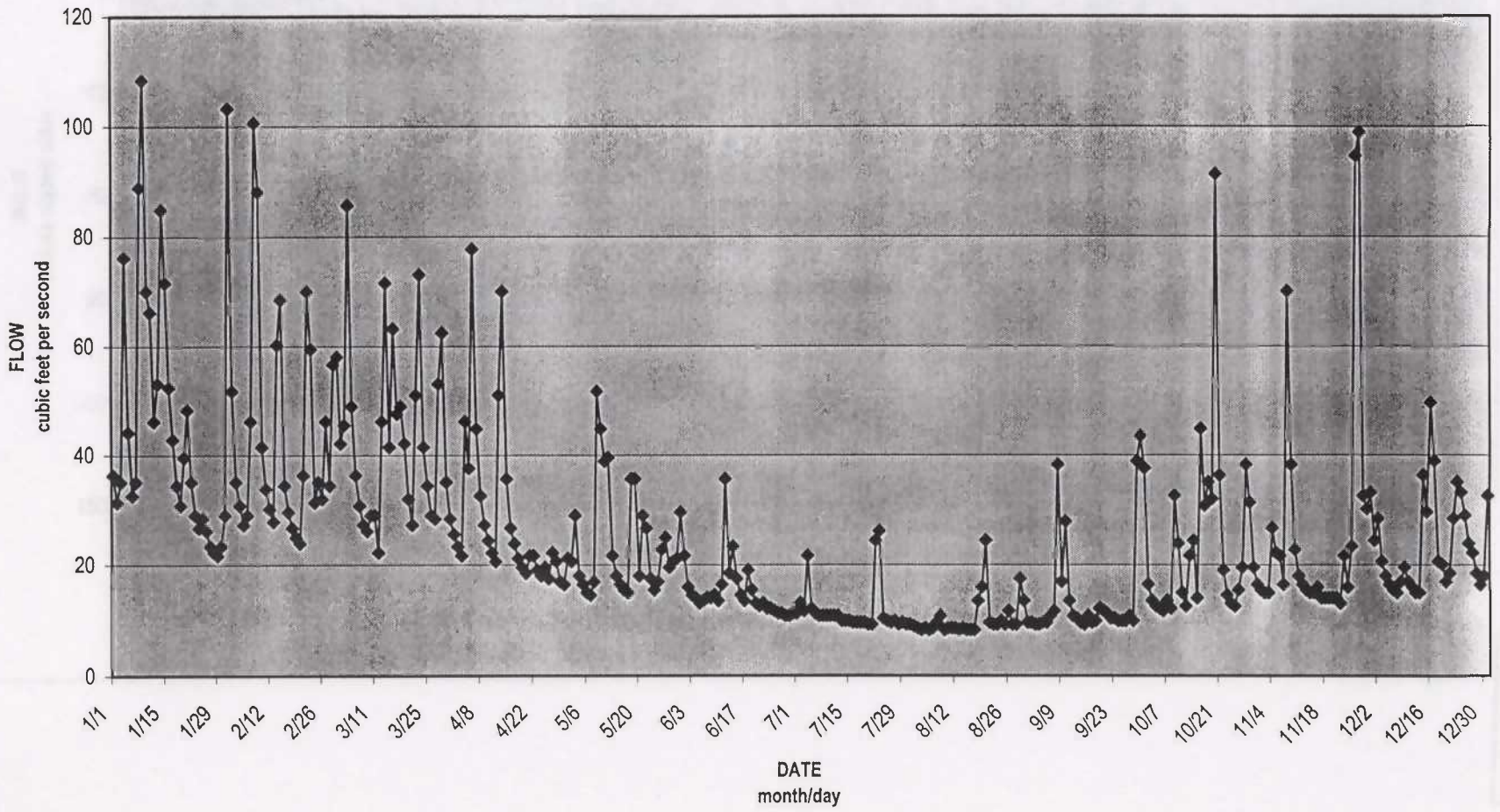
Figure 5b: 2000 Hydrograph, January through December
Little Bear Creek



o:/project/w/wood0000-0010/0500 deliverables/Figure 5a 5b 5c.xls/5b, 2000

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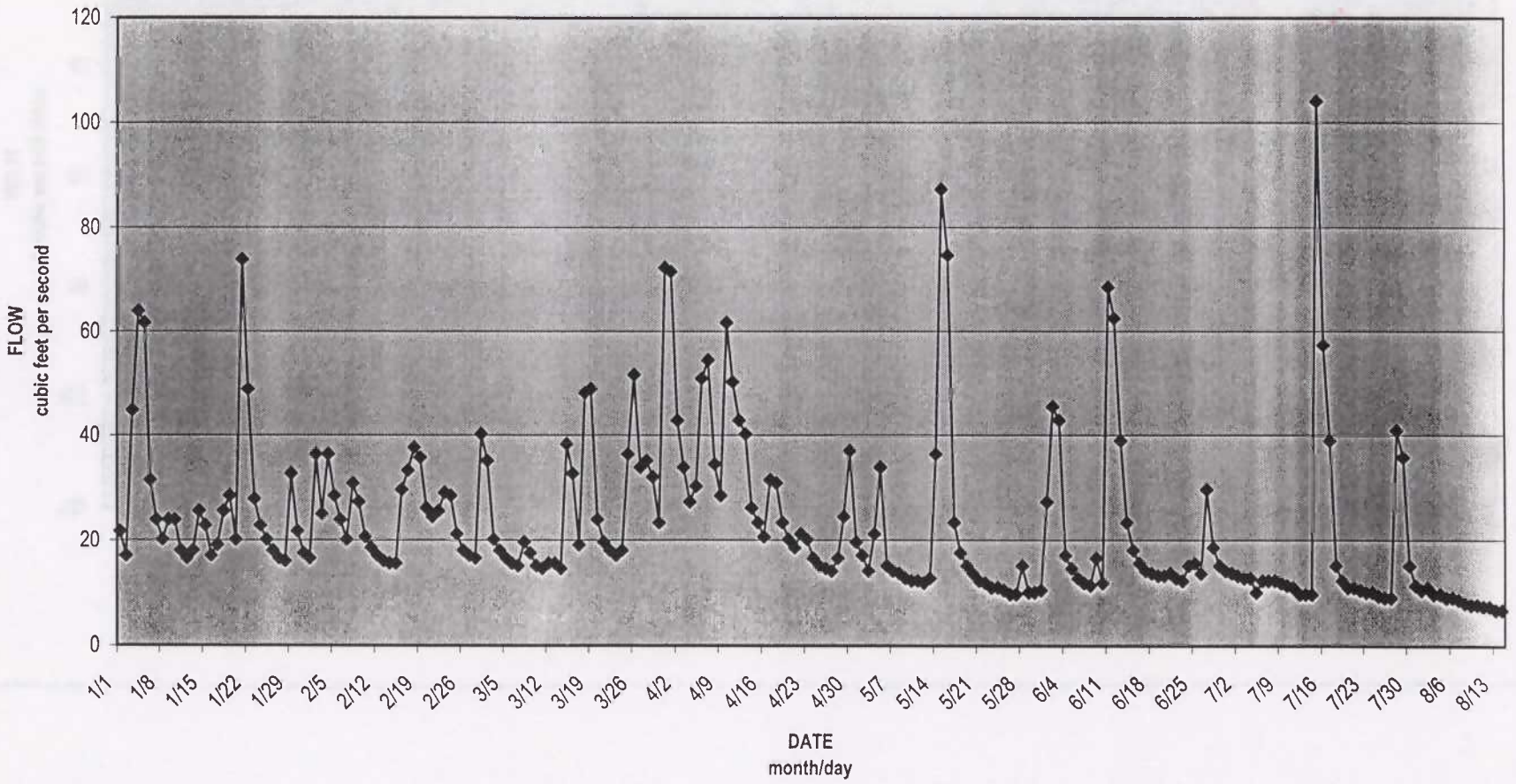
Figure 5c: 2001 Hydrograph, January through August
Little Bear Creek



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Increase in Drainage Network: The NMFS (1996) Matrix of Diagnostics/Pathways and Indicators utilizes an increase in drainage network to document change. A *properly functioning* stream will have zero or minimum increases in drainage network due to roads. An *at risk* stream will have a moderate increase in drainage density due to roads (e.g., 5 percent). A *not properly functioning* stream will have a significant increase in the drainage network due to roads (e.g., 20 to 25 percent).

The percentage of total impervious surface has increased to about 37 percent and road density to 5.9 kilometers per square kilometer (km/km^2) (2.28 mi/mi^2) in the past 12 years (Purser and Simmonds, Snohomish County Surface Water Management, unpublished data as reported by Kerwin, 2001). Based on these changes, the increase in drainage network indicator is **not properly functioning**.

4.4.9 Watershed Conditions

The watershed conditions pathway is gauged by three indicators: road density and location, disturbance history, and riparian reserves. Riparian habitat was documented above in Section 4.4.6 – Riparian Habitat.

Road Density and Location: The NMFS (as modified by the Mt. Baker Snoqualmie National Forest) has quantified parameters to rank the degree of road density and location within their Matrix of Diagnostics/Pathways and Indicators (Appendix L-2). Based on their criteria, a *properly functioning* watershed contains less than 1.61 km/km^2 (<1 mi/mi^2) of roads and no valley bottom roads. An *at risk* watershed contains 1.61 to 3.86 km/km^2 (1 to 2.4 mi/mi^2) of roads with some valley bottom roads. A *not properly functioning* watershed contains >3.86 km/km^2 of roads (>2.4 mi/mi^2), and many valley bottom roads.

May et al. (1997) documented numerous watershed characteristics based on aerial photographs from 1989. At that time, the percent total impervious surface in the Little Bear Creek Basin was 13.8 percent and the road density was 4.9 km/km^2 (1.90 mi/mi^2). They reported that the basin was composed of 43 percent undeveloped forest, 12 percent undeveloped open land, 32 percent rural residential land, 6 percent suburban residential land, 2 percent urban residential land, and 7 percent commercial industrial land. This equates to a total of 57 percent of the land being developed to some degree at that time.

During the past 12 years, the percentage of total impervious surface has increased to about 37 percent and road density to 5.9 km/km^2 (2.28 mi/mi^2) (Purser and Simmonds, Snohomish County Surface Water Management, unpublished data – as reported by Kerwin, 2001). Based on these changes, the NMFS watershed condition indicators for road density is **not properly functioning**. During this period, the amount of undeveloped forest has only dropped to 40 percent. This indicates that the majority of new impervious surface since 1989 has been established in the previously undeveloped open land and rural residential land.

Disturbance History: The NMFS (1996) defines a *properly functioning* watershed as containing <15 percent equivalent clear-cut acres (ECA) within the entire watershed with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian areas. Additional parameters specific for the Northwest Forest Plan do not apply. An *at risk* watershed

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also contains <15 percent ECA within the watershed, but disturbance is concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian areas. A *not properly functioning* watershed contains >15 percent ECA and disturbance is concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian areas.

This indicator is difficult to judge based on the NMFS (1996) criteria and may be more applicable to watersheds outside the Puget Sound lowlands due to the extensive amount of development within this region. The ECA concept appears to be applicable in watersheds where logging is the dominant land use. Instead, DEA proposes to utilize the Urban Stream Rehabilitation guideline presented by May (1996) that ranks a stream based on percent total impervious area (percent TIA). This system results in a ranking of natural (percent TIA < 5 percent), impacted (percent TIA 10 to 30 percent), degraded (percent TIA 30 percent to 40 percent), and non-supporting (percent TIA >45 percent). Therefore, DEA equated natural to *properly functioning*, impacted to *at risk*, and degraded and non-supporting to *not properly functioning*. The location of the disturbance can also be factored into the formula.

Since about 37 percent of the watershed is impervious, and much of the riparian zone in the lower reaches has been developed, this watershed appears to be degraded. Therefore, the disturbance history indicator is **not properly functioning**. This is especially apparent when reviewing the rate of increase in new impervious area from 1989 to present.

4.4.10 Habitat Access

The Habitat Access Pathway includes the Physical Barriers Indicator. The NMFS (1996) states that a *properly functioning* stream with man-made barriers allows upstream and downstream fish passage during all flows. An *at risk* stream with man-made barriers does not allow upstream and/or downstream passage at base/low flow. A *not properly functioning* stream with man-made barriers does not allow upstream and/or downstream fish passage during a wide range of flows.

The Adopt-A-Stream Foundation conducted a Washington State Department of Transportation (WSDOT) Level A assessment of 88 culverts that posed potential fish passage barriers throughout the Little Bear Creek watershed (Adopt-A-Stream, unpublished data as reported by Kerwin, 2001). They concluded that only 8 of these culverts were fully passable during winter and spring flow conditions. The remaining 80 culverts posed at least partial barriers during this high flow period. The 8 culverts that were fully passable during high flows could also pose fish passage barriers during lower flows. Although this may seem dire, adult salmon are not usually present during peak flow periods in the early winter and spring time period, and "most" juvenile salmonids are migrating downstream during the spring. Therefore, this condition may primarily impact resident trout and juvenile coho salmon. This conclusion does not negate the need to continue basin wide removal of restrictive culverts, or the conversion of round culverts to larger bottomless culverts and bridges.

Habitat Access is not a major limiting factor along the mainstem of Little Bear Creek as it flows through the City of Woodinville. Potentially restrictive road crossings containing culverts within the City of Woodinville include SR 202, 132nd Avenue NE, 134th Avenue NE, Highway 522, NE 195th Street, and NE 205th Street. The crossing at NE 178th Street is considered passable to all life stages regardless of flow. All crossings within the City of Woodinville are passable to adult salmonids during the late summer and early fall. All of these crossings are also passable to juveniles with the possible exception of NE 205th Street which likely restricts upstream movement

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by juveniles. It is likely that during peak flows that occur during the winter and spring, juvenile upstream passage is further restricted by all the aforementioned culverts. The primary issue is shear velocity due to the funneling effect of the culverts along the mainstem, and loss of three tributaries as the result of extensive culverting at their interface with Little Bear Creek in Reach 2 (Figure 3). Based on these conclusions, the physical barrier indicator within the City of Woodinville is **at risk**, but could become **properly functioning** as existing culverts are replaced with bridges, removed, or retrofitted to improve upstream passage for juvenile salmonids.

4.5 WILDLIFE

Biologists recorded bird, mammal, reptile, and amphibian species along Little Bear Creek both during surveys and incidentally during other site visits. Additional species to those observed likely use the area but remain undocumented by this study, as field visits were limited to spring and summer of a single year. A list of additional wildlife species that could potentially be present along the Little Bear Creek corridor but were not documented during these surveys is included in Appendix S.

4.5.1 Bird Observations

Thirty-nine bird species were observed along Little Bear Creek during site visits and surveys (Table 18). The majority of these species likely breed in the area, as most males were observed singing during the breeding season. One species, willow flycatcher (*Empidonax traillii*), is a federally designated species-of-concern. Five singing males were identified on three survey plots. The WDFW Priority Habitat and Species (PHS) program classifies great blue heron rookeries as vulnerable aggregations (Criterion 2) and are protected. Although no rookeries are documented within 2 miles of the corridor (WDFW, 2001b), suitable foraging habitat exists within the creek and adjacent wetlands, and biologists observed one individual during stream surveys.

Table 18:
Bird Observations Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	S Rank	Comment
1.	2, 3	Mallard	*Anas platyrhynchos*	S5B	
2.	2, 3	Great blue heron	*Ardea herodias*	S4S5	
3.	1, 2, 3	Cedar waxwing	*Bombycilla cedrorum*	S4N	NMBS*
4.	1, 2	Canada goose	*Branta canadensis*	S5B	
5.	2, 3	Red-tailed hawk	*Buteo jamaicensis*	S5B	
6.	3	Pine siskin	*Carduelis pinus*	S5B	
7.	1, 2, 3	American goldfinch	*Carduelis tristis*	S5B	
8.	1, 2, 3	House finch	*Carpodacus mexicanus*	S5	
9.	3	Swainson's thrush	*Catharus ustulatus*	S5B	NMBS
10.	1, 2, 3	Belted kingfisher	*Ceryle alcyon*	S5	NMBS
11.	1, 2	Killdeer	*Charadrius vociferus*	S5B	
12.	2, 3	Northern flicker	*Colaptes auratus*	S5	
13.	1, 2, 3	American crow	*Corvus brachyrhynchos*	S5	
14.	2, 3	Steller's jay	*Cyanocitta stelleri*	S5	
15.	2, 3	Willow flycatcher	*Empidonax traillii*	S5B	NMBS; Federal Species of Concern.
16.	3	Brewer's blackbird	*Euphagus cyanocephalus*	S5	
17.	3	Dark-eyed junco	*Junco hyemalis oreganus*	S5B	
18.	1	California gull	*Larus californicus*	S4B	Flying over creek.
19.	1, 2, 3	Song sparrow	*Melospiza melodia*	S5B	

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Table 18 continued

#	Reach #	Common Name	Scientific Name	S Rank	Comment
20.	1, 2, 3	Brown-headed cowbird	*Molothrus ater*	S4N	
21.	1	House sparrow	*Passer domesticus*	SE	
22.	2, 3	Black-headed grosbeak	*Pheucticus melanocephalus*	S5B	NMBS
23.	1, 3	Downy woodpecker	*Picoides pubescens*	S5	
24.	3	Hairy woodpecker	*Picoides villosus*	S4S5	
25.	2, 3	Spotted towhee	*Pipilo erythrophthalmus*	S5B	Nest observed in Reach 3.
26.	1, 2, 3	Black-capped chickadee	*Poecile atricapilla*	S5	Nest observed in Reach 2.
27.	2, 3	Chestnut-backed chickadee	*Poecile rufescens*	S5	
28.	1, 2, 3	Bushtit	*Psaltriparus minimus*	S5	Nest observed in Reach 3.
29.	3	Golden-crowned kinglet	*Regulus satrapa*	S5B	NMBS
30.	3	Red-breasted sapsucker	*Sphyrapicus ruber*	S4S5	
31.	1, 2, 3	European starling	*Sturnus vulgaris*	SE	Nest observed in Reach 2.
32.	1, 2, 3	Violet-green swallow	*Tachycineta thalassina*	S5B	NMBS
33.	1, 2, 3	Bewick's wren	*Thryomanes bewickii*	S5	
34.	1, 2, 3	American robin	*Turdus migratorius*	S5B	
35.	3	Warbling vireo	*Vireo gilvus*	S5B	NMBS
36.	3	Hutton's vireo	*Vireo huttoni*	S5	
37.	2, 3	Wilson's warbler	*Wilsonia pusilla*	S5B	NMBS
38.	1	Mourning dove	*Zenaidura macroura*	S5B	NMBS
39.	1, 2, 3	White-crowned sparrow	*Zonotrichia leucophrys*	S5B	NMBS

*NMBS = neotropical migrant bird species

The WDFW PHS program maintains a list of species for which it has occurrence and status information. A global rank (GRank) describes the species' relative rarity or endangerment worldwide, and a state rank (SRank) describes the status within Washington State. Most bird species observed in the study area have a GRank of G5, which signifies that they are demonstrably secure globally. Most species have an SRank of S5 or S4 (Table 18), defining them as "demonstrably secure in state" or "apparently secure, with many occurrences", respectively. SRanks may include the qualifiers "B" and "N", which indicate breeding and nonbreeding status, respectively, of migrant species. The breeding status of these species may differ greatly from their nonbreeding status in the state. SE indicates an established exotic species. Two codes for any one species indicates an intermediate rank.

Eleven of the species recorded along Little Bear Creek are neotropical migrant bird species. Neotropical migrants breed in North America and winter in Mexico, Central America, the Caribbean, and South America. The publication of results from long-term survey programs confirms that populations of many neotropical migrants are declining, in some cases precipitously. Habitat loss and related problems are key issues in the causes of the declines. Therefore, these species may be of interest, particularly if they are breeding in the area. The area could potentially provide breeding habitat for several of these species, including Swainson's thrush, black-headed grosbeak, willow flycatcher, warbling vireo, Wilson's warbler, mourning dove, and white-crowned sparrow (Table 18). In addition, neotropical migrant species not detected during surveys and field visits may use the corridor (Appendix S).

4.5.2 Mammal Observations

Biologists documented ten mammal species in the Little Bear Creek corridor (Table 19). None of the species observed have federal or state special status. Other mammal species that may utilize the corridor include mink (*Mustela vison*), striped skunk (*Mephitis mephitis*), and coyote (*Canis latrans*). Appendix S contains a complete list of mammals that could potentially be present based on habitat types and historic range.

Table 19:
Mammal Observations Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	Comment
1.	2	Beaver	*Castor canadensis*	Chewed shrubs and trails.
2.	3	Opossum	*Didelphis marsupialis*	Introduced, dead in stream.
3.	3	River otter	*Lutra canadensis*	Tracks, scat, and eaten salmon.
4.	2	Longtail weasel	*Mustela frenata*	Crossing stream on log.
5.	1, 2, 3	Myotis bat	*Myotis* spp.	
6.	2, 3	Black-tailed deer	*Odocoileus heminonus columbianus*	Tracks along stream bank; pellets.
7.	2, 3	Raccoon	*Procyon lotor*	Tracks along stream bank.
8.	2	Norway rat	*Rattus norvegicus*	Introduced.
9.	2, 3	Eastern gray squirrel	*Sciurus carolinensis*	Introduced.
10.	1, 2	Eastern cottontail	*Sylvilagus floridanus*	Introduced, dead young in nest (Reach 2).

4.5.3 Reptile and Amphibian Observations

Four reptile and amphibian species were observed in and along Little Bear Creek during field visits and surveys (Table 20). None of the species have state or federal special status. Other reptiles and amphibians not documented during this survey that could potentially be present along the Little Bear Creek corridor include: northern alligator lizard (*Elgaria coerulea*), painted turtle (*Chrysemys picta*), red eared slider (*Trachemys scripta*), common garter snake (*Thamnophis sirtalis*), western terrestrial garter snake (*Thamnophis elegans*), long-toed salamander (*Ambystoma macrodactylum*), rough-skinned newt (*Taricha granulosa*), western red-backed salamander (*Plethodon vehiculum*), ensatina (*Ensatina eschscholtzii*), western toad (*Bufo boreas*), and red-legged frog (*Rana aurora*). Both species of turtles were included due to the close proximity of several lakes to the study area.

Table 20:
Amphibian and Reptile Observations Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	Comment
1.	3	Pacific Tree frog	*Hyla regilla*	3 in wetland near reach end.
2.	2	Bull frog	*Rana catesbeiana*	Introduced species captured next to stream.
3.	Tributary D	Northwestern salamander	*Ambystoma gracile*	Larva in small tributary.
4.	3	Northwestern garter snake	*Thamnophis ordinoides*	Near barricades at NE 195th.

4.5.4 Wildlife Habitat

Habitat in the Little Bear Creek corridor consists of wetlands, uplands, and a riparian zone. Vegetative composition in the riparian zone is discussed in detail in Section 4.4.6, Riparian Habitat. Wetland habitats include mixed forest, young deciduous, and scrub/shrub wetlands. Upland

habitats include second- and third-growth mixed forest, young alder, shrub, and open grassy areas. Exotic and invasive plant species occur both as infestations and in small, scattered clusters.

Most of the corridor in Reach 1 is disturbed shrub, dominated by Himalayan blackberry, red alder saplings, and Scotch broom. Approximately 5.1 percent of the corridor along Reach 1 consists of forested riparian habitat. An area of non-native planted species occurs in the developed area between 130th Avenue NE and NE 178th Street. The corridor is relatively narrow along this reach and provides limited wildlife habitat, although the mouth of the creek adjoins more heavily vegetated habitat along the Sammamish River and may be utilized by birds and other wildlife using the Sammamish River corridor. Red alder saplings, red-osier dogwood, and Himalayan blackberry were dominant in Reach 1 sampling plots. No snags, logs, or suitable raptor nesting or perching trees fell within sampling plots. Invasive species are common in all habitat types in the reach. The wildlife community in this reach is most likely made up of species habituated to human disturbance and able to utilize highly fragmented habitat (see Tables 18, 19, and 20 for wildlife species occurrence by reach).

Approximately 22 percent of Reach 2 is composed of young and mature deciduous forest. The remaining area is largely scrub/shrub, much of it disturbed and dominated by invasive weeds. One small area at the southeast junction of Highway 522 and SR 202 that fell within a sampling plot consisted of mature riparian vegetation, including red cedar of 61 to 76 centimeters (24 to 30 inches) DBH and several black cottonwoods and Douglas firs each approximately 61 centimeters (24 inches) DBH. Dominant species in this plot were hazelnut, big leaf maple, and Indian plum. Red alder, black cottonwood, and big-leaf maple dominate the deciduous forest in Reach 2. Common species include Himalayan blackberry, salmonberry, willow, Douglas fir, and giant horsetail. Few mature trees occurred outside of the mature forested sampling plot, although 2 snags were present on another plot. Sampling plots in disturbed riparian habitat, including young forest and scrub/shrub, were dominated by red alder, with infestations of Himalayan blackberry, Scotch broom, reed canarygrass, and other invasive species. Common native species included salmonberry, willow, and bitter cherry. The most extensive tracts of undeveloped land in Reach 2 are highly disturbed, while less disturbed areas tend to be small and highly fragmented. These areas support scattered mature trees, some red cedar along the creek, that may provide limited perching/nesting opportunities for raptors. The reach contains little breeding habitat for neotropical migrant bird species, which generally breed in forest interiors.

Reach 3 contains the highest proportion of mature trees and native species-dominated areas, as well as the most extensive tract of habitat. Deciduous and mixed forest makes up approximately 46 percent of the habitat in this reach, with the remainder in shrub and grass habitats. The reach supports potential raptor and neotropical migrant bird habitat, particularly in the northern region, where habitat is most extensive and large conifers occur more frequently. Sampling plots in Reach 3 fell into three general vegetative communities translated here into habitat types. Douglas fir, western red-cedar, big-leaf maple, and red alder dominated forested sampling plots. Common species were western hemlock, red-osier dogwood, salmonberry, trailing blackberry, willow, vine maple, red elderberry, skunk cabbage, and lady fern. Less frequent species included red huckleberry, piggyback, and Indian plum. DBH averaged approximately 71 centimeters (28 inches) for Douglas fir and western red-cedar, 41 centimeters (16 inches) for big-leaf maple, and 23 centimeters (9 inches) for red alder. Snags, stumps, and logs were more common than in the other reaches, averaging one of each per sampling plot. Young deciduous forest in Reach 3 was dominated by red alder, and western red-cedar, black cottonwood, vine maple, and salmonberry

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were common. Invasive species, mainly reed canarygrass and giant horsetail, were encroaching on one sampling plot. Red alders averaged 13 centimeters (5 inches) DBH, and a few larger cottonwoods ranging from 15 to 38 centimeters (6 to 15 inches) DBH were recorded. One stump and little downed wood occurred on two plots. Shrub wetland sampled in Reach 3 consisted of alder saplings, Himalayan blackberry, reed canarygrass, evergreen blackberry, and bracken fern.

5.0 RESTORATION POTENTIAL

The Little Bear Creek watershed has changed significantly since the arrival of European settlers in the late 1800s. Although the Little Bear Creek corridor is still utilized by numerous species of fish and wildlife the quality of instream and riparian habitat has been impacted by changes in land use. Throughout this report the existing status of numerous pathways and indicators as defined by the NMFS (1996) have been documented. The determination of *properly functioning*, *at risk*, and *not properly functioning* for each "indicator" was used as a basis for the prioritization of restoration efforts. Baseline conditions determined to be *not properly functioning* are likely the most limiting conditions for salmonids and are therefore considered the highest priority for restoration followed by the conditions determined to be *at risk*. Table 21 represents a summary of the baseline conditions in Little Bear Creek as they pertain to listed salmonids. Other important considerations in prioritizing possible restoration opportunities are cost, feasibility, and probability of success.

Table 21:
Little Bear Creek Environmental Baseline Condition Summary

PATHWAY	INDICATORS	BASELINE CONDITIONS
Water Quality	Temperature	Juvenile Migration and Rearing = Not Properly Functioning to At Risk Adult Migration and Spawning = Properly Functioning
	Sediment	Not Properly Functioning
	Chemical Contamination & Nutrients	Not Properly Functioning
Habitat Access	Physical Barriers	At Risk
Habitat Elements	Substrate	At Risk
	Large Woody Debris	Not Properly Functioning
	Pool Frequency	Not Properly Functioning
	Pool Quality/Depth	At Risk (not properly functioning in Reach 1)
	Off-Channel Habitat	Not Properly Functioning
	Refugia	Not Properly Functioning
Channel Conditions and Dynamics	Width/Depth Ratio	Reach 1: Not Properly Functioning Reach 2 and 3: At Risk
	Streambank Condition	Not Properly Functioning
	Floodplain Connectivity	Not Properly Functioning
Flow/Hydrology	Change in Peak/Base Flows	At Risk
	Increase in Drainage Network	Not Properly Functioning
Watershed Conditions	Road Density and Location	Not Properly Functioning
	Disturbance History	Not Properly Functioning
	Riparian Reserve/Conservation Areas	Not Properly Functioning (at risk in Reach 3)

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The NMFS matrix of pathways and indicators is divided into six major pathways each having several indicators. The following discussion on stream and riparian habitat restoration possibilities and prioritization follows this habitat component approach. Many of these indicators are interwoven in that correcting one will also improve another. An example of this is that large woody debris, riparian reserve, refugia, pool frequency and quality, streambank conditions, and substrate are all related. Another important consideration is that no single action will fully restore Little Bear Creek, and that improving existing conditions will be the result of a multitude of efforts taken over an extended period of time.

The City of Woodinville has already begun undertaking numerous restoration measures along the Little Bear Creek corridor (Appendix R). This includes land acquisition, culvert removal, fish passage improvements, and non-native plant removal. These measures, in addition to those outlined below, will help improve fish and wildlife habitat along the Little Bear Creek corridor.

5.1 WATER QUALITY

Temperature: The temperature indicator ranges from **properly functioning** to **not properly functioning** depending on time of year and life cycle of the species under consideration (see Section 4.4.7 and Table 16). Stream temperature increases as Little Bear Creek flows towards the Sammamish River. Based on the results of data collected from two hobo temperature data loggers installed at the downstream and upstream extremes of Little Bear Creek within the City of Woodinville, stream temperature typically increases by 0.4 degree Celsius within the city.

Additional data documenting the contribution tributaries and ambient air temperature makes to the overall increase of stream temperature would be beneficial in analyzing potential mitigating measures. However, increasing shade by planting conifer trees along the mainstem and tributaries to Little Bear Creek is the primary action the City of Woodinville could undertake to address this issue. The simplistic step of drastically increasing the abundance of conifers along both banks of Little Bear Creek would help increase shade and thereby reduce the rate of increase in stream temperature. Furthermore, planting conifer trees along both banks would help increase bank stability, reduce the abundance of invasive species such as reed canarygrass, provide wildlife habitat, reduce sedimentation, and eventually provide LWD and habitat complexity.

Sediment: The sediment indicator is **not properly functioning** due to a high percentage of fines within the substrate. Primary sources of sediment include stormwater runoff from upland sources such as roads and disturbed areas that directly enter Little Bear Creek or its tributaries, eroding and sloughing banks, and upstream sources. Remedies to reduce the percent of fines within the substrate include best management practices (BMPs) associated with construction projects, bank stabilization efforts, stormwater impact reduction measures, and isolated sediment removal measures from potential spawning areas or introduction of quality spawning gravel (typically not practicable). The most practicable measures the City of Woodinville could undertake to address this issue include bank stabilization efforts utilizing native vegetation, increasing the enforcement and use of BMPs, and working with Snohomish County to address upstream sources.

Chemical Contamination and Nutrients: The chemical contamination and nutrients indicator is **not properly functioning** (Table 21). This determination was based primarily on high fecal

coliform levels (a 1998 303[d] listing), the presence of pesticides, and the presence of metals in sediment samples collected in Reach 1.

The presence of high fecal coliform levels in Little Bear Creek is likely the result of failing septic tanks and runoff from fields with livestock. Both of these potential sources appear to be restricted to the upper portions of Little Bear Creek in Snohomish County and therefore not within the jurisdiction of the City of Woodinville to correct. The source of pesticides in Little Bear Creek may also be the result of actions occurring in the upper watershed.

The presence of metals is likely the result of road runoff entering Little Bear Creek through stormwater runoff in tributaries and direct discharge of stormwater from retention/detention facilities throughout the watershed. However, no existing data on metal concentrations from various potential sources exists. Therefore, identification of priority sites that contribute the highest metal concentrations to Little Bear Creek would need to be initiated prior to the initiation of corrective actions. Junk and construction yards located in Reach 2 and 3, and immediately north of King County may also contribute to the high metal concentrations in Little Bear Creek. An alternative to investing money and time into additional data collection is to insert catch-basin filters in high capacity parking lots that have the highest probability of contributing pollutants. Existing stormwater catch basins can be fitted with filter systems designed to capture priority pollutants such as soluble metals. The overall cost of installing and maintaining catch basin filters depends on the quantity of systems installed. The installation of catch basins would not eliminate existing contamination, but would reduce the rate of future accumulation.

5.2 HABITAT ACCESS

Habitat Access is **at risk**, and therefore not an imminent concern (Table 21). Both the City of Woodinville and Snohomish County are currently addressing habitat access concerns at 132nd Avenue NE and NE 205th Street (Appendix R). The predominance of the culverts identified as potential barriers to fish passage by the Adopt-A-Stream foundation are in Snohomish County and therefore outside of the jurisdiction of the City of Woodinville to correct.

Although the 134th Avenue NE crossing is not currently a fish passage barrier to migrating adult salmonids, they do stack-up immediately downstream of the crossing. The City of Woodinville should investigate the feasibility of purchasing the wrecking yard on the west side of Little Bear Creek serviced by this crossing. If this lot could be purchased several stream enhancement opportunities could occur. The first goals would be to remove soil contaminants within the lot and remove all structures. The second goal would be to use this crossing for enhancement efforts between Little Bear Creek and Highway 522 within Reach 2. Once these actions were completed the crossing could be permanently removed.

5.3 HABITAT ELEMENTS

Four of six indicators of the Habitat Elements pathway are **not properly functioning** (Table 21). Indicators that are **not properly functioning** include LWD, pool frequency, off-channel habitat, and refugia. Although the substrate indicator is **at risk** versus **not properly functioning**, the status of this indicator is also a concern due to its impact on salmonid reproduction.

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The lack of LWD plays a major role in decreasing pool frequency and the availability of refugia. The importance of LWD in creating and maintaining pool frequency and refugia is so vital that this may be the single most important habitat element requiring immediate attention in Little Bear Creek. Furthermore, because the riparian zone along Little Bear Creek does not contain adequate numbers of large conifers for LWD recruitment, this indicator will remain **not properly functioning**. The addition of LWD by mechanical means in itself is simplistic and only moderately expensive. However, streamside access and uncertainty in obtaining desired results can create problems. These facts limit the applicability of installing LWD or creating pool habitat. However, some areas with good access are present, and careful design and implementation can increase the probability of success. Sites where access is good include most of Reach 1, within Reach 2 near 132nd Avenue NE and 134th Avenue NE, and within Reach 3 immediately upstream of NE 195th Street. Additional sections of stream could be accessed along Highway 522.

Another important issue is the availability of future recruitment of LWD. Large conifer trees that could potentially add to the presence of instream LWD are lacking along the Little Bear Creek corridor. The only way to address this issue is to plant thousands of conifers along the riparian corridor. Although the time-delay between planting conifer saplings and achieving LWD recruitment would be many decades, this action is necessary for the long-term interest of Little Bear Creek. Because of this time-delay, the planting of conifers is of the highest priority. Additional actions associated with this effort include the removal of non-native and invasive species to facilitate conifer establishment, and long-term monitoring. Additional value is created by this action since planting conifers along the riparian zone will increase bank stability, shade, and wildlife habitat. The entire remaining vegetated corridor along Little Bear Creek is in need of immediate and intensive planting of conifer saplings.

Restoring or improving pool frequency above what would result from the placement of LWD in accessible locations is problematic and costly. Two sites where stream restoration efforts could be undertaken include the lowermost section of Reach 1 and within Reach 3 immediately upstream of NE 195th Street (Appendix G). Both of these sites are fully armored, linear, lack LWD, and consist of low-gradient riffle habitat. Because these sites are degraded, owned by the city, and accessible, they are deemed the best candidates for intensive site specific restoration efforts that could address a multitude of the indicators for the Habitat Elements pathway that are not properly functioning. Primary actions that could occur at these sites include removal of bank armoring, creation of refugia and off-channel habitat, creation of pool habitat, revegetation, and installation of LWD.

Off-channel habitat can also be used as refugia by juvenile salmonids. Off-channel habitat could be created as part of the site specific restoration plan that would be developed for the two stream restoration sites mentioned above. Another simplistic and relatively inexpensive measure that would create additional off-channel habitat and refugia would be to reduce the length of two or three culverts that currently extend into the active stream channel located in Reach 2 (Appendix D – Reach 2 Photos 10, 12, 17, 20, and 21). These culverts drain the unnamed tributaries within the City of Woodinville as shown on Figure 3. The idea here is to cut each culvert back as far as possible into the adjacent uplands for a distance of at least 6 meters (>20 feet) so that new off-channel habitat (and wetlands) is created where culverts and their associated fill material currently exists. The newly exposed area would need to be graded to the stream's

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base-flow level and planted with native hydrophytic vegetation. LWD could also be installed at these sites to increase their overall functionality.

5.4 CHANNEL CONDITIONS AND DYNAMICS

Two indicators of the Channel Conditions and Dynamics pathway that are **not properly functioning** include streambank condition and floodplain connectivity. Streambank conditions can be improved by replacing non-native and invasive species with conifers as mentioned previously. Extensive sections of the streambank, especially between Little Bear Creek and Highway 522 could be greatly improved. The removal of armoring in conjunction with revegetation in the lower section of Reach 1 near the mouth and immediately upstream of NE 195th Street will also help to improve streambank conditions.

Floodplain connectivity relates to hydrologic linkage between Little Bear Creek and adjacent off-channel areas, wetlands, riparian vegetation, and succession. No connectivity occurs where stream armoring is present or the stream is abutted by development. No other areas were identified where floodplain connectivity could be increased except as where previously mentioned.

5.5 FLOW/HYDROLOGY

The Flow/Hydrology pathway includes two indicators that were identified as **not properly functioning**. The percent impervious surface within the watershed and abundance of man-made drainage networks are the primary factors influencing this pathway. The two actions that can improve this pathway include reducing the percent of impervious surface, and improving or creating retention/detention facilities within the watershed. The preservation and restoration of existing habitat are critical in protecting against the continued degradation of this pathway. These issues are watershed-wide problems that extend far beyond the Little Bear Creek corridor. Because of the scale of this issue, it is most appropriately dealt with through the implementation of the Growth Management Act (GMA), Shoreline regulations, and city and county codes throughout the Little Bear Creek watershed. However, retrofitting of stormwater retention/detention facilities and elimination of impervious surface should be undertaken whenever the opportunity arises. Actions that reduce the speed at which stormwater travels through existing ditch networks to Little Bear Creek will further reduce the flashy conditions of the existing hydrographs (Figures 5a through 5c).

5.6 WATERSHED CONDITIONS

All indicators for the Watershed Conditions pathway including road density and location, disturbance history, and riparian reserve/conservation areas are **not properly functioning**. With the exception of the riparian reserve/conservation areas indicator (previously addressed), the remaining indicators are influenced primarily by the total amount of impervious surface within the watershed. As was the case with the Flow/Hydrology pathway, this issue is most appropriately dealt with through the implementation of the GMA, Shoreline regulations, and city and county codes throughout the watershed.

Table 22 below summarizes the pathway, indicator, priority, and action for each baseline condition identified as *not properly functioning*. Included in Table 22 are indicators that may have been partially *properly functioning* or *at risk* in one reach or for a specific life history (adult

migration/spawning) but otherwise *not properly functioning*. The priority of each indicator was determined based on time required to achieve desired results, degree of additional benefit, potential for success, and feasibility. Several of the indicators will benefit from the same basic action (e.g. installation of LWD and planting conifers). Although prioritized, the actions required to address these conditions in Little Bear Creek should occur simultaneously.

Table 22:
Not Properly Functioning Baseline Conditions Summary

PATHWAY	INDICATORS	Priority	Basic Action
Water Quality	Temperature	Medium	Plant conifers in riparian zone to increase shading.
	Sediment	Medium	Stabilize problem areas (e.g. LB of Reach 2), stabilize banks, reduce/eliminate upland sources, clean substrate (not practicable).
	Chemical contamination and nutrients	Medium	Identify key sources and implement corrective actions at sources.
Habitat Elements	Large Woody Debris	High	Install LWD and plant conifers for future recruitment.
	Pool Frequency	Medium	Will increase through installation of LWD
	Off-Channel Habitat	High	Create through LWD and retracting culverts
	Refugia	High	Create through LWD and retracting culverts
Channel Conditions and Dynamics	Width/Depth Ratio	Low	Remove armoring and taper back, and address incision resulting from changes in hydrology.
	Streambank Condition	High	Remove non-natives & plant > 10,000 conifers
	Floodplain Connectivity	Medium	Protect and restore corridor
Flow/Hydrology	Increase in Drainage Network	Medium	Reduce ditching and impervious area.
Watershed Conditions	Road Density and Location	Medium	Limit new roads and remove unnecessary ones
	Disturbance History	Medium	Protect and restore corridor
	Riparian Reserve/Conservation Areas	High	Remove non-natives, plant > 10,000 conifers, preserve existing habitat, and acquire more.

In summary, several key actions could potentially improve existing habitat conditions in Little Bear Creek. These recommended actions include:

1. Obtain, preserve, and enhance land along Little Bear Creek to minimize further habitat degradation from continued development along the Little Bear Creek corridor. Undeveloped properties along the corridor with quality riparian habitat should be high priority acquisitions, such as, the properties to the north of the City's "Lumpkin" property (east of 134th Avenue NE crossing). Another area to consider would be the properties to the west of 134th Avenue NE as described in item 7.
2. Immediately initiate a program to reestablish conifers within the riparian zone throughout the Little Bear Creek corridor.
3. Restore hardened rip/rap banks along Little Bear Creek. Include creation of pool habitat, and addition of large woody debris as part of the restoration plan.
4. Retrofit potential pollution-generating sites such as large parking lots and roadways with pollution prevention and storm flow retention facilities where such facilities are presently absent.

5. Reforest upland areas dominated by introduced species such as reed canarygrass and Himalayan blackberry.
6. Create off-channel habitat at each culverted tributary confluence with Little Bear Creek. This can be accomplished by daylighting the maximum extent of culverted tributary possible at each confluence.
7. The City of Woodinville should investigate the feasibility of purchasing the wrecking yard on 134th Avenue NE along the west side of Little Bear Creek. If this lot could be purchased several stream enhancement opportunities could occur. The first goals would be to remove soil contaminants within the lot and remove all structures. The second goal would be to use this crossing for enhancement efforts between Little Bear Creek and Highway 522 within Reach 2. Once these actions were completed the 134th Avenue NE crossing could be permanently removed, or converted to a bridged crossing.
8. The newly purchased city property immediately upstream of NE 195th Street is an ideal site for intensive in-stream, riparian, and upland habitat restoration activities. Actions that would benefit Little Bear Creek at this site include removal of bank armoring, creation of pool habitat, removal of impervious surface (pavement) and non-native vegetation, and installation of large woody debris, riparian vegetation, and upland vegetation.
9. Maintain regular street sweeping, storm drainage system cleaning, and add sediment traps where feasible. This will reduce the amount of sediment entering Little Bear Creek.

5.7 WILDLIFE HABITAT

The Little Bear Creek corridor was originally dominated by large expanses of old-growth forest composed of primarily conifers. These forests were extensively logged throughout the late 1800s and early 1900s and subsequently converted to agricultural land. More recently, agricultural land has rapidly been replaced with an urban landscape. Wetlands adjacent to the Sammamish River were historically extensive but were later filled to reduce flooding and create more developable land. Habitat features such as snags, downed wood, large conifers with a multi-canopy understory, and large wetland complexes are now uncommon or absent along the Little Bear Creek corridor.

Because the existing landscape has been significantly degraded from native conditions, numerous wildlife habitat enhancement opportunities exist. Based on our survey results, five primary actions that would improve wildlife habitat have been identified including:

1. Replacement of existing reed canarygrass, Himalayan blackberry, and scotch broom expanses with native vegetation.
2. Addition of conifers and mast (food) producing shrubs within existing deciduous dominated forest habitat.
3. Addition of downed woody debris to the forest floor.
4. Wetland creation within the corridor.
5. Installation of bird boxes for cavity nesting species.

The first four actions would help create more natural conditions conducive to native wildlife species. These four actions would benefit wildlife by creating suitable habitat, and Little Bear Creek by improving buffer functions. The installation of bird boxes is presented as a temporary measure to provide habitat for cavity nesters until other restoration efforts are able to reestablish suitable cavity nesting sites.

Numerous opportunities for wildlife habitat enhancement exist along the Little Bear Creek corridor in the City of Woodinville. Non-native plant removal opportunities exist along all reaches of the creek. The south end of Reach 1 is highly disturbed and in need of restoration. Little cover exists and non-native plants, which generally provide poor wildlife habitat, are common. The creek in the remainder of Reach 1 is closely bordered by development and would also benefit from restoration, as the existing vegetation provides little cover for wildlife.

The south end of Reach 2 in the vicinity of 132nd Avenue NE also has habitat enhancement opportunities. Shrub habitat on the left bank between 132nd Avenue NE and 134th Avenue NE is heavily infested with Himalayan blackberry, reed canarygrass, and other invasive species and is in need of weed removal and enhancement. Large areas of Himalayan blackberry and Scotch broom exist on the right bank beyond the riparian strip. The area from 134th Avenue NE to the north end of Reach 2 would benefit from the removal of reed canarygrass and other exotics, followed by restoration and enhancement. Although it is highly disturbed, the corridor is relatively wide in the middle stretch of Reach 2 and could potentially provide habitat for birds and mammals. Access to the right bank is difficult because of thick blackberry. The riparian zone becomes very narrow and shade and cover decrease from south to north. The north end of Reach 2 in particular would benefit from habitat restoration, as there is currently only sparse tree cover.

The portion of Reach 3 below NE 195th Street is bordered by private property on the right bank and Highway 522 on the left bank, and accessibility is poor. The area along Highway 522 is densely vegetated with Himalayan blackberry, and intensive clearing would be necessary to access and enhance this area. Private ownership along the left bank (east side) could hinder restoration attempts along this segment.

A shrub area accessed by a gravel lot off of 136th Avenue NE immediately north of NE 195th Street has good access and potential to provide wildlife habitat. The area is adjacent to a stand of mixed forest, which supports scattered large conifers and could provide a corridor for wildlife using the shrub area. Restoration of the gravel lot and adjacent areas would likely provide additional habitat for wildlife using the corridor north of this point.

Wildlife habitat improves with the increase of forest in the northern portion of Reach 3. Abundance of potential nesting and perching trees increases northward, and the corridor increases in width. The middle of Reach 3 is accessible from 136th Avenue NE, and this area provides opportunities for habitat improvement. Weed removal and the addition of native trees and shrubs to upland clearings outside of the riparian zone would enhance habitat in this area. While much of the forested area is young deciduous trees, larger trees increase in number to the north. This area might benefit most from the preservation of large conifers and tracts of forest.

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King County	Snohomish County	Bothell	Kirkland	Redmond	Woodinville	DOE/WDFW Science
Proposed Wetland Buffers Rural Class 1 – 300 ft Class 2 - 200 ft Class 3 – 100 ft Class 4 - 50 ft Urban Class 1 – 100 ft Class 2 - 50 ft Class 3 - 50 ft Class 4 - 25 ft	**Current Wetland Buffers** Urban Category 1 – 75 ft Category 2 – 50 ft Category 3 – 25 ft Category 4 -25 ft **Note: These numbers are significantly below the science recommended buffers and will change significantly per Sno. Co. Planner**	**Proposed Wetland Buffers** Combining the efforts of King County and Tri County Model in BAS	**Wetland Buffers** Class 1 Primary Basin (associated with Salmon Bearing streams) – 100 ft Class 2 – 75 ft Class 3 – 35 ft Secondary Basin – Class 1 – 75 ft Class 2 – 50 ft Class 3 – 25 ft	**Wetland Buffers** Redmond is conducting their BAS work and have not proposed any buffers to date	**Proposed Wetland Buffers** Class 1 – 150 -35 ft. reduction with enhancement Class 2 - 100 - 50 ft. reduction with enhancement Class 3 - 25 ft	**Wetland Buffers** a. **Category I** High intensity 300 ft Moderate intensity 250 ft Low intensity 200 ft b. **Category II** High intensity 200 ft Moderate intensity 150 ft Low intensity 100 ft c. **Category III** High intensity 100 ft Moderate intensity 75 ft Low intensity 50 ft d. **Category IV** High intensity 50 ft Moderate intensity 35 ft Low intensity 25 ft

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Proposed King County	Current Snohomish County	Proposed Bothell	Kirkland	Proposed Redmond	Proposed Woodinville	DOE/WDFW Science
Stream Buffers	**Stream Buffers**	**Stream Buffers**	**Stream Buffers**	**Stream Buffers**	**Stream Buffers**	**Stream Buffers**
Urban S & F Waters – 115 ft S&F Waters (high on the basin condition map) – 165 ft N Waters – 65 ft O Waters – 25 ft Rural S&F Waters – 165 ft N Waters - 65 ft O Waters - 25 ft Type N in Bear Creek Basin 100ft	Urban (in UGA) Class 1 (with Chinook salmon) – 150 ft Class 2 (with salmonids) – 100 ft Class 3 – (without salmonids) 50 ft **Note: these are Sno Counties current buffers and are subject to change, but change will not be dramatic per Sno. Co. Planner**	Type 1 - Salmon Bearing Streams – 100 ft buffers and have provision for implementation of additional fish protection where needed on a case by case evaluation. Type 2 – waiting for information Type 3 – waiting for information	Class A – Primary Basin (used by salmonids, but Kirkland has no Chinook Salmon bearing waters other than their lake shoreline) Class A - 75 ft Class B – 60 ft Class C – 50 ft Secondary Basin Class A –70 ft Class B - 50 ft Class C - 25 ft	Redmond is conducting their BAS work and has not proposed any buffers to date	Type 1 – 150 ft - Can build in first 35 ft with mitigation Type 2 – 100 ft – Can build in first 50 ft with mitigation Type 3 – 50 ft can build in first 25 ft with mitigation	Type 1 & 2 (Shorelines) – 250 ft Type 3 (Perennial or fish bearing 5 – 10 ft wide) – 200 feet Type 3 – (perennial or fish bearing less than 5 feet) 150 ft

* **REMINDER**: Science Technical Memos studies indicate that buffers 100 to 150 feet wide provide most (on the order of 80 percent) of the potential functions.

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Mr. Ray Sturtz
Community Development Director
City of Woodinville
17301 - 133rd Avenue NE
Woodinville, WA 98072

Dear Mr. Sturtz:

RE: Comments on City of Woodinville's Draft Critical Areas Ordinance Update

Thank you for the chance to comment on the proposed draft revision of the Critical Areas Ordinance (CAO) for the City of Woodinville (City). I have reviewed the portions of the June 18, 2004, revision that pertain to wetlands.

I appreciate the work that went into this proposed revision and your efforts to include best available science (BAS) in developing your regulations. The Washington State Department of Ecology (Ecology) supports the stated goal of the CAO "to maintain a standard of no net loss in the functions and values of wetlands."

We would like to suggest changes to the proposed CAO that reflect the best available science and would better promote the goal of protecting wetlands and their beneficial functions and values.

It appears that the City does not propose to amend Sections 21.24.050 through 21.24.120 of the existing municipal code. Because they are directly concerned with critical areas, we suggest that you consider revising these sections along the lines suggested.

Section 21.24.050 Complete exemptions

This section of the existing code is not included in the draft of the City's CAO amendments, but it should be reexamined and revised in the light of the best available science.

Except for emergencies that make this impractical, applicants should be required to first get written confirmation from the City that proposed activities meet the requirements for exemption. All exempted activities must use reasonable methods to avoid potential impacts to critical areas. Exemption does not give permission to alter or degrade a critical area or ignore risk from natural hazards. Any part of a critical area that suffers incidental damage or alteration that is not a necessary outcome of the exempted activity should be promptly restored, rehabilitated, or replaced at the responsible party's expense.

Exemptions should take account of potential impacts on the functions and values of critical areas.

(1) The exemption for emergencies should not eliminate the need for later mitigation to offset the impacts of emergency activity. Once the immediate threat has been addressed, any adverse impacts on critical areas should be minimized and mitigated.

(2) The agricultural exemption should not include activities that expand agricultural impacts into previously unaffected wetlands or that convert wetlands to nonwetlands. "Agricultural activities" should not include removing trees, diverting or impounding water, excavation, ditching, draining, culverting, filling, grading, and similar activities that introduce new adverse impacts to wetlands.

Section 21.24.060 Partial exemptions

(1)(b) The proposed exemption for single detached residences allows increasing the footprint in a wetland or stream buffer by up to 1,000 square feet. Mitigation in the form of enhancement or expansion of another part of the buffer should be required to offset such impacts.

Section 21.24.070 Exceptions

Any loss authorized under this section of acreage and functions of critical areas and associated buffers should be fully compensated according to mitigation requirements in Section 21.24.340.

Section 21.24.090 Disclosure by applicant

To make sure of avoiding impacts on buffers protecting the highest-rated streams and wetlands, the applicant should disclose any sensitive areas within 300 feet of the applicant's property, not 100 feet as now required.

Section 21.24.120 Contents of sensitive area special study

In addition to those listed, requirements for sensitive area special studies for wetlands should include study-area limits; methods used; data collected; mapping of study area limits, wetlands, and buffers; characterization and classification of wetlands, including vegetation, soils, habitats, and hydrology; analysis of wetland functions and values; and descriptions of proposed actions, efforts to avoid potential impacts, and compensation requirements.

The following comments cover the portions of the CAO that, along with definitions in 21.06.xxx through 21.06.711, constitute the proposed amendments.

Section 21.24.310 Wetlands: designation and ranking

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The date of the *Washington State Wetlands Identification and Delineation Manual* is 1997, not 1977. We recommend that Woodinville adopt Ecology's four-tier classification system (Categories I through IV), which is based on analysis of wetland functions and represents the best available science. The *Washington State Wetland Rating System for Western Washington – Revised* (Ecology Publication #04-06-025; http://www.ecy.wa.gov/pubs/0406025.pdf), which has just been made final, was developed through an analysis of wetland functions, extensive field research, and scientific review by a team of about 35 planners and scientists. It is based on a better understanding of wetland functions, ways to evaluate them, and what is needed to protect them. Ecology's guidance on buffer widths and compensation ratios is based on this revised classification, taking into account not only the functions that need to be protected, but also the impacts of adjacent land use.

Section 21.24.320 Wetlands: development standards

(1) Buffers

Although the proposed buffers for wetlands are an improvement over the existing code, in most cases they fall short of the widths needed to protect wetland functions in urban settings. They fall even further short when buffer widths are reduced by up to 50% "with enhancement" of "significantly degraded" buffers. Providing incentives for landowners to enhance degraded wetland buffers is a good idea, but coupling this with automatic reduction of buffer widths would strip many wetlands of the buffers needed to protect their functions. The proposed ordinance offers no guidance on determining the levels of buffer degradation or enhancement required to qualify for this reduction. Consequently, this provision for reducing buffer widths poses dangers of misunderstanding and conflict, in addition to inadequate protection of wetland functions.

The word "minimum" should be changed to "standard" in the sentence "Any wetland restored … or enhanced … shall have the minimum buffer required for the highest wetland class involved." "Minimum" could be interpreted to mean that the buffer of a mitigation wetland could be reduced in return for being enhanced from a significantly degraded condition. Such buffer reduction would be inappropriate for a compensatory mitigation site.

Ecology's function-based classification system takes into account the condition of existing buffers and factors that into the wetland ranking. We urge you to adopt standards based on that four-tiered classification, which are recommended in the attached Appendix 8-C of Volume 2 of our BAS document, *Freshwater Wetlands in Washington State*, (download the entire document at http://www.ecy.wa.gov/programs/sea/bas_wetlands/index.html). Also attached are Appendices 8-E and 8-F, which explain the reasons for the recommended buffer widths and compensation ratios.

Buffer Alternative 3 (Tables 4 through 7) described in Appendix 8-C offers the most flexibility by basing buffer widths on the wetland category, the intensity of adjacent land use, and the specific wetland functions that require protection.

The advantages of using this approach include the following:

1. It provides for specific buffer widths based on the more detailed information provided by the new wetland rating system that the City is proposing to adopt.
2. It is based on the best available science regarding wetland buffers and provides for wider buffers around the more valuable and sensitive wetlands and narrower buffers around the wetlands that are less valuable and sensitive.
3. It will generally result in smaller buffers around wetlands in highly urbanized areas because many of the wetlands in developed areas are not providing the habitat functions that require larger buffers.
4. It provides incentives to landowners and developers to incorporate low-impact site-development measures to reduce runoff, noise, light, etc. Using such measures allows for reduced buffers.
5. It provides incentives to landowners and developers to provide connectivity between wetlands on their property and other habitat areas in exchange for reduced buffers.

This approach will also provide a greater degree of predictability for applicants and reduce the risk that the City will act in an arbitrary or capricious manner in applying buffer reductions.

Where the proposed CAO departs from the guidance of best available science, the City should set forth the reasons for this departure and its implications and potential risks. The City's reasoning and analysis should be part of the findings of the adopting ordinance.

(2) Buffer width averaging
In addition to the criteria given in the proposed CAO, it should be shown that no feasible alternatives to the site design could be accomplished without buffer averaging. The proposed CAO would allow reduction of a buffer width in places by up to 20% or 50 feet, whichever is greater. We recommend the further limitation of maintaining a buffer width of at least 35 feet at all points. A narrower buffer may not be wide enough to fully protect wetland functions.

Section 21.24.330 Wetlands: permitted alterations

(1) The proposition that a wetland might "not serve any of the valuable functions of wetlands" is unsound. Some wetlands support only a few functions at a low level, but no wetland is devoid of them. A determination that a wetland fails to serve any wetland functions should not be the basis for permitting alterations to wetlands. The proposed CAO refers in this section to "valuable functions of wetlands identified in WMC

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21.06.710 …," but wetland functions are not identified in the section cited or elsewhere in the CAO.

Activities and uses with impacts on Category I wetlands should be prohibited except as provided for by exception or variance. Non-water-dependent activities with adverse impacts on Category II and III wetlands should be prohibited unless an applicant demonstrates that a project's purpose cannot reasonably be accomplished by avoiding such impacts or with less impact on wetlands.

(4) & (5) Utilities such as transmission lines, sewer lines, and pipelines can require clearing and permanently maintaining wide areas, with adverse effects on wetland and buffer functions. Ecology recommends that the City require specific compensatory mitigation for the impacts of utility construction and maintenance.

(7) Use of wetlands or wetland buffers as sites for stormwater ponds, as proposed in this section, is inconsistent with protecting wetland functions and values. The proposed CAO cites requirements of the [1998] *King County Surface Water Design Manual*, which is now being updated to achieve equivalency with Ecology's *Stormwater Management Manual for Western Washington* (2001). Volume I, "Minimum Technical Requirements," of the Ecology manual states the following under "Minimum Requirement #8: Wetlands Protection":

> Stormwater treatment and flow control facilities shall not be built within a natural vegetated buffer, except for:
> - necessary conveyance systems as approved by the local government; or
> - as allowed in wetlands approved for hydrologic modification and/or treatment in accordance with Guidesheet 1B.

Guidesheet 1B and others from Appendix 1-D of Ecology's stormwater manual are a good guide to the level of protection that should be required for different categories of wetlands with respect to stormwater facilities. As a rule, Category IV wetlands are the only ones that may be considered, under specific circumstances, for modification for runoff control.

(8) Multipurpose trails made of impervious materials should avoid wetlands and buffers whenever possible and to the greatest extent possible. Other trails should be permeable, for pedestrians only, and be located outside of wetland buffers if possible. When allowed, trails must have no adverse impacts on water quality and be restricted to the outer 25% of the wetland buffer, with barriers to intrusion on the side of the trail closer to the critical area. Trail construction should avoid damaging significant trees and other habitat elements.

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Section 21.24.340 Wetlands: mitigation requirements

(1) & (2) The aim of mitigation should be to achieve no net loss of wetland functions and values, not just biological functions. Water quality and hydrologic functions require equivalent compensation. Compensatory mitigation plans should be consistent with the interagency *Draft Guidance on Wetlands, Mitigation in Washington State,* Part 2, 2004 (Ecology Publication #04-06-013B), or updated and final versions of this document. This guidance, developed by Ecology, the U.S. Army Corps of Engineers, and the Environmental Protection Agency, updates and replaces the 1994 *Guidance for Developing Freshwater Wetlands Mitigation Plans and Proposals* cited in the proposed CAO.

(6) As this guidance points out, compensatory mitigation projects should be monitored for at least five years, preferably ten. Ten years or more of monitoring are needed for forested and scrub-shrub communities, which take at least eight years after planting to reach 80-percent canopy closure.

(7) Proposed mitigation ratios would be adequate for some categories of wetlands with certain functions but inadequate for others. We suggest that compensation ratios be based on Ecology's four-tier rating system, using both on the category of the wetland impacted and the nature of the mitigation, i.e.:

- reestablishment or creation,;
- rehabilitation;
- enhancement; or
- a combination of reestablishment or creation and enhancement.

As discussed on pages 12 to 19 of Appendix 8-C of Volume 2 of Ecology's *Freshwater Wetlands in Washington State*, this would better account for the risk of mitigation failure and the at least temporal loss of wetland functions and values. Table 9 in this appendix shows suggested compensation ratios for different types and categories of wetlands and for various kinds of mitigation. As the proposed CAO provides, these ratios may be increased in specific cases according to the probability of success, the difference in functions, the timing of mitigation, and other factors.

Section 21.24.340 [sic] Wetlands: limited exemption

Best available science offers no support for excluding wetlands from protection based on size or hydrologic isolation. Even very small and isolated wetlands can provide habitat and important ecological processes. The proposed exemption for wetlands less than 1,000 square feet should be justified by analysis of the exemption's cumulative impact on wetland functions within specific basins or watersheds. In-lieu fees that could be spent on wetland projects in the City may be considered in place of direct mitigation for minor impacts.

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After reviewing the proposed CAO we believe it does not adequately include the best available science and will not protect wetland functions and values. Some of the language in this draft has been taken from the Critical Areas Assistance Handbook produced last year by the Department of Community, Trade and Economic Development (CTED). However, critical provisions recommended in the CTED handbook have been omitted or changed to the point where significant degradation of existing wetland functions and values will result. We urge you to consider our suggestions for improvement and evaluate the enclosed documents. We are available to discuss our comments with you and provide additional assistance.

I look forward to working with you to support your efforts to update Woodinville's CAO using best available science. Please call or e-mail me with any questions or for further discussion. I can be reached at (425) 649-4447 or riro461@ecy.wa.gov.

Sincerely,

Richard K. Robohm
Wetland Specialist

Enclosures

RKR:rc
cc: Sam Wentz, Department of Community, Trade and Economic Development
Donna Bunten, Ecology CAO Review Coordinator
Erik Stockdale, Wetlands Specialist

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2004 PLANNING COMMISSION MEETINGS

AGENDA SCHEDULE - *REVISED 09/17/04*

09/22/04	**SPECIAL MEETING** **PUBLIC HEARING** – Critical Areas Ordinance	7:00 pm
10/06/04	**REGULAR MEETING** Planning Commission Annual Docket: Discussion and Recommendation to City Council	7:00 pm
10/20/04	**REGULAR MEETING**	7:00 pm
11/03/04	**REGULAR MEETING** Implementing regulations (Downtown & Little Bear Creek Master Plan Sign Code Remand from City Council (billboards and subdivision signs) Economic Development Plan Scope and Schedule	7:00 pm
11/17/04	**REGULAR MEETING**	7:00 pm
12/01/04	**REGULAR MEETING**	7:00 pm
12/15/04	**REGULAR MEETING**	7:00 pm