EXHIBIT 17
PAGE 1 OF 46

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Title: Assessment of the Wetlands on the Woodinville High School Annex Property, King County, Washington

Project: 88-33

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EXHIBIT 17
PAGE 2 OF 46

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TABLE OF CONTENTS

List of Figures

List of Tables

1.0 INTRODUCTION AND IDENTIFICATION OF THE PROJECT

This report presents the results of our study of the plant communities, soils, and hydrology within the Woodinville High School Annex property, within King County, Washington. The Woodinville High School Annex property, approximately 21.9 acres in size, is located within portions of Section 3, in Township 26 North, Range 5 East, in King County, Washington. (See Figure 1 for site location). The proposal is to develop portions of the property for an annex to the Woodinville High School.

The primary purpose of this study was to identify, describe, and locate any wetlands on the property. Wetlands are considered to be waters of the United States pursuant to Section 404 of the Clean Water Act. In accordance with Section 404, wetlands are under the jurisdiction of the U.S. Army Corps of Engineers (COE). Wetlands are also protected as sensitive areas under the King County Sensitive Areas Ordinance (King County Ordinance 4365, 1979). The COE wetland definition is part of the King County Sensitive Areas Ordinance.

2.0 METHODS AND PROCEDURES

2.1 Wetland definition and methodology used for wetland determination

The Clean Water Act was enacted by Congress in 1977 to protect and maintain the integrity of the nations aquatic resources. Section 404 of the Act "authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits for the discharge of dredged or fill material into the waters of the United States, including wetlands" (Environmental Laboratory 1987:5). This legislation has since become the primary federal regulation controlling development activities in wetland areas.

The U.S. Army Corps of Engineers (COE) uses the following definition to identify and delineate wetlands. A wetland is defined as,

> "Those areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (Federal Register 1982:13).

EXHIBIT 17
PAGE 7 OF 46

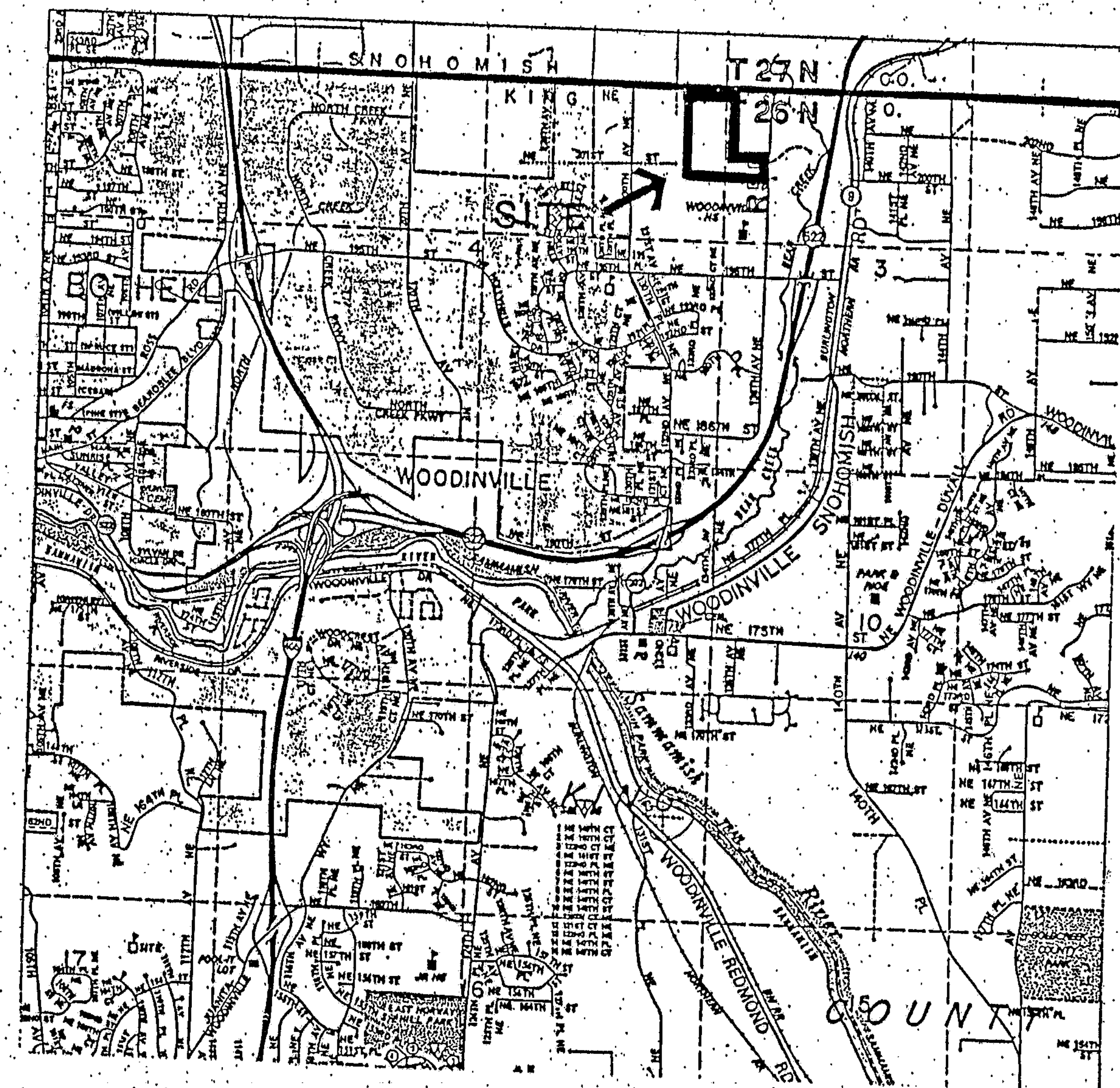

Figure 1. Site location map showing the Woodinville High School Annex property.

It is the interaction of hydrology, soils, and vegetation in wetlands that results in the characteristics unique to wetlands. The COE definition recognizes that the vegetation, soils, and hydrology of wetlands exhibit unique characteristics, and that these characteristics may be used to identify and delineate wetlands. King County uses the COE wetland definition for determination of wetland.

The COE's technical guidelines for wetland identification and delineation utilize the three parameters of vegetation, soil, and hydrology. Various indicators of these parameters are used as diagnostic characteristics to determine wetland or non-wetland conditions. Generally, a minimum of one positive wetland indicator for each of the three parameters must be found in order to make a positive wetland determination (Environmental Laboratory 1987:13). This multi-parameter approach provides a logical, technical basis for wetland determinations.

This study focused on the application of the COE's technical guidelines for the purposes of identifying and locating wetlands within the Woodinville High School Annex property.

2.2 Field Sampling Procedures

The methodology of wetland analysis in this study is based on the COE Wetlands Delineation Manual (Environmental Laboratory 1987).

Field surveys were conducted to describe the vegetation cover-types, to investigate soil and hydrologic characteristics, and to identify wetland on the property. These surveys were conducted on May 2, 13, 19, and July 11, 1988. The property was traversed so that the various plant communities and soil "types" on the property were encountered. Vegetation and soil and hydrologic conditions were assessed at various plots representing "homogeneous" plant cover-types. Wetland boundaries were defined by assessing the location where all three parameters were no longer positive.

2.3 Characterization of Plant communities (vegetation)

Vegetation on the Woodinville High School Annex property was classified into plant communities types. These communities were described using the Braun-Blanquet cover-abundance method (Table A.1) (Mueller-Dombois and Ellenberg 1974). Plant community composition and species cover-abundance were noted at observation points within homogeneous communities (plots). Scientific nomenclature of all plant species encountered follows that of Hitchcock and Cronquist (1973). The plant community descriptions satisfy the COE technical guideline for the identification of the dominant vegetation.

Plant community classifications were based on the composition of the overstory (where present) and the understory vegetation. Wetland community classification was based on the U.S. Fish and Wildlife Service (USFWS) system described by Cowardin et al. (1979). Upland communities were classified using a modification of the system described by Anderson et al. (1976).

To simplify the task of analyzing the vegetation data collected during the field survey, the methodology of Wentworth and Johnson (1986) and the COE (Environmental Laboratory 1987) were adapted into a quantitative and objective method of vegetation designation. The focus of this methodology was the application of two quantitative indices to discriminate between wetland and upland plant communities.

The wetland indicator status (WIS) initiated by the US Fish and Wildlife Service (Reed 1987) was incorporated into these indices. The WIS was used to determine which plants were adapted to wetland conditions. These ratings essentially segregate species into "ecological groups". These groups (or WIS assignments) combine species with similar probabilities of occurrence in wetlands. These probability groups are related by similar abilities to withstand saturated soil conditions. The WIS categories are defined in Table A.2.

The first index used to analyze vegetation information was the percentage of dominant species with a WIS rating of facultative or wetter. This index addresses the COE requirement of determining a "prevalence of vegetation" adapted to wetland conditions. The COE's technical guideline for determining the presence of hydrophytic vegetation is that greater than 50% of the prevalent vegetation must be facultative or wetter (Environmental Laboratory 1987). In the COE definition, prevalent vegetation is considered "the dominant species comprising the plant community or communities" (Environmental Laboratory 1987:16). A cover class value of 2 (5 - 25 % cover-abundance), in the Braun-Blanquet scale, was used as the lower limit for the dominant vegetation. For each observation point, the percentage of species that were facultative or wetter, for all species with a cover value of 2 or greater, was calculated. An example of this calculation is given in Appendix B. Vegetation was classified as hydrophytic according to the COE's technical guideline if greater than 50% of the prevalent vegetation was facultative or wetter.

The second vegetation index calculated for each plot was a weighted mean of the WIS ratings. This weighted mean index (WMI), averages the WIS of all species in the plot by weighting each of the species encountered based on their dominance in the community. The WMI provides a measure of the adaptation of the plant community to saturated soil conditions. The WMI calculated for this report followed the recommendations of Wentworth and Johnson (1986) as a method for wetland identification. This index indicates the degree to which the prevalent vegetation is adapted to wetland conditions. This index is useful when vegetation is composed of many species with wide ranges in their WIS assignments. The WMI provides a value that can be used to assist in classifying vegetation as either wetland or non-wetland. Further discussion of the methodology is given in Appendix B.

The calculation of a WMI involves taking the sum of the products of WIS and dominance values for all species in a given plot, and dividing this by the sum of all dominance values. To accomplish this, WIS ratings were assigned numerical values (i.e., UPL=5, FACU=4, FAC=3, FACW=2, OBL=1; Table B.1) and the dominance values were calculated as the percentage midpoints of the Braun-Blanquet cover-abundance classes (Table B.2). (Further segregation of the five WIS categories with the plus or minus signs used by Reed (1987) was not done for the purposes of the WMI calculation.) Plants that were not identifiable to species and that had a range in WIS ratings were assigned the average for the range of WIS ratings. The calculation of this index is further explained in Appendix B, where an example of the calculation is given.

Essentially, a WMI assigns a WIS to the community by weighting each species' WIS by its relative cover. The WMI provides an objective parameter useful in designating a plant community as wetland or upland. Figure B.1 is a scale that provides an explanation of the WMI. Ideally, the "breakpoint" between wetland and upland vegetation is a WMI of 3.0 (i.e. FAC), with wetland being less than 3.0 and upland being greater than 3.0. However, a WMI close to 3.0 implies a great deal of uncertainty in making a wetland determination. When the WMI is near 3.0, vegetation may not be clearly indicative of either wetland or upland. However, as the WMI of a plot, or cover-type, approaches the extremes of the scale (i.e., 1 or 5), the probability of vegetation being indicative of either wetland or upland increases (Figure B.1).

Using both the COE's technical guideline for the determination of hydrophytic vegetation and the WMI provides an objective method of determining whether the vegetation of an area is adapted to wetland or non-wetland conditions. However, both of these indices, or guidelines, are only as good as the classification system on which they are based. Inaccuracies of the WIS assignments will be reflected in the indices. In cases where inconsistency occurs between a species' WIS and its ecological niche, based on field observation and apparent soil and hydrological conditions, vegetation indices may need to be evaluated more critically.

Both the WMI and percentage of wetland species are useful for making wetland designations but soil and hydrology information is also required, particularly when the vegetation is not clearly indicative of wetland or upland (i.e., when a community is dominated by facultative species, or has a WMI near 3.0). "When wetlands are occupied by facultative species, WMI or any other analysis of vegetation may be a poor choice for designation purposes." (Wentworth and Johnson 1986). For these reasons and to be consistent with the COE technical guidelines, soil and hydrologic conditions were investigated at each plot to determine whether an area was wetland or non-wetland.

2.4 Characterization of Soils

The soils of the Woodinville High School Annex property were mapped by the U.S. Soil Conservation Service (SCS) and described by Snyder et. al. (1973). However, field investigation of the soils on the property was necessary to determine the accuracy of the SCS map and to determine whether any hydric soils were present.

Hydric soil is one of three positive indicators of wetland. Hydric soil is defined as a soil "that in its undrained condition is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation." (Soil Conservation Service 1985:i). Classification of hydric and non-hydric soils follows the U.S. Soil Conservation Service (1985).

Soil morphology may be used to identify hydric soil. Therefore, soil assessment was conducted during our site visits. Soil morphology was described from exposed soil profiles in pits excavated to a depth of approximately 16 inches. Observations of topography, soil texture, and degree of disturbance (i.e., filling and/or grading) were also recorded. Soil augering was used to determine the variation and distribution of soil properties across the property.

Soil colors are a soil property that may be used as an indicator of drainage conditions. Soil color descriptions in this report are based on the three spectral variables: hue (the dominant spectral color), value (the relative brightness of color) and chroma (a measure of the purity of color) (Buol, et al. 1980). Alphanumeric values were assigned to these spectral variables using the notation of the Munsell Color System (Munsell Color 1975).

Soil profiles were examined for hydric soil indicators. These indicators include, but are not limited to 1) gley, 2) mottling in a low chroma matrix, 3) histic soil horizons, and 3) saturated or inundated conditions. Gley is the presence of gray, greenish gray, or bluish colors in the soil. Gley indicates that soil conditions are anaerobic for sufficient time that iron occurs in a reduced form. Mottling in a low chroma matrix is the occurrence of "spots" of contrasting soil colors within a soil that has a low chroma matrix color. Low chroma is defined as having a chroma less than or equal to 2, according to standard Munsell notation, and indicates colors of low purity, or gray colors. The presence of mottles in a low chroma matrix indicates alternating oxidized and reduced conditions, or alternating saturated and unsaturated soil conditions. A histic soil horizon is a horizon dominated by organic soil material. In most cases, organic soils are indicators of very poorly to poorly drained conditions. Histic horizons typically develop on sites with nearly constantly saturated conditions, since anaerobic conditions associated with saturated conditions retard the decay of plant materials. Saturated or inundated soil conditions are an indicator of hydric soils. However, recent weather conditions must be taken into account, as intense precipitation can produce saturated or inundated conditions in an otherwise non-hydric soil.

While hydric soil morphology can be an indicator of wetland soil, it does not by itself define a soil, or area, as wetland. Drained hydric soils that continue to exhibit hydric morphology but are no longer flooded or saturated for sufficient time to favor the growth and regeneration of hydrophytic vegetation are no longer classified as wetland (Cowardin et al. 1979; Environmental Laboratory 1987; Soil Conservation Service 1985).

Conversely, a soil may be subjected to saturated or flooded conditions for a sufficient period to favor the growth of hydrophytic vegetation, yet lack "typical" hydric soil morphology. This phenomena occurs commonly in young or poorly developed soils. Examples of soils lacking hydric morphology, yet meeting the hydric soil definition, include poorly drained recent deposits, such as sand bars, and poorly drained minesoils, or other recently disturbed soils. Hydric soil morphology may not be developed in these soils because of their young age. Also, in some soils certain soil materials may "mask" the usual morphological indicators of poorly drained conditions and therefore soil colors and other morphological properties indicative of poorly drained conditions may not be prevalent. Therefore, careful observation of soil morphology in association with vegetation, topography, and hydrology is needed in soils that area young or disturbed.

Finally, soil morphology is an indicator of the environmental conditions under which the soil developed. However, morphology may not necessarily reflect present environmental conditions when conditions have been recently altered or where soil development is limited. In these circumstances, evaluation of vegetation and hydrology must be weighted heavily in a wetland determination.

2.5 Characterization of Hydrology

The importance of hydrology to the existence of wetland is clearly stated in the COE definition of wetlands as:

> "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 typically adapted for life in saturated soil conditions" (Environmental Laboratory 1987:13).

Wetland hydrology is the determining factor for wetland formation. Without wetland hydrology an area can not be classified as wetland. It is the primary determinant for the development of hydric soils and hydrophytic vegetation. Thus, in identifying and delineating wetlands, the goal is to determine the extent of wetland hydrology.

> "The term 'wetland hydrology' encompasses all hydrological characteristics of areas that are periodically inundated or have soils saturated to the surface at some time during the growing season. Areas with evident characteristics of wetland hydrology are those where the presence of water has an overriding influence on characteristics of vegetation and soils due to anaerobic and reducing conditions, respectively..." (Environmental Laboratory 1987:34)

Indicators of wetland hydrology include both recorded and field data. Recorded data typically include the stream, lake, and tidal gage records of the COE, US Geological Survey (USGS), state, county and/or local governments. Field data includes visual observation of inundation, soil saturation, watermarks, driftlines, sediment deposits, and drainage patterns (Environmental Laboratory 1987).

Topography and the hydraulic conductivity of soil materials are important factors controlling local hydrology. Wetland hydrology exists because the either 1) topography directs water towards or impedes water flow out of an area, or 2) soil conditions impede drainage, or 3) both topographic and soil conditions favor wetland hydrology. Topography and soil properties are important factors determining the existence of wetlands. Therefore, observations of topography and soil properties are a necessary part of any wetland determination.

Inundation or soil saturation are the most direct evidence of wetland hydrology. However, observations of inundation or saturation must be considered in the context of the prevailing weather conditions. Saturation does not necessarily indicate wetland hydrology, for even a well drained soil may have ponded or saturated conditions when the rate of precipitation exceeds the infiltration rate, or hydraulic conductivity of the soil. However, saturated soil in association with hydric soil morphology is a reasonable indicator of wetland hydrology.

Due to the seasonality of precipitation in the Pacific Northwest a positive indicator of wetland hydrology (i.e., saturation) may not be present during all seasons of the year. In these cases, the presence of hydric soil morphology can imply wetland hydrology during drier seasons. However, care must be taken when implicating wetland hydrology from morphology because hydric soil morphology may persist even if wetland hydrology is no longer present, as in drained soils. A drained hydric soil is not a wetland soil if it fails to support hydrophytic vegetation (Cowardin et al. 1979; Environmental Laboratory 1987; Soil Conservation Service 1985). On the other hand, the lack of hydric soil morphology does not necessarily preclude an area from having wetland hydrology or being wetland. Therefore, care must be made in interpreting soil and vegetation information in regards to its relevance to hydrology.

3.0 EXISTING CONDITIONS

3.1 General Property Description

United States Fish and Wildlife Service (USFWS) Wetland Inventory Maps (Cowardin et al. 1979) were examined to determine if any wetland plant communities had been mapped on the property by this agency. No wetland was identified on the property, according to this inventory (Figure 2). The USFWS inventory was based on aerial photograph interpretation and many wetlands may go undetected, particularly in forested areas.

King County Wetland Inventory maps (King County 1983) did not indicate any wetlands within the property (Figure 3). According to the King County map any wetlands on the property would be in the Little Bear Creek drainage basin.

Despite the lack of any mapped wetlands on the property, field surveys revealed that portions of the property contained 1) hydrophytic plant communities 2) hydric soil, and 3) positive wetland hydrology. Positive indicators for all three parameters indicated the presence of wetland within the property.

Figure 4 shows the boundaries and existing conditions of the Woodinville property. Figure 5 is a topographic map of the site. Both Figures 4 and 5 are located in the back pocket of this report.

Three areas of palustrine, broad-leaved deciduous forested wetland (PFO1) were identified and delineated on the property (Figure 4). In addition, several riparian zones were identified on the property. Riparian zones were distinguished from wetland based on the presence of a well defined stream channel (R3UB) with only a narrow zone of hydric soil and hydrophytic vegetation paralleling the streambed. The boundary between the wetland areas and the riparian zones is not a surveyed line, because 1) the distinction between wetland and riparian zone is based largely on the extent of the wetland associated with the stream, and 2) there really is no defined boundary between these types of wetlands. The distinction between riparian zone and wetland area is largely for discussion and regulatory purposes. Both the wetland areas and the riparian zones are wetlands and are under COE and King County jurisdiction.

The forested uplands surrounding the wetlands were predominantly upland broad-leaved deciduous forest (Fd) (Figure 4). An area of non-wetland pastureland (P/G) and a homesite (Ur) occurred in the southeast portion of the property.

EXHIBIT 17 11
PAGE 16 OF 46

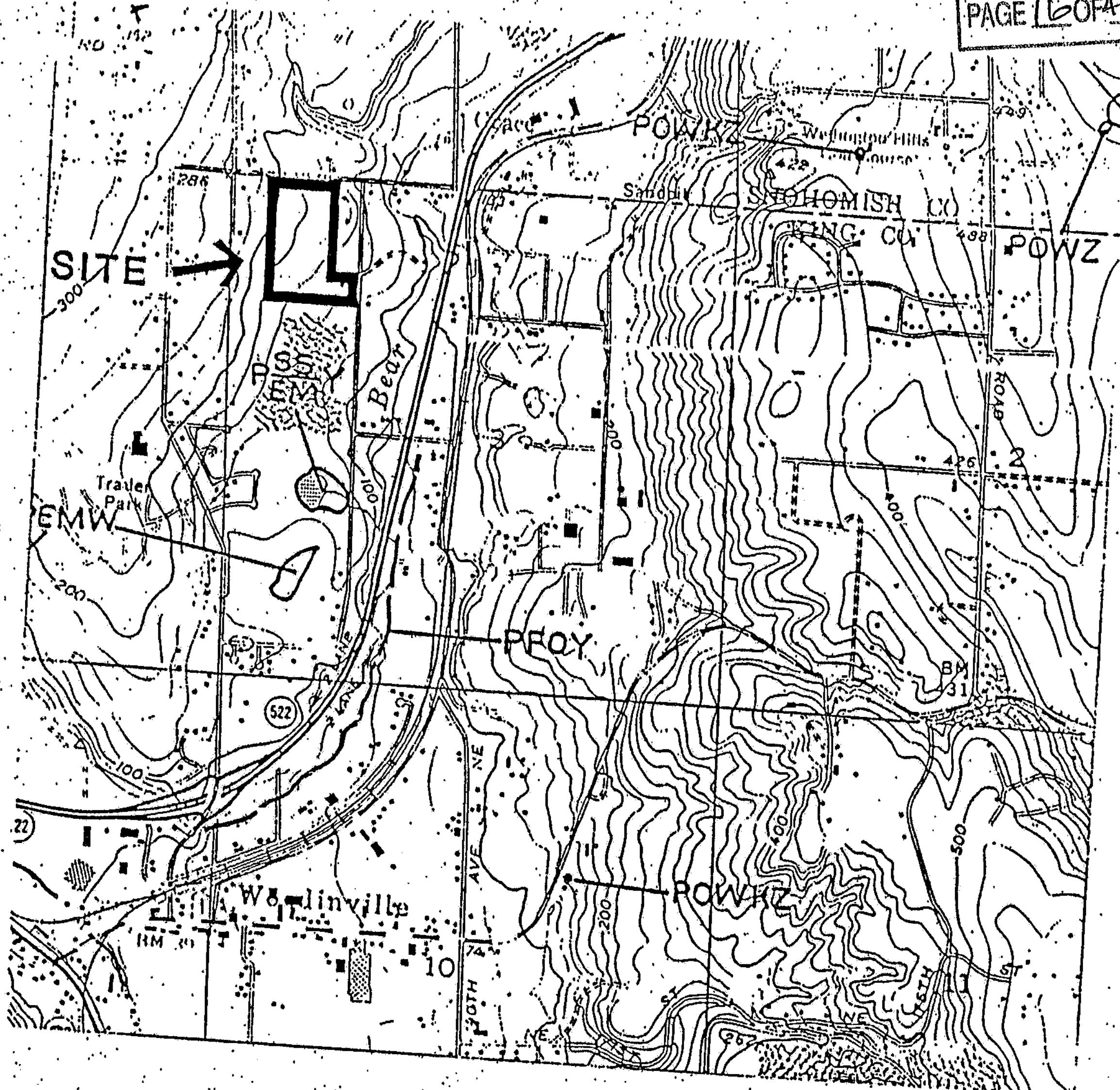

Figure 2. United States Fish and Wildlife Service Wetland Inventory Map for the area including the Woodinville High School Annex property (Cowardin et al. 1979).

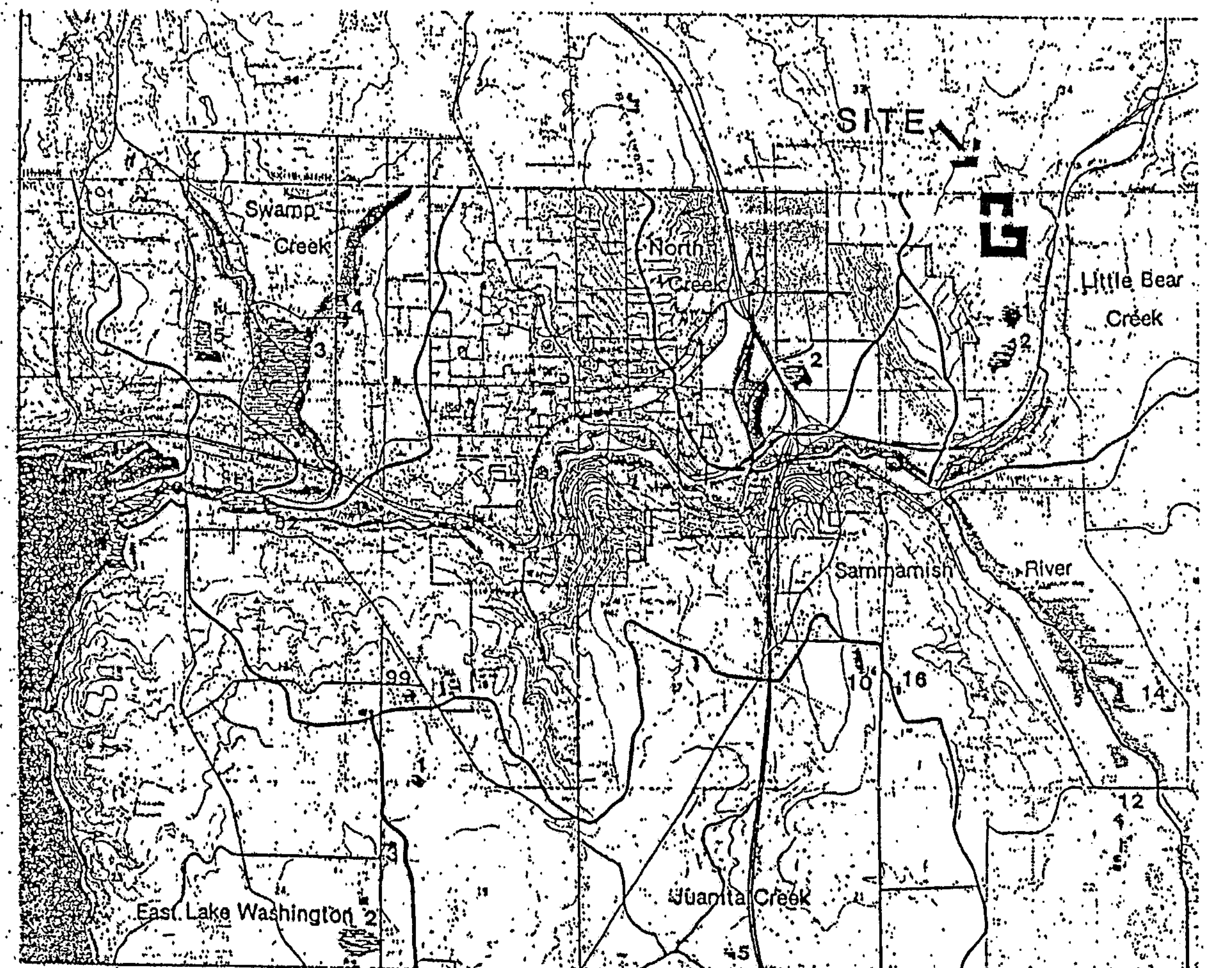

Figure 3. King County Wetland Inventory Map for the area including the Woodinville High School Annex property (King County 1987).

The soils on the property were mapped by the SCS (Figure 6) and descriptions of the mapped soil series are described in the Soil Survey of King County Area, Washington (Snyder et. al. 1973). The SCS mapped the property as Everett gravelly sandy loam, 5 to 15 percent slopes (Figure 6 and Table 1).

Soil Conservation Service mapping units commonly have inclusions of other soils that are not noted because they are too small to map at the scale of the survey. Often times these inclusions can be classified as hydric soil or wetland. Within the Woodinville High School Annex property inclusions of hydric soil were found. Considerable portions of the property contained soils that did not conform to the Everett series. These soils were poorly to very poorly drained hydric soils that correlated with the presence of hydrophytic vegetation. These areas of hydric soil and hydrophytic vegetation were classified as wetland and subsequently surveyed (Figure 4).

The poorly drained soils were mineral hydric soils, while the very poorly drained soils were organic soils. The mineral soils would likely be classified as the Norma soil series and the organic soils would be classified as the Shalcar soil series (Table 1). The Norma soil is a poorly drained soil formed in coarse-loamy deposits. The Shalcar series is composed of soils formed in shallow, well-decomposed deposits of organic matter. The depth of organic soil ranged from a few inches to over several feet in depth. Areas with deeper organic deposits could be classified as Seattle muck, but generally the deeper areas of muck were small in size and were inclusions within Shalcar soil. The poorly drained mineral soils generally fringed the wetland areas or occurred as islands within the wetland, while the organic soils occurred within lower lying and more inundated areas of the wetland. The hydric soils occupied gently sloping to nearly level slopes that were predominantly concave in form (Figure 5).

The upland areas of the property had non-hydric soil that could be classified as the Everett series (Table 1). The Everett series is a non-hydric soil formed from loamy-skeletal glacial outwash. The Everett soils were gently to moderately sloping (Figure 5), and generally occupied convex landsurfaces.

The vegetation and hydrology within the Woodinville High School property correlated with soil properties in the unoccupied portions of the property. The non-hydric Everett soil supported upland deciduous forest, while the hydric soils supported predominantly hydrophytic vegetation.

Within the wetland were scattered elevated islands of deep organic deposits composed of decayed logs and/or stumps that often supported some non-hydrophytic plant species. These

EXHIBIT 17 14
PAGE 19 OF 46

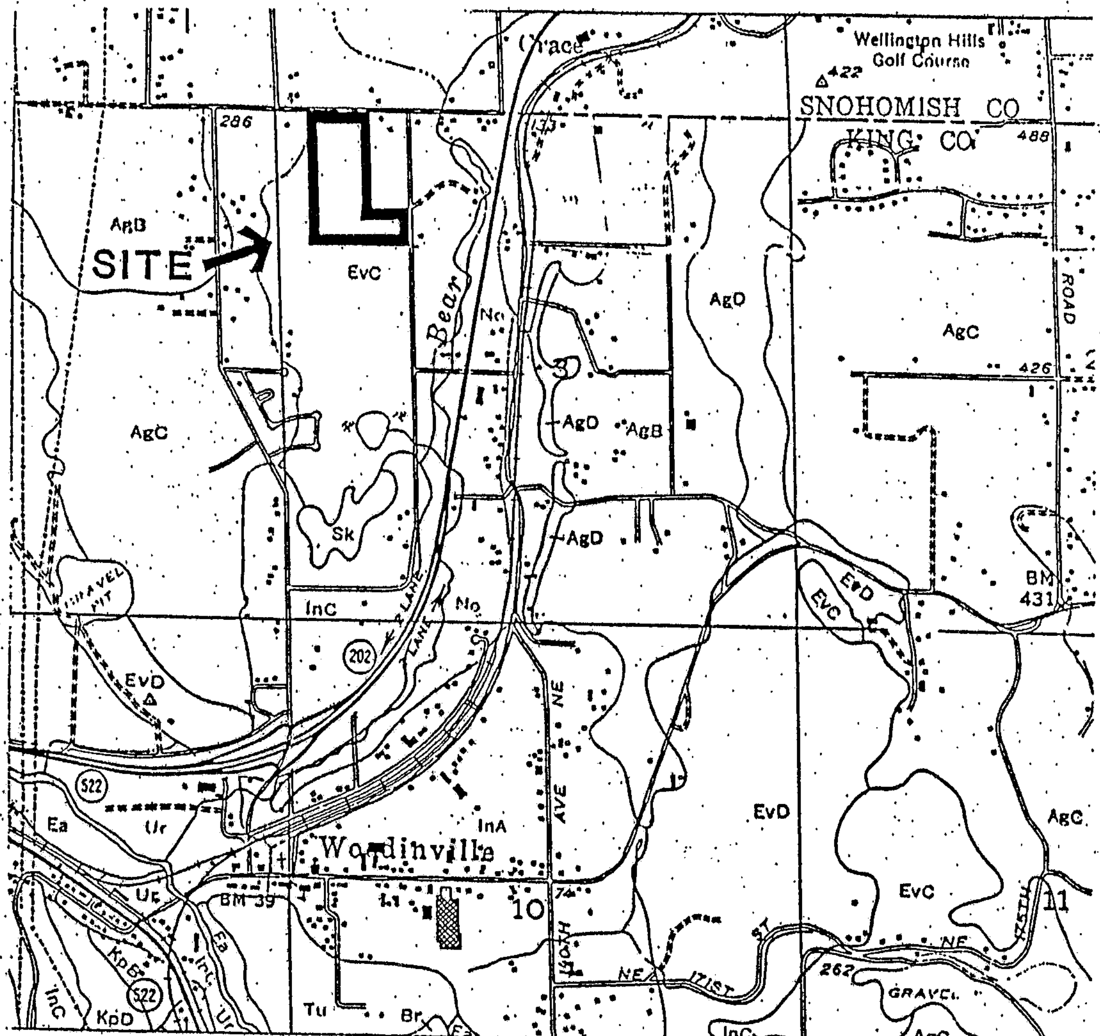

Figure 6. Soil Conservation Service Soil Survey Map for the area including the Woodinville High School Annex property (Snyder et al. 1973).

Table 1. Soil Information. Key to soil mapping units on the Woodinville High Scholl Annex property and short description of the soils as described by SCS (Snyder et al. 1973, Soil Conservation Service 1985).

Map Symbol	Mapping Unit	Hydric	Drainage Class	Depth to High WT	Permeability	Particle-size Class	Geographic Setting and Parent Material
EvC	Everett gravelly sandy loam, 5 to 15 % slopes	No	Somewhat excessively drained	> 5′	Rapid	Sandy-skeletal	Formed in gravelly glacial outwash on terraces and terrace fraonts at eleveations ranging from 0 to 500 feet.
No	Norma	Yes	Poorly	+1 - 1′	Moderately rapid	Coarse-loamy	Formed in old alluvium in depressions on till plains and along drainageways at elevations ranging from 0 to 1000 feet.

EXHIBIT 17
PAGE 20 OF 46

Table 1. Continued.

Map Symbol	Mapping Unit	Hydric	Drainage Class	Depth to High WT	Permeability	Particle-size Class	Geographic Setting and Parent Material
Sm	Shalcar muck	Yes	Very poorly drained	+1 - 1.5' Oct-May apparent	moderate over very rapid to very slow	Loamy/ sapric #	Formed in herbaceous and woody organic deposits overlying alluvium and glaciofluvial deposits in depressional areas on outwash terraces, till plains, and stream terraces at elevations ranging from 50 to 700 feet. Less than 51 inches of organic soil.

* WT = water table
# sapric = well decomposed organic matter

islands were small in size, supported a large number of facultative species, and were surrounded by hydric soil. Therefore, these elevated islands were not classified as non-wetland, but rather they were elevated mesophytic micro-sites.

Forested wetlands often have a variety of micro-sites, due to the uneven surfaces found within this class of wetland. In forested wetlands, depressions may contain standing water, organic soil and obligate plant species, while immediately adjacent, a mound may support more mesophytic, or in some cases xerophytic, plant species. These mounds that support non-hydrophytic species are often formed as a result of tree throw. The saturated soils of forested wetlands can cause trees to be susceptible to tree throw. Tree throw can result in the development of "pit and mound" topography, characterized by pits, or excavations formed by the toppled tree, and mounds, formed by uprooted soil/root masses, and by the fallen tree itself. Mounds tend to be favored locations for seedling establishment, being elevated above the surrounding saturated or inundated soils. Several generations of tree growth on mounds and tree throw tends to favor the development of large mounds on which less water-tolerant species can colonize and grow. This was apparent at the Woodinville High School Annex property. This diversity of micro-sites created a diversity of plant species and structure.

Tree throw and the poor drainage tended to create an open canopy within the forested wetlands on the Woodinville High School Annex property.

Landform and underlying geologic deposits greatly influence hydrology. The Woodinville High School Annex property is located on sloping glaciofluvial deposits. The property slopes moderately downslope from the west to the east (Figure 5). The glaciofluvial deposits underlying the property were predominantly coarse textured, but there were strata of finer textured material (Golder 1984). The sloping conditions of the site and the stratification of the outwash deposits results in the emergence of groundwater seepage across the slope.

A change in slope angle and form was usually apparent at the boundary between wetland and adjacent upland. The uplands tended to have convex slopes that ranged from moderately sloping to nearly level, while the wetlands generally had nearly level to gently sloping concave slopes. Convex slopes are generally areas of diverging water flow and concave surfaces tend to be areas of converging water flow. This pattern of water flow often results in the formation of wetland and hydric soil on concave surfaces, particularly if there is considerable drainage area upslope.

Groundwater seepage from upslope areas appeared to provide the bulk of the water within the site. In addition to seepage, other sources of water for the wetland included, two small streams (Riparian Zones 4 and 5) that entered the property along the western property boundary. These streams carried surface water runoff into the wetlands. The streams on the property were classified as riparian, upper perennial, unconsolidated bottom wetland (R3UB). The soils were saturated to inundated throughout the wetlands at the time of the field survey. Some areas of the wetlands showed evidence of defined surface flow (Figure 4). Wetland 3 was a small seep adjacent to Riparian Zone 1. At the lower end of the wetland there were three streams that drained the property (Figure 4). Riparian Zone 1 flowed northeast and drained Wetland 1. Riparian Zones 2 and 3, flowed east to southeast, and drained Wetland 2.

3.2 Wetland and Riparian Zone Descriptions

Wetland areas and riparian zones were differentiated for discussion purpose, as well as regulatory purposes. The riparian zones within the property contained wetland communities that were restricted to a narrow zone along a well defined channel. In contrast, the wetland areas were larger areas, with or without well defined surface flow channels.

3.2.1 Wetlands 1 and 2

The two large wetlands identified in Figure 4 were classified as palustrine, broad-leaved deciduous forested wetlands (PFO1). Wetland 1 and 2 were generally similar habitats and will be described together. The soils within these wetlands were predominantly saturated hydric soil. The lowest portions of the wetlands had organic soil, while slightly elevated soils, or soils along the fringe, were commonly mineral. Many portions of the wetlands were inundated with up to several inches of water. The rest of the wetland had soils that were saturated to the surface, or at some shallow depth.

Vegetation within the wetlands was predominantly hydrophytic (Tables 2,3,4). The dominant tree species was red alder (FAC). Other trees scattered throughout the wetland but at low cover, included: Douglas fir (UPL), western red cedar (FAC), western hemlock (FACU), and cascara (UPL). Douglas fir was limited to a few large individual trees that were restricted to elevated mounds formed from deep organic deposits that included stumps and logs. The shrub layer was dominated by salmonberry (FAC) and vine maple (FACU+). Scattered throughout the shrub layer of these wetlands was western red cedar (FAC), devil's club (FAC), English holly (UPL), Pacific blackberry (UPL), and red elderberry (FACU). Many of the non-hydrophytic shrubs were located on elevated

Table 2. Vegetation Data for Plot 1.

SPECIES	WIS	Cover Class Midpt.	WIS x Midpt.
Trees			
Alnus rubra *	3.0	37.5	112.5
Pseudotsuga menziesii	5.0	2.5	12.5
Thuja plicata *	3.0	2.5	7.5
Tsuga heterophylla	4.3	2.5	10.8
Shrubs			
Acer circinatum	3.7	62.5	229.4
Rubus spectabilis *	3.0	37.5	112.5
Ilex aquifolium	5.0	2.5	12.5
Rubus ursinus	5.0	2.5	12.5
Sambucus racemosa	4.0	2.5	10.0
Thuja plicata (s) *	3.0	2.5	7.5
Herbs			
Maianthemum dilatatum	4.3	62.5	270.6
Athyrium felix-femina *	3.0	15.0	45.0
Lysichitum americanum *	1.0	15.0	15.0
Tolmiea menziesii *	3.0	15.0	45.0
Dicentra formosa	5.0	2.5	12.5
Dryopteris austriaca	5.0	2.5	12.5
Equisetum hyemale *	2.0	2.5	5.0
Polystichum munitum	5.0	2.5	12.5
Smilacina stellata	3.3	2.5	8.3
Trillium spp.	5.0	2.5	12.5
Musci, spp. #	---	2.5	---
SUMS		277.5	966.7

Weighted Mean Index: 3.5

% of Dominant Species w/FAC or Wetter WIS: 71

HYDROPHYTIC VEGETATION: YES

Classification: Palustrine, broad-leaved deciduous forested wetland (PFO1).

* Hydrophytic species (i.e., facultative or wetter).

\# Not included in calculations.

(s) Sapling life form

EXHIBIT 17 20
PAGE 25 OF 46

Table 3. Vegetation Data for Plot 3.

SPECIES	WIS	Cover Class Midpt.	WIS x Midpt.
Trees			
Alnus rubra *	3.0	37.5	112.5
Rhamnus purshiana	5.0	2.5	12.5
Thuja plicata *	3.0	2.5	7.5
Tsuga heterophylla	4.3	2.5	10.8
Shrubs			
Rubus spectabilis *	3.0	87.5	262.5
Acer circinatum	3.7	37.5	137.6
Oplopanax horridum *	3.0	2.5	7.5
Sambucus racemosa	4.0	2.5	10.0
Herbs			
Athyrium felix-femina *	3.0	15.0	45.0
Lysichitum americanum *	1.0	15.0	15.0
Tiarella trifoliata	3.3	15.0	49.9
Dicentra formosa	5.0	2.5	12.5
Equisetum hyemale *	2.0	2.5	5.0
Oenanthe sarmentosa *	1.0	2.5	2.5
Phalaris arundinacea *	2.0	2.5	5.0
Polystichum munitum	5.0	2.5	12.5
Tolmiea menziesii *	3.0	2.5	7.5
Musci, spp. #	---	2.5	---
Graminae spp. #	---	2.5	---
SUMS		235.0	715.9

Weighted Mean Index: 3.0

% of Dominant Species w/FAC or Wetter WIS: 67

HYDROPHYTIC VEGETATION: YES

Classification: Palustrine, broad-leaved deciduous forested wetland (PFO1).

* Hydrophytic species (i.e., facultative or wetter).

\# Not included in claculations.

Table 4. Vegetation Data for Plot 4.

SPECIES	WIS	Cover Class Midpt.	WIS x Midpt.
Trees			
Alnus rubra *	3.0	37.5	112.5
Thuja plicata *	3.0	2.5	7.5
Tsuga heterophylla	4.3	2.5	10.8
Shrubs			
Rubus spectabilis *	3.0	62.5	187.5
Acer circinatum	3.7	37.5	137.6
Sambucus racemosa	4.0	2.5	10.0
Herbs			
Athyrium felix-femina *	3.0	37.5	112.5
Maianthemum dilatatum	4.3	37.5	162.4
Tolmiea menziesii *	3.0	37.5	112.5
Blechnum spicant *	2.7	15.0	40.1
Lysichitum americanum *	1.0	15.0	15.0
Tiarella trifoliata	3.3	15.0	49.9
Dryopteris austriaca	5.0	2.5	12.5
Oenanthe sarmentosa *	1.0	2.5	2.5
Polystichum munitum	5.0	2.5	12.5
Urtica dioica	3.3	2.5	8.3
Musci, spp. #	---	2.5	---
Gramineae spp. #	---	2.5	---
SUMS		312.5	994.2

Weighted Mean Index: 3.2

% of Dominant Species w/FAC or Wetter WIS: 67

HYDROPHYTIC VEGETATION: YES

Classification: Palustrine, broad-leaved deciduous forested wetland (PFO1).

* Hydrophytic species (i.e., facultative or wetter).

\# Not included in calculations.

micro-sites within the wetland, such as stumps, logs or small mounds. The canopy of the forested wetland was fairly open and there were a number of snags (dead standing trees).

The herbaceous layer of these two forested wetlands varied depending on micro-site condition. Within depressions, wetland obligates, such as skunk cabbage and water parsley, were generally well distributed, while on slightly elevated areas greater numbers of facultative species occurred. Overall the two wetlands had an herb layer dominated by: lady-fern (FAC), false lily-of-the-valley (FACU-), skunk cabbage (OBL), pig-a-back plant (FAC), trefoil foamflower (FAC-), and deer-fern (FAC+). Herbaceous species of low cover included: Pacific bleeding heart (UPL*), wood-fern (UPL*), scouringrush horsetail (FACW), sword-fern (UPL*), starry Solomon-plume (FAC-), trillium (UPL*), water-parsley (OBL), reed canarygrass (FACW), stinging nettle (FAC-), and undifferentiated grasses and mosses. Skunk cabbage (OBL) was widely distributed throughout the wetlands but was particularly concentrated in depressions that contained standing water and organic soil deposits. Water-parsley (OBL) was common in depressions, but was of low cover for the total wetland. Lady-fern (FAC) and skunk cabbage (OBL) were the most widely distributed herbs within these forested wetlands (i.e., they occurred as dominants within the three plots described). The non-hydrophytic species, such as Pacific bleeding heart (UPL*), sword-fern (UPL*), and trillium (UPL*), were of low cover and generally restricted to elevated micro-sites. Complex patterns of vegetation occurred, due to the amount of micro-relief within the wetlands.

The percentage of the dominant species that were facultative or wetter ranged from 67% to 71% (Tables 2,3,4), thus meeting the COE's technical guideline for the presence of hydrophytic vegetation. The weighted mean index of the forested wetlands ranged from 3.0 to 3.5, generally on the upland side of the scale but still within the "gray" zone of this index (Figure B.1). Forested wetlands in the Pacific Northwest tend to have high WMIs because the species common in these wetlands are rated as facultative to facultative upland (Wentworth and Johnson 1986). Many of the non-hydrophytic species within these wetlands were restricted to elevated micro-sites that allowed sufficient rooting depth for species intolerant of saturated soil conditions to grow.

A series of soil pits were excavated within the Wetlands 1 and 2. Soil augering was used to determine the variability and distribution of soil properties. The predominant type of soil was a shallow organic soil overlying coarse textured mineral soil. The organic soil material was generally black (N2/0 to 10YR 2/1) and well decomposed, except at the soil surface, where recently deposited and more poorly decomposed material occurred. The underlying mineral soil was usually gray (5Y 5/1) to light gray (5Y 6/1), and in places greenish gray (5GY 6/1). The organic layer in the soil pits examined was generally 1 to 2 feet thick, however, using an auger the organic soil was found to be considerably thicker in places. Golder Associates (1984) measured deposits of organic soil that were greater than 4 feet thick within these wetlands. A strong odor of hydrogen sulfide, indicative of reduced conditions, was evident upon excavating many of the soil pits. Based on the presence of a histic epipedon (i.e., an organic soil horizon), hydrogen sulfide odors, and gley in the subsoil, the soils of the wetland were classified as hydric.

Positive indicators of wetland hydrology were apparent throughout Wetland 1 and Wetland 2. Soil pits rapidly filled with water upon excavating them. Water levels ranged from the surface to only several inches below the surface. Ponding was evident in many areas. Surface runoff was limited to small channels that were classified as riparian, upper perennial, unconsolidated bottom (R3UB). Based on the presence of saturated and inundated soil conditions, the wetlands were determined to have a positive indicator of wetland hydrology. Landscape position, being at the base of moderate slopes, was also indicative of wetland conditions.

3.2.2 Wetland 3

Wetland 3 (Figure 4) was a seepage area that was classified as a palustrine, broad-leaved deciduous forested wetland (PFO1). This wetland was small in size, and had a predominance of hydrophytic vegetation, contained hydric soil, and had positive wetland hydrology. The soils were saturated throughout this seep. The soil ranged from shallow organic hydric soil to mineral hydric soil. Vegetation included red alder (FAC), salmonberry (FAC), and skunk cabbage (OBL). A detailed species list was not made for this wetland because it was of small size and compositionally was not much different from the other forested wetlands within the property.

3.2.3 Riparian Zones

Several well defined streams (Riparian, upper perennial, unconsolidated bottom (R3UB)) occurred on the property (Figure 4). Outside of the large wetlands, these streams had a narrow zone parallel to the channel that supported hydrophytic plant species. These areas are designated as riparian zones on the Existing Conditions Map (Figure 4). Riparian zones would be classified as waters of the United States and therefore are under the jurisdiction of the COE. Generally these riparian zones were of limited width and generally were restricted to the floodplain of the stream.

The streams were small in size and appeared to have less than 5 c.f.s. mean annual flow, based on observations of the size of the stream channel and associated floodplains. The wetlands on the property therefore would probably be classified as associated wetlands above the headwaters.

A wide range of soil types occurred along the streams, ranging from gravelly to fine textured soils depending upon location. This range in soil properties is characteristic of alluvial soils, due to the dynamic nature of the alluvial landscape. The soils of the riparian zones would be classified as hydric.

The prevalent vegetation along these channels was hydrophytic. Vegetation included red alder (FAC), western red cedar (FAC), western hemlock (FACU), salmonberry (FAC), lady-fern (FAC), and skunk cabbage (OBL). No complete species list was made for these riparian zones because they were of limited extent (i.e. narrow). Species composition within the riparian zones was similar to the larger forested wetlands on the property.

3.3 Non-wetland Descriptions

The forested non-wetland areas of the property were classified as upland broad-leaved deciduous forest (Fd). Tables 5 and 6 provide vegetation information for the forested non-wetland areas of the property. The dominant tree species of the deciduous forest was red alder (FAC), with scattered individuals of Douglas fir (UPL), western red cedar (FAC), and western hemlock (FACU), occurring at low cover. Vine maple (FACU+), salmonberry (FAC), red elderberry (FACU) Pacific blackberry (UPL), and Cascade oregongrape (UPL) were the dominant shrubs. Shrubs of minor importance included: big-leaf maple (FACU), hawthorn (FAC), English holly (UPL), Indian plum (UPL), Himalayan blackberry (FACU-), devils club (FAC), and western hemlock (FACU). The herbaceous layer was dominated by Pacific bleeding heart (UPL), lady-fern (FAC), sword-fern (UPL*), pig-a-back plant (FAC), and undifferentiated grasses. Wood-fern (UPL), trillium (UPL), sedge spp. (FAC-OBL), false lily-of-the-valley (FACU-), reed canarygrass (FACW), and trefoil foamflower (FAC-) all occurred at low cover within the upland areas of the property.

Soils within the upland areas of the property were non-hydric and conformed to the Everett soil series. Profiles excavated in the upland portions of the property lacked positive indicators of hydric soil. The predominant soil of the upland was coarse textured, with high-chroma soil matrix colors. The subsoil of these upland soils ranged from brown (10YR 5/3) to dark yellowish brown (10YR 4/4). The soil surface was predominantly convex in profile and the slope angle ranged from nearly level to moderately sloping.

Table 5. Vegetation Data for Plot 2.

SPECIES	WIS	Cover Class Midpt.	WIS x Midpt.
Trees			
Alnus rubra *	3.0	62.5	187.5
Pseudotsuga menziesii	5.0	2.5	12.5
Thuja plicata *	3.0	2.5	7.5
Tsuga heterophylla	4.3	2.5	10.8
Shrubs			
Acer circinatum	3.7	37.5	137.6
Rubus spectabilis *	3.0	15.0	45.0
Sambucus racemosa	4.0	15.0	60.0
Oplopanax horridum *	3.0	2.5	7.5
Rubus discolor	4.3	2.5	10.8
Rubus ursinus	5.0	2.5	12.5
Herbs			
Dicentra formosa	5.0	62.5	312.5
Athyrium felix-femina *	3.0	15.0	45.0
Polystichum munitum	5.0	15.0	75.0
Dryopteris austriaca	5.0	2.5	12.5
Tolmiea menziesii *	3.0	2.5	7.5
Trillium spp.	5.0	2.5	12.5
Musci, spp. #	---	2.5	---
Graminae spp. #	---	2.5	---
SUMS		245.0	956.8

Weighted Mean Index: 3.9

% of Dominant Species w/FAC or Wetter WIS: 43

HYDROPHYTIC VEGETATION: NO

Classification: Upland, broad-leaved deciduous forest (Fd).

* Hydrophytic species (i.e., facultative or wetter).

\# Not included in calculations.

Table 6. Vegetation Data for Plot 5.

SPECIES	WIS	Cover Class Midpt.	WIS x Midpt.
<u>Trees</u>			
Alnus rubra *	3.0	37.5	112.5
Pseudotsuga menziesii	5.0	2.5	12.5
Tsuga heterophylla	4.3	2.5	10.8
<u>Shrubs</u>			
Acer circinatum	3.7	37.5	137.6
Rubus ursinus	5.0	37.5	187.5
Berberis nervosa	5.0	15.0	75.0
Rubus spectabilis *	3.0	15.0	45.0
Sambucus racemosa	4.0	15.0	60.0
Acer macrophyllum (s)	4.0	2.5	10.0
Crataegus spp. *	3.0	2.5	7.5
Ilex aquifolium	5.0	2.5	12.5
Oemleria cerasiformis	5.0	2.5	12.5
Rubus discolor	4.3	2.5	10.8
Rubus laciniatus	5.0	2.5	12.5
Tsuga heterophylla (s)	4.3	2.5	10.8
<u>Herbs</u>			
Dicentra formosa	5.0	15.0	75.0
Polystichum munitum	5.0	15.0	75.0
Tolmiea menziesii *	3.0	15.0	45.0
Graminae spp.	---	15.0	---
Carex spp. *	2.0	2.5	5.0
Maianthemum dilatatum	4.3	2.5	10.8
Phalaris arundinacea *	2.0	2.5	5.0
Tiarella trifoliata	3.3	2.5	8.3
SUMS		235.0	941.8

Weighted Mean Index: 4.0

% of Dominant Species w/FAC or Wetter WIS: 33

HYDROPHYTIC VEGETATION: NO

Classification: Palustrine, broad-leaved deciduous forested wetland (PFO1).

* Hydrophytic species (i.e., facultative or wetter).

Not included in calculations.

(s) Sapling life form

No positive indicators of wetland hydrology were apparent in the upland forests within the property.

Based on the lack of positive indicators for all three parameters, the forested uplands of this property were classified as non-wetlands. These forested non-wetlands were predominantly upland broad-leaved deciduous (Figure 4).

Other areas of non-wetland included pastureland (P/G) and a homesite (Ur). Vegetation within the pastureland was heavily grazed. Soils within the pasture and around the homesite were non-hydric. Based on the lack of hydric soil, hydrophytic vegetation, and wetland hydrology the pasture and homesite were classified as non-wetland.

3.4 Overview of Plant Communities, Soils and Hydrology on the Woodinville High School property

Both wetland and non-wetland were found within the Woodinville High School Annex property (Figure 4). The upland areas of the property were classified as upland broad-leaved deciduous forest (Fd), pastureland (P/G) and built-up land (Ur). The wetlands were classified as palustrine, broad-leaved deciduous forested wetland (PFO1) and riparian, upper perennial, unconsolidated bottom wetland (R3UB) (i.e. stream channel). For the purposes of discussion and regulatory purposes the wetland areas of the property were separated into riparian zones and wetland areas. Riparian zones are areas with well defined stream channels with only a narrow zone of hydrophytic vegetation paralleling the channel. On the other hand, wetland areas were those areas of wetland with no well defined stream channel, or if there was a well defined stream channel, there was a wide expanse of wetland associated with the stream.

4.0 LIMITATIONS OF THIS REPORT

We have prepared this report for the use of Gross, Thurman, & deMers, Inc. and their consultants. It should be recognized that definition of plant community boundaries is an inexact science, and different individuals and agencies will often disagree on exact boundaries, and even plant community classifications. Hence, it is imperative that before any site work or detailed planning is undertaken, that appropriate regulatory agencies be contacted to verify the conclusions of this report.

Within the limitation of schedules and scope of work, we warrant that the work performed conforms to accepted standards in the field. The results and conclusions of the report represent our professional opinion based on the information provided by the project proponent and their consultants, and gathered in the course of the study. No other warranty, expressed or implied is made.

EXHIBIT 17
PAGE 34 OF 46

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APPENDIX A

Vegetation Information

EXHIBIT 17
PAGE 37 OF 46 32

Table A.1. Key to Braun-Blanquet Cover-Abundance Scale.

5	Any number, with cover more than 3/4 of the reference area (>75%);
4	Any number, with 1/2 to 3/4 cover (50 - 75%);
3	Any number, with 1/4 to 1/2 cover (25 - 50%);
2	Any number, with 1/20 to 1/4 cover (5 - 25%);
1	Numerous, but less than 1/20 cover, or scattered, with cover up to 1/20 (5%);
+	Few, with small cover (<5%);
r	Solitary, with small cover (<5%)

Table A.2. Key to Wetland Indicator Status (WIS) categories

Indicator Category	Indicator Symbol	Definition
Obligate	OBL	Plants that occur almost always (estimated probability >99%) in wetlands under natural conditions, but which may also occur rarely (est. probability <1%) in nonwetlands.
Facultative Wetland Plants	FACW	Plants that occur usually (est. probability >67% - 99%) in wetlands, but also occur (est. probability 1% - 33% in nonwetlands.
Facultative Plants	FAC	Plants with a similar likelihood (est. probability 33% - 67%) of occurring in both wetlands and nonwetlands.
Facultative Upland Plants	FACU	Plants that occur sometimes (est. probability 1% - <33% in wetlands, but occur more often (est. probability >67% - 99%) in nonwetlands.
Obligate Upland Plants	UPL	Plants that occur rarely (est. probability <1%) in wetlands, but occur almost always (est. probability >99%) in nonwetlands under natural conditions.

FAC+ species are considered to be wetter (i.e., have a greater estimated probability of occurring in wetlands) than FAC species, while FAC- species are considered to be drier (i.e., have a lesser estimated probability of occurring in wetlands) than FAC species (Environmental Laboratory 1987:18-19)

Plants that have the wetland indicator status (WIS) listed as a range (i.e., Carex spp. <u>FAC-OBL</u>, Salix spp. <u>FAC-OBL</u>), indicates that the plant was unable to be identified to species, and that most of the species in that particular genus fall in that particular range of indicators.

"NR" indicates that the plant species was not rated.

Table A.2. Continued.

For purposes of this report, any plant species not appearing on the National List of Plant Species That Occur In Wetlands of the Pacific Northwest (coded UPL*) "was assumed to be an upland species" (Environmental Laboratory 1987).

Table A.3. Scientific and common names of plant species observed at the Woodinville High School Annex property.

Scientific Name	Common Name	WIS
TREES:		
Alnus rubra	Red alder	FAC
Pseudotsuga menziesii	Douglas fir	UPL*
Rhamnus purshiana	Cascara	UPL*
Thuja plicata	Western red cedar	FAC
Tsuga heterophylla	Western hemlock	FACU-
SHRUBS:		
Acer circinatum	Vine maple	FACU+
Acer macrophyllum (sapling)	Big-leaf maple	FACU
Berberis nervosa	Cascade oregongrape	UPL*
Crataegus spp.	Hawthorn	FAC
Ilex aquifolium	English holly	UPL*
Oemleria cerasiformis	Indian plum	UPL*
Oplopanax horridum	Devil's club	FAC
Rubus discolor	Himalayan blackberry	FACU-
Rubus laciniatus	Evergreen blackberry	NR
Rubus spectabilis	Salmonberry	FAC
Rubus ursinus	Pacific blackberry	UPL*
Sambucus racemosa	Red elderberry	FACU
Thuja plicata (sapling)	Western redcedar	FAC
Tsuga heterophylla (sapling)	Western hemlock	FACU-
HERBS		
Athyrium felix-femina	Lady-fern	FAC
Blechnum spicant	Deer-fern	FAC+
Carex spp.	Sedge	FAC-OBL
Dicentra formosa	Pacific bleedingheart	UPL*
Dryopteris austriaca	Wood-fern	UPL*
Equisetum hyemale	Scouringrush horsetail	FACW
Graminae spp.	Undifferentiated grasses	
Lysichitum americanum	Skunk cabbage	OBL
Maianthemum dilatatum	False lily-of-the-valley	FACU-
Musci spp.	Undifferentiated mosses	
Oenanthe sarmentosa	Water-parsley	OBL
Phalaris arundinacea	Reed canarygrass	FACW
Polystichum munitum	Sword-fern	UPL*
Smilacina stellata	Starry Solomon-plume	FAC-
Tiarella trifoliata	Trefoil foamflower	FAC-
Tolmiea menziesii	Pig-a-back-plant	FAC
Trillium spp.	Trillium	UPL*
Urtica dioica	Stinging nettle	FAC-

APPENDIX B

Methodology for Calculation of Vegetation Indices

Vegetation is widely recognized as one of three key site characteristics (including soils and hydrology) that may be used in the designation of wetlands. Because vegetation is often the most accessible of these characteristics, its use in wetland designation is common. There is, however, no consensus regarding methods which will yield the most efficient, objective, and consistent wetland designations from vegetation data.

The National Wetland Plant Species List (NWPSL) lists vascular plants of the United States according to their natural frequency of occurrence in wetlands. Ecological groups recognized in the NWPSL are: obligate wetland, facultative wetland, facultative, facultative upland, and by exclusion from the list, obligate upland. From this list, Wentworth and Johnson (1986) assigned ecological indices to these groups which were used to compute weighted averages (WA) for quantitative data (such as plant cover).

Wentworth and Johnson (1986) found WA of vegetation data to be an effective tool for assessing wetland status of vegetation types. These averages effectively ranked vegetation types or stands in a way that was well correlated with independently-derived ranking for the same types or stands relative to environmental moisture gradients, and the results of WA could be used to designate vegetation types as wetlands or uplands in a way that agreed well with designations based on other criteria.

Variation of weighted averages among sample units representing a vegetation type was generally small relative to the range of ecological indices assigned. Studies of with-in type variation led to guidelines regarding the reliability of wetland designations (Figure 2).

We have adopted this methodology as an effective tool in determining the presence or absence of wetland vegetation. We also calculate the percent of the dominant species that are wetland plants (adapted from Environmental Lab, 1987). The use of these techniques is briefly explained below. For each plot, a species list is developed and each species is assigned a Wetland Indicator status (WIS) based on the US Fish and Wildlife NWPSL (Table B.1).

Table B.1. USFWS Wetland Indicator Status (WIS) and Equivalent Numeric Values.

WIS Symbol	WIS Category	Numeric Value
UPL	Obligate Upland	5
FACU	Facultative Upland	4
FAC	Facultative	3
FACW	Facultative Wetland	2
OBL	Obligate Wetland	1

The cover abundance value assigned to each species using the Bran-Blanquet (B-B) scale (Table B.2) is converted to the mid-point of its cover class range.

Table B.2. Braun-Blanquet scale values and cover class mid-points used in vegetation analysis.

Braun-Blanquet Scale	Cover Class Range (%)	Cover Class Mid-point (%)
5	75-100	87.5
4	50- 75	62.5
3	25- 50	37.5
2	5- 25	15.0
1	1- 5	2.5
+	<5	2.5
r	<5	2.5

From the cover range mid-point and the WIS value, the percent of wetland dominants and weighted mean index are calculated. A species is considered dominant if its cover is greater than 5% (a Braun-Blanquet value of 2 or greater).

EXHIBIT 17
PAGE 44 OF 46

1. Calculation of percent dominant wetland species in a plot (a species is considered 'wetland' if its WIS rating is FAC or wetter):

x species are classified as dominant
y species are dominant and have WIS ratings of FAC or wetter

Then: % wetland species = y/x * 100

2. Calculation of Weighted Mean Index (WMI):

$$\text{WMI} = \frac{\text{sum of (CCM * WIS)}}{\text{sum of (CCM)}}$$

where CCM = cover class midpoint (%) for each species, and WIS = Wetland Indicator Status value for each species.

The following example (using sample data) demonstrates these calculations.

Table B.3. Example Calculation of Vegetation Indices.

Scientific Name	WIS Symbol	WIS Value	B-B Cover Value	Cover Class Midpoint	Midpt. x WIS Value
Hierochloe odorata	FACW	2	4	62.5	125.0
Ranunculus repens	FACW	2	2	15.0	30.0
Phalaris arundinaceae	FACW	2	1	2.5	5.0
Holcus lanatus	FAC	3	1	2.5	7.5
Dactylis glomerata	FACU	4	1	2.5	10.0
Lolium perenne	FACU	4	+	2.5	10.0
Juncus spp.	FAC-OBL	2	+	2.5	5.0
TOTALS				90.0	192.5

WMI = 192.5/90.0 = 2.1

100% of the dominant species are FAC or wetter.

With a predominance of species rated FAC or wetter (100% of the "dominants"), the vegetation for this example plot would be considered hydrophytic under the COE's criteria (Environmental Lab 1987). A WMI of 2.1 also indicates hydrophytic vegetation (see Figure B.1).

Varying degrees of confidence may be assigned to wetland or upland designation based on weighted average scores; scores that are farther from the theoretical wetland/upland boundary of 3.0 are considered to be better indicators of wetland or upland status.

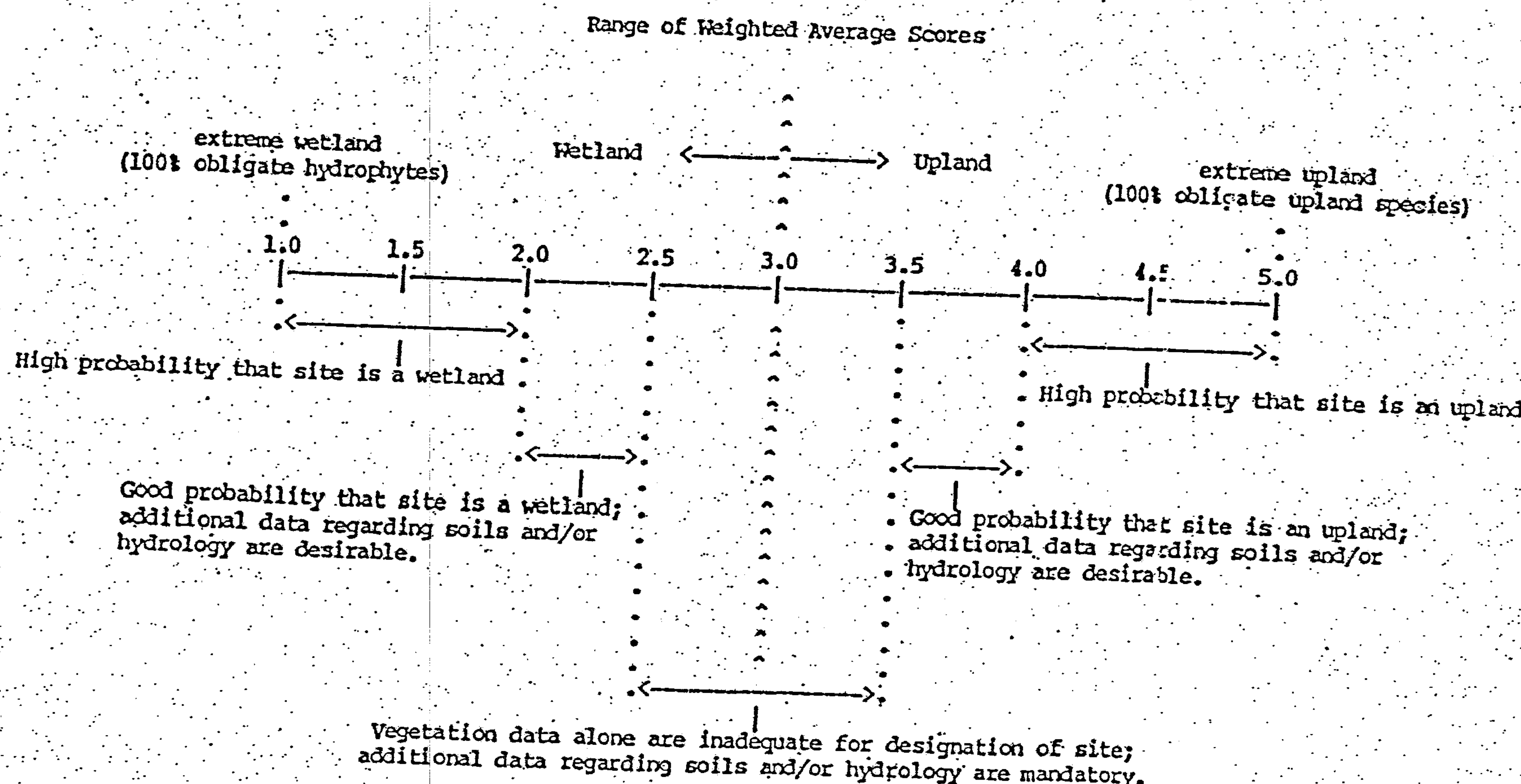

Figure B.1. Weighted Mean Index (WMI) Scale. (Wentworth and Johnson 1986).

EXHIBIT 17
PAGE 45 OF 46

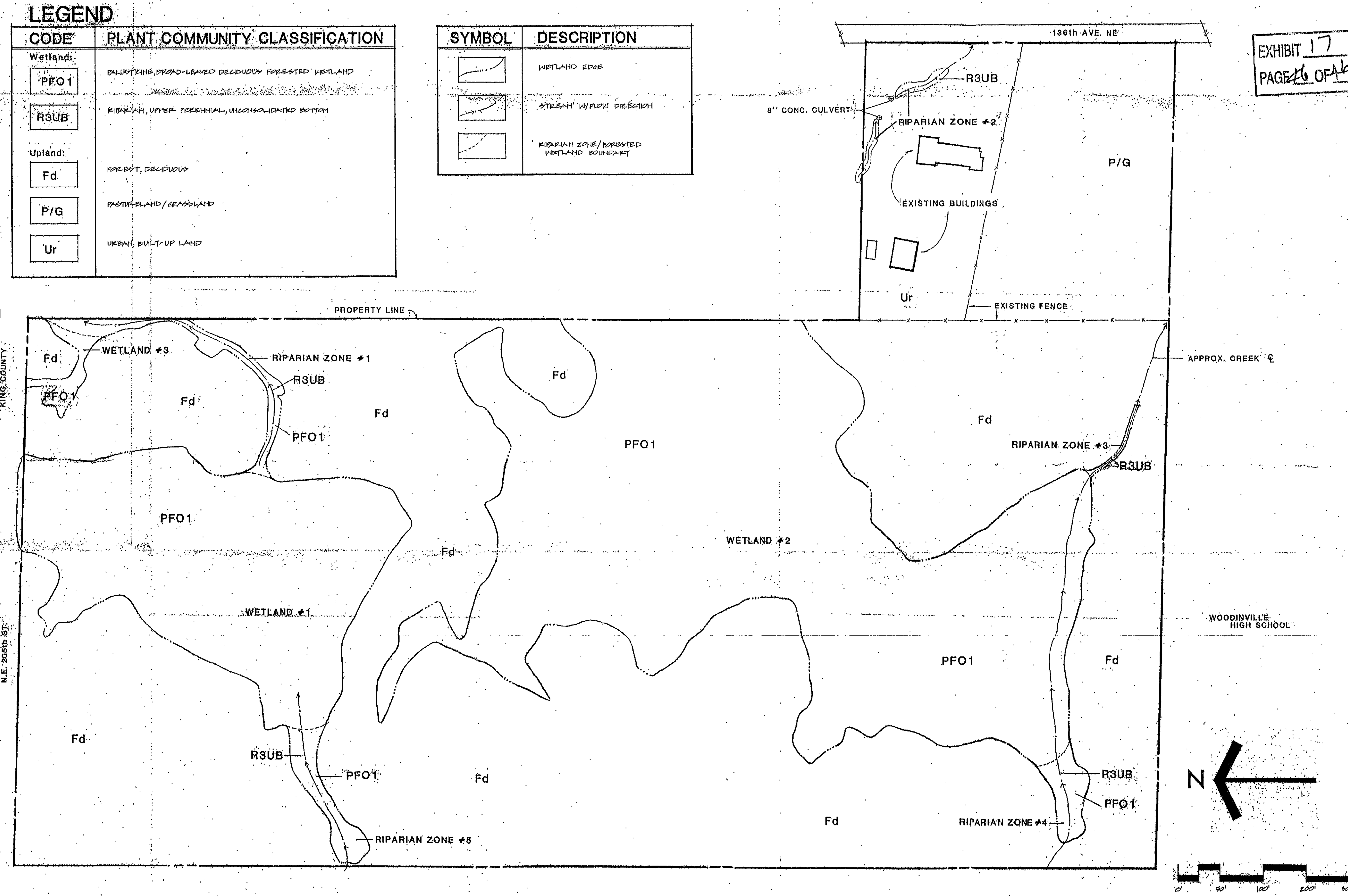

EXHIBIT 17
PAGE 46 OF 46

EXISTING CONDITIONS

FIGURE 4 WOODINVILLE HIGH SCHOOL ANNEX PROPERTY KING COUNTY, WASHINGTON

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RAEDEKE ASSOC. PROJECT # 8833

SCALE: 1" = 50'
APPROVED BY:
DRAWN BY H. SIKATEK
DATE:
REVISED
BASE INFO. SUPPLIED BY TRIAD ASSOC.
DRAWING NUMBER