NORTH CREEK REGIONAL STORMWATER DETENTION FACILITY

WETLAND AND HABITAT ASSESSMENTS

Prepared for

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SUMMARY

This study describes wetlands on the proposed North Creek Regional Detention facility located south of Mill Creek, west of the Bothell-Everett highway, and north of the confluence of North Creek and an unnamed creek. Much of the wetlands on the site have been disturbed through farming, grazing, ditching, peat mining, and diking. This study was conducted to document wetlands, wildlife habitat, and fisheries on the site and to assess potential impacts and restoration potential of a proposed regional stormwater detention facility.

The property was examined from August 1990 through January 1992, to describe and document vegetation communities, soils and hydrologic characteristics, and fish and wildlife habitat throughout the site.

Vegetation on the site of the proposed facility was characteristic of disturbed wetlands. The dominant herbaceous vegetation included reed canarygrass, water foxtail, bulrush, soft rush, creeping buttercup, common velvet-grass, slough sedge, and common cattail. The shrub component of the wetland was dominated by Douglas's spirea and willow. Overstory vegetation along North Creek and along the southern end of the project site included black cottonwood, red alder, willow, and scattered western redcedar.

Soils on the site of the proposed facility were mapped as the Mukilteo muck and Norma loam series; both are federally listed hydric soils. These soils are a very deep and poorly drained, with moderate to moderately slow permeability. Wetland hydrology occurred throughout the project site. Soils were saturated and ponded to depths of several feet. The topography of the area directs stormwater and surface water run-off into North Creek and the surrounding wetland.

The North Creek wetland meets the criteria of a Class I wetland (Snohomish County Aquatic Resources Protection Program) and the Category I and II criteria of the Washington State Four-tier Wetlands Rating System. These ratings reflect the moderate to high ecological value of the wetland due to its size and the presence of peat soils. In addition, the wetlands perform water quality and quantity control functions.

Fish habitat within the project area appears productive, with both spawning and rearing habitat present. Many small fish were observed in smaller side channels and ditches associated with the wetland. Species such as minnows, sculpins and other freshwater marsh-adapted fish are undoubtedly present, along with rearing cutthroat trout and coho salmon fry. Steelhead trout fry may also use some of the creeks as rearing habitat.

Forty-three bird species were observed during the site visits, including waterfowl, raptors, woodpeckers, and songbirds. The project site is used by overwintering and migratory water fowl. Due to its size and habitat diversity, the site is an important resource to wildlife. Large mammals in the area include black bear, coyote, beaver, and raccoon. Various small mammals, reptiles, and amphibians also inhabit the site.

The wetlands on the project site perform important hydrologic functions that benefit North Creek and the surrounding watershed. This wetland provides a site for groundwater discharge, stores floodwaters, augments low flows, and improves water quality.

The stormwater detention facility will result in alteration of the current hydrology which may cause changes in the associated wetland and its function. Possible impacts include alteration of plant species' distribution, alteration of wildlife habitat, and increased sedimentation. However, since the hydrologic changes result in relatively infrequent and short term flooding of vegetated areas which already experience long periods of soil saturation, significant impacts to vegetation are not anticipated. The County will likely remove grazing horses and cattle from the site, a management decision which would substantially benefit fisheries and wildlife habitat, water quality, vegetation structure and vegetation diversity within the wetland. A monitoring program should be implemented to verify these conclusions.

Improvements to the wetland areas could increase the wildlife habitat of the wetland. Providing nesting sites, including nest baskets, snags, or nest boxes would likely increase bird populations. Planting portions of the wetlands with trees and shrubs would increase plant diversity and provide forage and nesting sites for wildlife.

I. INTRODUCTION

This study describes wetlands, vegetation types, and their use by wildlife on the proposed site of the North Creek Regional Detention Facility. The site is located near Mill Creek, Washington (Section 7, T27N R5E). This study was conducted to document wetlands on the site and provide baseline information to support environmental review of the proposed detention facility. The assessment area included all areas below the 220 foot elevation (the approximate maximum flood elevation).

The goal of the detention facility is to provide additional flood protection along North Creek by optimizing the storage potential of the Snohomish County property at 180th Street SE. Four alternatives were developed using a rigorous computer modeling effort coupled with regulatory agency and public coordination (KCM, 1992). The alternative which optimizes site storage capabilities is an embankment which includes a box culvert for low- to mid-range flows, a primary overflow for extreme storms, and an emergency overflow and bypass pipeline for use if culvert blockage occurs. However, while the four alternatives have different engineering, hydraulic, and financial considerations, they generally result in similar environmental impacts to wetlands on the project site. Therefore, the analysis presented in this report focuses on Alternative D, the County's preferred alternative, but can be used to adequately evaluate the impacts of all "build" alternatives.

The project site is located south of Mill Creek, Washington, west of the Bothell-Everett highway, and north of the confluence of North Creek and an unnamed creek. The area was farmed and mined for peat; it is currently used as pasture for cattle and horses. The area has numerous ditches located throughout the site that drain water into Nickel Creek and the unnamed creek. The site is a natural drainage basin which collects surface and stormwater run-off from the North Creek, the unnamed creek, Nickel Creek and Penny Creek watersheds. North Creek flows north to south along the western edge of the project site.

North Creek has been channelized and a dike has been constructed along the east side of the stream. An unnamed creek flows from the east in a south westerly direction through the southern end of the project site. Nickel Creek flows north to south through the center portion of the site through a narrow ditch where it joins the unnamed creek just prior to entering North Creek. Beaver dams occur along North Creek and other dams occur along ditches and the unnamed creek. The beaver dams divert water out of the creek channels and into the grazed wetland.

II. METHODS

WETLAND DEFINITION

Wetlands have been variously defined by scientists and government agencies. Most definitions recognize the interaction of hydrology, soils, and vegetation in creating physical and biological characteristics unique to wetlands. Snohomish County, state, and federal agencies define wetlands as areas having the following attributes:

- The site supports predominantly hydrophytic vegetation.
- The substrate is predominantly undrained hydric soil.
- The substrate is saturated or inundated by water for a period of seven days or more during the growing season each year (defined as the period from March to November).

Snohomish County wetlands were identified and delineated using the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (Federal Interagency Committee for Wetland Delineation 1989). According to the manual, wetlands are identified by examining vegetation, soils and hydrology for wetland or upland characteristics. This multi-parameter approach provides a logical, technical basis for delineating wetlands.

Before visiting the site, we reviewed USGS and National Wetland Inventory maps and air photos to identify potential wetlands on the property. *Wetland Plants of the Pacific Northwest* (Reed 1987) provided information on wetland vegetation. The Soil Survey of Snohomish County (Debose and Klungland et al. 1983) and the list of hydric soils prepared by the U.S.D.A. Soil Conservation Service (1987) were used to identify hydric soils.

The site was surveyed in August, 1990, and vegetation communities, soils and hydrologic characteristics were described and documented. This field information was used to identify wetland plant communities on the site maps. Since the entire site is essentially wetland, and these wetlands extend off site, boundaries were not delineated.

CHARACTERIZATION OF VEGETATION

Several types of wetland vegetation communities are present on the site (see Figure 1). Plants were identified according to Hitchcock and Cronquist (1976). Descriptions of vegetation included a species list (Table 1) and dominance estimates. Species were also classified by their adaptation to wetland conditions following Reed (1987) (Table 1). Wetland communities were classified using the U.S. Fish and Wildlife Service system (Cowardin et al. 1979).

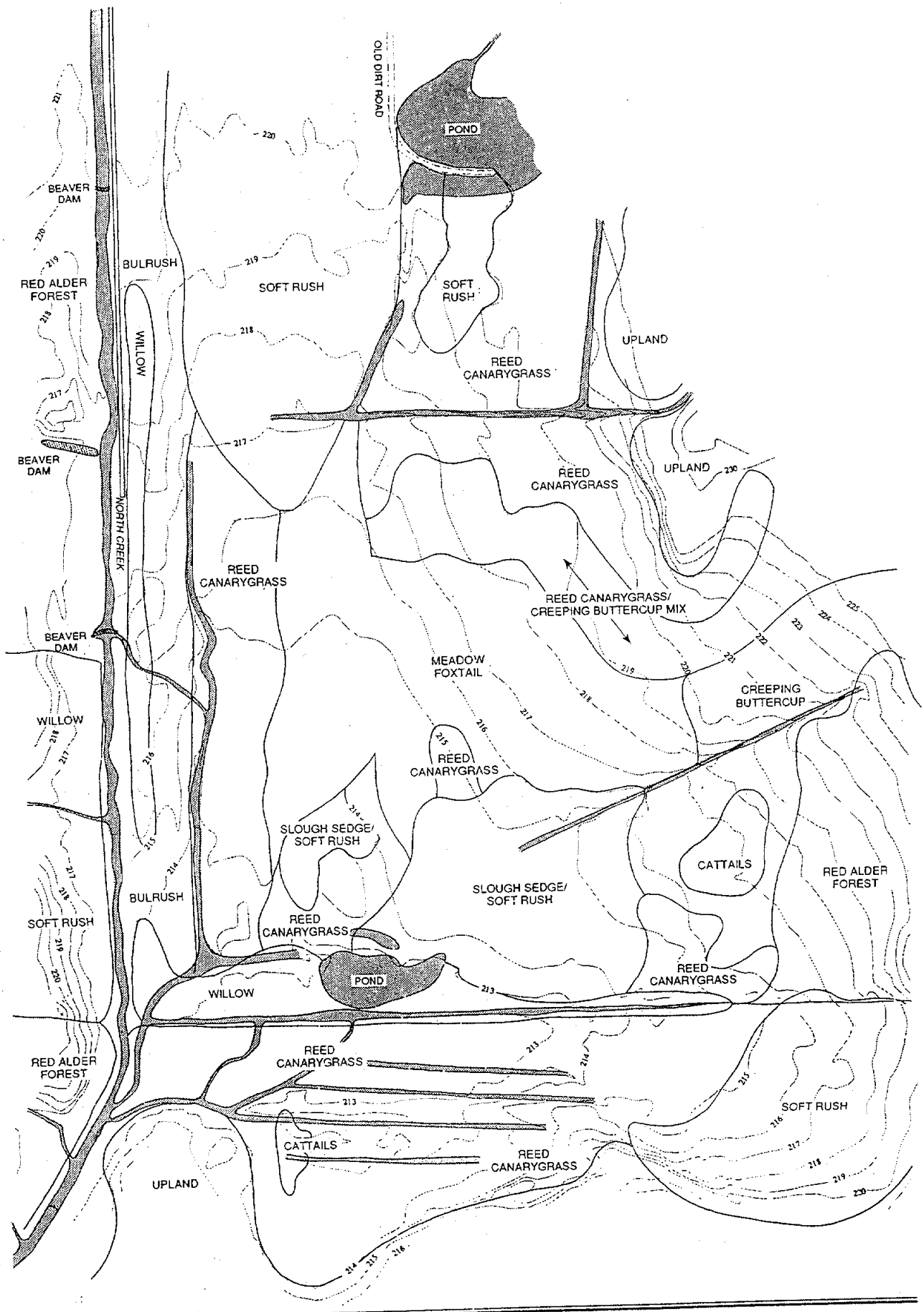

Figure 1.
Wetland Plant Communities at the Proposed North Creek Regional Detention Facility

Table 1. Plant species found in and adjacent to the proposed North Creek Detention Facility.

Scientific Name	Common Name	WIS
Trees		
Alnus rubra	Red alder	FAC
Betula papyrifera	Paper birch	FACU
Populus tremuloides	Quaking aspen	FAC
Populus trichocarpa	Black cottonwood	FAC
Prunus emarginata	Bittercherry	UPL
Pseudotsuga menziesii	Douglas-fir	UPL
Rhamnus purshiana	Cascara	UPL
Salix spp.	Willow	FACW
Thuja plicata	Western redcedar	FAC
Shrubs		
Cornus stolonifera	Red-osier dogwood	FACW
Lonicera spp.	Twin-berry	FAC
Lonicera involucrata	Honeysuckle	FAC
*Rubus discolor**	Himalayan blackberry	FACU
*Rubus laciniatus**	Evergreen blackberry	UPL
Rubus spectabilis	Salmonberry	FAC
Salix spp.	Willow	FACW
Sambucus racemosa	Red elderberry	FACU
Spiraea douglasii	Douglas spirea	FACW
Symphoricarpos albus	Common snowberry	FACU
Herbs		
*Agrostis alba**	Redtop	FACW
Alopecurus geniculatus	Water foxtail	FACW
Athyrium felix-femina	Lady-fern	FAC
*Bromus inermis**	Smooth brome	UPL
Carex obnupta	Slough sedge	OBL
Carex spp.	Sedge	FACW
Circaea alpina	Enchanter's nightshade	FACW
*Cirsium arvense**	Canadian thistle	FACU
*Cirsium vulgare**	Bull thistle	FACU
*Dactylus glomerata**	Orchard-grass	FACU
Epilobium angustifolium	Fireweed	FACU
Epilobium watsonii	Watson's willow-herb	FACW
Equisetum arvense	Field horsetail	FAC
Equisetum hyemale	Scouringrush horsetail	FACW
Equisetum telmateia	Giant horsetail	FACW
Galium spp.* (some varieties.)	Bedstraw	FAC
Graminae spp.	undifferentiated grasses	FAC
*Holcus lanatus**	Common velvet-grass	FAC
*Iris pseudacorus**	Yellow Iris	OBL

Scientific Name*	Common Name	WIS
Juncus effusus	Soft rush	FACW
Juncus spp.	Rush	FAC
Lemna minor	Duckweed	OBL
Lysichitum americanum	Skunk cabbage	OBL
Maianthemum dilatatum	False lily-of-the-valley	FACU
Mentha spp.* (some varieties)	Mint	FACW
*Mimulus glabratus**	Yellow Monkey-flower	OBL
Oenanthe sarmentosa	Water-parsley	OBL
*Parentucella viscosa**	Parentucellia	FAC
*Phalaris arundinacea**	Reed canarygrass	FACW
Phleum pratense	Timothy	FACU
Plantago major	Common plantain	FAC
Poa spp.* (some varieties)	Bluegrass	FAC
Polygonum spp.* (some varieties)	Smartweed	FAC
Potamogeton spp.* (some varieties)	Marsh cinquefoil	OBL
Pteridium aquilinum	Bracken-fern	FACU
*Ranunculus repens**	Creeping buttercup	FACW
Rumex spp.* (some varieties)	Dock	FAC
Scirpus spp.	Bulrush	OBL
*Senecio jacobaea**	Tansy ragwort	UPL
*Solanum dulcamara**	Bittersweet nightshade	FAC
Taraxacum officinale	Common dandelion	FACU
*Trifolium pratense**	Red clover	FACU
Trifolium repens	White clover	FACU
Typha latifolia	Common cat-tail	OBL
Urtica dioica	Stinging nettle	FAC
Verbascum spp.	Mullein	UPL
Veronica scutellata	Marsh speedwell	OBL
Veronica spp.* (some varieties)	Speedwell	FACW

* Denotes introduced or exotic species

[1]Key to Wetland Indicator Status (WIS):

Category	Symbol	Definition
Obligate Wetland Plants	OBL	Plants that almost always (>99% of the time) occur in wetlands, but which may rarely (<1% of the time) occur in non-wetlands.
Facultative Wetlands Plants	FACW	Plants that often (67 - 99% of the time) occur in wetlands, but sometimes (1 - 33% of the time) occur in non-wetlands.
Facultative Plants	FAC	Plants with a similar likelihood (33 - 67% of the time) of occurring in both wetlands and non-wetlands.

Facultative Upland Plants	FACU	Plants that occur sometimes (1 - 33% of the time) occur in wetlands, but occur more often (67 - 99% of the time) in non-wetlands.
Obligate Upland Plants	UPL	Plants that rarely (<1% of the time) occur in wetlands, but almost always (>99% of the time) occur in non-wetlands.

The dominant herbaceous species on site are non-native plants such as reed canarygrass, Canadian thistle, creeping buttercup and various pasture grasses. Plants tolerant of grazing include bentgrass, orchard-grass, and smooth brome. These plants are characteristic of many disturbed wetlands in western Washington. They typically invade wetlands and other areas following clearing or other disturbances to native vegetation, and are maintained on a site by grazing. In the absence of disturbances, native plants including redcedar, red alder, spirea, willow, and dogwood would be expected to become established in drier portions of the wetland. Slough sedge, bulrush, and cattails would be expected to replace reed canarygrass in wetter portions of the site.

In shrub-dominated areas, Douglas's spirea, willow, and red-osier dogwood are dominant. Overstory vegetation adjacent and west of North Creek and along the southern edge of the project site includes black cottonwood, red alder, willow, and a few western redcedar.

CHARACTERIZATION OF SOILS

Hydric soils (soils formed under wetland conditions) are a positive indicator of wetland conditions. 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 [wetland] vegetation" (Soil Conservation Service 1985). Classification of hydric and nonhydric soils followed the SCS (1987) list. Soil profiles were examined to a depth of 18 inches for hydric soil indicators.

Some of the principal indicators of hydric soils include these soil characteristics:

- Gley. Gley is the presence of gray, greenish-gray, or bluish colors in the soil. Gley indicates a lack of oxygen in the soil for a sufficient time to reduce iron compounds. Reduced iron compounds are grey, while oxidized iron compounds, found in nonhydric soils, are reddish-yellow.

- Mottling in a low chroma matrix. Soil mottling is the occurrence of spots of contrasting soil colors within a soil. The presence of mottles indicates alternating oxidized and reduced conditions, corresponding to alternating saturated and unsaturated soil conditions typical of many wetlands. Soil colors were described

using the Munsell color system (Munsell Color 1975). Munsell notation is a designation of color by degrees of three variables, hue, value and chroma. For example a very dark grayish brown 10YR 3/2 notation is a color in hue of 10YR, value of 3, and chroma of 2.

- Histic soil horizons. A histic soil horizon is a soil layer dominated by organic material. In most cases, organic soils (histosols) are indicators of very poorly to poorly drained conditions typical of wetlands. Histosols typically develop on sites with prolonged saturation. Under these conditions, decay of plant materials is retarded and organic materials accumulate, eventually forming a histic horizon.

- Saturation or inundation. Observations of saturated or inundated (flooded) soils are indicators of poor drainage and hydric soils. Hydric soils develop on sites saturated, at least periodically, during the growing season.

Wetland soils on the site were mapped by the Soil Conservation Service as the Mukilteo muck and Norma loam series (Debose and Klungland et al. 1983), both are listed hydric soils (Soil Conservation Service 1987) and are a very deep, poorly drained with moderate to moderately slow permeability. Upland Everett and Alderwood soils were mapped by the SCS on upland areas adjacent to the site.

Mukilteo muck soils formed from decomposing organic material. A typical soil profile consists of a dark reddish brown to black organic layer. The subsoil is a black organic layer over an olive gray fine sandy loam. The Norma soil developed in glacial outwash and alluvium. A typical soil profile consists of a very dark gray loam over a dark, grayish brown sandy loam. The substratum is a dark gray sandy loam.

A small area at the far south end and adjacent to the project site was mapped as the Alderwood series. Alderwood is a well-drained soil with moderately rapid permeability. This upland soil has a very dark brown gravelly sandy loam over a dark yellowish brown to dark brown very gravelly sandy loam. Alderwood soils may have high water tables during periods of above-normal winter precipitation.

A small area of nonhydric Everett soils occurs near the north end of the project site. The Everett soil series are well-drained, gravelly sandy loams typically dark brown to brown in color. The Everett soil series lacks high water tables even during periods of heavy rain.

CHARACTERIZATION OF HYDROLOGY

Typically, wetland hydrology occurs where the presence of water has an overriding influence on vegetation and soils, resulting in the development of wetland soils and wetland plant communities. Sites with wetland hydrology are periodically inundated and/or saturated during part of the growing season. Wetland hydrology normally exists where topography directs water into low-relief areas dominated by soils with poor drainage characteristics.

Inundation and soil saturation are the most obvious indicators of wetland hydrology. Where saturation is absent, hydric soil morphology can be used to imply wetland hydrology. When saturated soils and hydric soil morphology occur, strong indicators of wetland hydrology exist. In artificially drained soils, such as those with fill materials, these conditions must be carefully interpreted because hydric soil indicators may persist for many years after drainage has eliminated wetland conditions.

Wetland hydrology was observed throughout the project site. Soils were saturated to the surface or ponded to depths of several feet even during mid to late summer. Much of the wetland receives water from perennial streams (North Creek and Penny Creek), seeps, and springs.

WETLAND FUNCTIONAL ANALYSIS

Wetland functions were assessed using the Wetland Evaluation Technique (Adamus 1987) and best professional judgement. Wildlife habitat and fisheries habitat were examined in greater detail to determine potential wildlife and fisheries use. Detailed discussions of the wildlife and fisheries habitat are presented in the following sections.

Wildlife Habitat

Wildlife utilization of wetland areas was assessed using three different techniques. Bird use was censused on two occasions during the spring. Nesting waterfowl usage was documented during an additional site visit on June 20, 1991. Utilization by non-avian wildlife species was determined by direct evidence (sightings, tracks, and droppings) or through habitat analysis.

The site was censused for relative bird abundance during the migration season on April 11 and 12, and during the breeding season on June 5 and 6, 1991. We used the variable radius plot technique (Wakeley 1987) at six observation stations located to represent the available habitat types. Four stations were located along a transect parallel to North Creek, providing an unobstructed view of the open wetland and the riparian zone along North Creek. The fifth station was located near the pond at the south end of the wetland. The sixth station was located in the open emergent wetland east of Penny Creek.

During the census, bird species present within visual and auditory range were identified and counted during 15-minute timed observations at each station. Bird species, number, habitat use, behavior, as well as the direction and distance from the observer, were recorded. Date, time, weather, and temperature were also recorded.

Two visits were made to the site on September 12 and October 4, 1990 to assess wildlife presence and habitat conditions. Presence of bird species and evidence of mammal occurrence were also observed. Habitat types were differentiated by vegetation type and the presence or absence of water.

Fisheries Habitat

A qualitative survey of North Creek and the associated wetland focused on a general assessment of habitat, including identification of critical or limiting habitat. The survey assessed spawning and rearing potential, along with existing water quality concerns. The fisheries habitat was examined on September 12, 1990.

III. VEGETATION COVER TYPES

Areas of emergent and scrub/shrub vegetation occurred throughout the project area. Under the U.S. Fish and Wildlife classification system (Cowardin et al. 1979), wetlands on the property were primarily palustrine emergent wetlands. Areas along North Creek and a channel along the unnamed creek were palustrine scrub/shrub wetlands. Descriptions of plant communities found on the project site are summarized below (see Table 2 and Figure 1.)

Table 2. Areal extent of plant communities on the North Creek Regional Detention Site.

Plant Community	Approximate Area (Acres)	Typical Elevations (feet)
Reed canarygrass	29	213-225
Soft rush	19	215-220
Red Alder forest	14	217+
Meadow foxtail	13	214-219
Willow	6	215-216
Creeping buttercup	6	216-220
Bulrush	6	214-220
Reed canarygrass and Creeping buttercup mixed	5	216-225
Open Water	2	213
Cattail	1	213-217
Slough sedge/ soft rush	1	216
Total:	**102**	

Red alder forest (14 acres)

Red alder, western redcedar, and big-leaf maple dominated the overstory on the west side of North Creek and on the southeast portion of the site. The shrub layer consisted of salmonberry, red elderberry, and red-osier dogwood. The herbaceous layer was dominated by skunk cabbage with lady-fern, scouring rush, and water-parsley.

Soils in these areas consisted of a dark, reddish brown (10YR 3/3) organic surface layer 2 inches deep over an inorganic black (10YR 2/1) silt loam to 18 inches deep over a dark gray (10YR 4/1) sandy silt loam. Soils were saturated to the surface with free-standing water at a depth of 4 inches. The elevation of this plant community is between 217 and 224 feet.

Willow (5.9 acres)

Stands of willow and Douglas's spirea occurred along the banks of North Creek and along the ditches in the southern portion of the site. Other shrubs present included red-osier dogwood, red alder and black cottonwood saplings. The herbaceous component consisted of skunk cabbage, reed canarygrass, duck weed, soft rush, and cattails. Reed canarygrass in an exotic invasive species common to disturbed wetlands.

Soils in these areas were a black (10YR 2/1) organic layer 6 inches deep over a black (5YR 2.5/1 to 10YR 2/1) silty organic layer 12 inches deep. The subsoil was greenish gray (5G 5/1) clay with black (10YR 2/1) organic stains. Soils were saturated to the surface with 4 inches of standing water on the surface. The elevation of this plant community is between 211 and 213 feet.

Douglas's spirea (< 1 acres)

Several small thickets dominated by Douglas's spirea were scattered throughout the project site. Other shrubs commonly found in these areas include evergreen blackberry (an exotic), salmonberry, and Pacific blackberry. The herbaceous layer consisted of exotic species, including reed canarygrass and creeping buttercup, as well as native species, including field horsetail and bittersweet nightshade.

Soils in these areas were mapped as the Mukilteo muck series. The surface layer in these areas was a black (10YR 2/1) organic material 6 inches deep over a black (5YR 2.5/1) to (10YR 2/1) silty organic layer 12 inches deep. The subsoil was greenish gray (5G 5/1) clay with black (10YR 2/1) organic stains. Soils were saturated to the surface with areas of standing water up to 4 inches deep. Most of these areas occurred along unnamed creek and a channel at the southern end of the project site, at elevations below 215 feet.

Soft rush (19 acres)

A dense cover of soft rush, with velvet-grass and creeping buttercup, was common surrounding the pond in the northern portion of the site, in the southeast, and on a portion of the west side of North Creek. Smooth brome, Canadian thistle, orchard-grass, bed straw, and stinging nettle also occurred on these sites. All of these species except soft rush and stinging nettle are exotic plants which have become well-established west of the Cascades. Soft rush is commonly found in wet pastures and other disturbed wetlands.

Soils were mapped as the Norma series. The surface layer was a black (10YR 2/1) silty loam over a dark reddish brown (5YR 2.5/2) silty loam to 12 inches deep. The subsoil was a gray to light gray (5YR 6/1) sandy silty clay 18 inches deep. Soils in these areas were saturated within 4 inches of the surface, and free-standing water was present at 12 inches. The elevation of this plant community is between 214 and 220 feet.

Reed canarygrass (29 acres)

Reed canarygrass dominated the largest portion of the project area. Only a few other plant species occurred in these areas; they included bittersweet nightshade, field horsetail, speedwell and exotics including bedstraw and creeping buttercup.

Soils in these areas were mapped as the Mukilteo muck series. The surface layer was a black (10YR 2/1) organic muck 18 inches deep. Below 18 inches the substrate was a very dark brown (10YR 2/2) silty clay. Soils were saturated within 4 inches of the surface and free-standing was observed water at 4 inches. Elevations were 213 feet in central portions of the site and between 220 and 225 feet in peripheral areas.

Cattails (< 1 acre)

Very dense stands of common cattail occurred on several wet depressions in the southern portions of the project site. Other herbs present in these areas included, soft rush and the exotics yellow monkey-flower and creeping buttercup.

Soils in these areas were mapped as the Mukilteo muck series. The surface layer was a black (5YR 2.5/1) organic muck to 18 inches over a yellowish red (5YR 4/6) peat. Soils were saturated to the surface, with areas of ponding water 4 inches deep near the 212 foot elevation in the southwest and the between 216 and 219 feet elevation in the southeast area.

Small-fruited bulrush (5 acres)

Areas dominated by small fruited bulrush and reed canarygrass occurred at the confluence of North Creek and unnamed creek. Slough sedge, bittersweet nightshade, soft rush and exotic species including bentgrass and creeping buttercup were also common in these areas.

Soils in these areas were mapped as the Mukilteo muck series. The surface layer was a dark reddish black (5YR 2.5/1) organic loam 6 inches deep over a dark reddish black (5YR 2.5/1) clayey loam. The subsoil was a dark reddish brown (10YR 2/2) peat. Soils were saturated to the surface, with areas of ponding water 4 inches deep between 213 and 220 feet.

Slough sedge/soft rush (< 1 acre)

Areas dominated by slough sedge occurred in several of the wetter areas in central portions of the site. Herbs common to these areas included creeping buttercup, soft rush, Watson's willow herb, and water-parsley.

Soils in these areas were mapped as the Mukilteo muck series. The surface layer was a dark reddish brown (5YR 2.5/2) loam with organic stains 6 inches deep over a black (10YR 2/1) silt loam with organic stains. The substrate was a black (5YR 2.5/1) peat. Soils were

saturated to the surface with free-standing water in the soil pits at 16 to 18 inches. These areas were generally between 213 and 216 feet.

Creeping buttercup (8 acres)

Several large areas of creeping buttercup occurred scattered throughout the central and eastern portions of the site. Also present in these areas were slough sedge, parentucellia, soft rush, and bulrush. Both creeping buttercup and parentucellia are exotics common to Western Washington.

Soils in these areas were mapped as either the Norma or Mukilteo muck series. The surface layer was a very dark brown (10YR 2/2) loam 6 to 8 inches deep over a very dark grayish brown (10YR 3/2) loam to 18 inches deep. Soils in these areas were saturated at 6 to 8 inches from the surface with standing water at depths below 21 inches at elevations generally between 218 and 220 feet.

Meadow foxtail (13 acres)

Large central portions of the site, grazed by cattle and horses, were dominated by meadow foxtail, timothy, soft rush, reed canarygrass, and the two exotics orchard-grass and curly dock.

Soils in these areas were mapped as the Mukilteo muck series. The surface layer was a dark reddish brown (5YR 2.5/2) loam to 6 inches deep over a black (10YR 2/1) silty organic loam. Below 12 to 14 inches was a black (5YR 2.5/1) organic peat. Soils were saturated within 4 inches of the surface with areas of seasonal standing water up to 12 inches deep at elevations between 216 and 225 feet.

Open water (2 acres)

Small areas of open water occurred in the north and south ends of the project area. Emergent vegetation around the perimeter of the pond included water-parsley, bulrush, common cattail, and soft rush.

Areas of open water occurred within the Mukilteo muck mapping units. Soils in these areas had a dark reddish black (5YR 2.5/1) organic surface 6 to 8 inches deep over a black (10YR 2/1) organic silty loam 10 to 12 inches deep. The substrate (below 18 inches) was a very dark brown (10YR 2/2) peat. Soils were saturated to the surface with areas of standing water up to 3 feet deep. The pond in the north is at an elevation of 220 feet; the pond in the south occurs below 214 feet.

Upland

A low dike occurs on the east side of North Creek. This dike is an narrow upland area dominated by Douglas's spirea, willow, red alder, and red-osier dogwood. On the south end

of the dike are several larger black cottonwood. Other shrubs include the common exotic species, evergreen and Himalayan blackberry. The herbaceous component consists of stinging nettle and introduced species including reed canarygrass, Canadian thistle, and nightshade.

Soils on the dike are compact gravels that were dredged from North Creek. They have a light yellowish brown (2.5Y 6/4) gravelly silty loam 8 inches deep. The subsoil is a brown (10YR 5/3) gravelly sandy silt loam 8 to 14 inches over a dark gray (2.5YR N4/0) sandy clay loam. Soils were examined to 24 inches and no saturation was observed. Upland plant communities typically occurred at elevations in excess of 225 feet.

IV. WETLAND FUNCTIONS

The North Creek wetland meets the criteria of a Class I wetland (Snohomish County Aquatic Resources Protection Program) and Category I and II wetland criteria of the Washington State Four-tier Wetlands Rating System. These ratings reflect the moderate to high ecological value of the wetland, including habitat diversity and peat deposits. Wetlands receiving these ratings typically provide significant wildlife habitat, in addition to providing other wetland functions, such as hydrologic and recreation/education.

While the North Creek wetland represents important wildlife habitat, it is a disturbed wetland system that has undergone significant changes (including diking, ditching, farming, peat mining, and grazing) that reduce the wildlife habitat value of the wetland. These disturbances have affected other functional values of the wetland, such as the degree of hydrologic connection between the wetland and North Creek.

Functions of the wetland were determined from field observations based on the Reppert (1979), WET (Adamus 1987) methodology, and professional judgement. They are summarized below and in Table 3.

FISHERIES HABITAT

Fish habitat within the wetland area appears productive. Many small fish (less than two inches in length) were observed in the side channels. Species such as minnows, sculpins and other freshwater marsh-adapted fish are undoubtedly present, along with rearing cutthroat trout and coho salmon fry. Steelhead trout fry could also use some of the diverted creek flow for rearing, although Washington Department of Fisheries biologists familiar with North Creek thought that steelhead fry, in general, were more likely to rear in the faster water of North Creek.

Fish habitat in North Creek appeared to contain several stretches of potential spawning habitat, with good gravel and limited cover. Steelhead appear to spawn in the area, as evidenced by three flagged redds. On October 4, 1990, we observed a pair of sockeye salmon redd-building/ mating at the confluence of North and the unnamed creek, adjacent to the site's southwest corner. Rich Johnson (WDF) also noted that sockeye, coho, and chinook salmon, along with steelhead and cutthroat trout, are found in North Creek. The area is also used as a migration corridor and rearing area by trout and salmon.

These reaches showed signs of significant degradation from cattle that cross in several places. Erosion of stream banks had been caused by cattle, and sediment loading along the creek edge was high. Algal growth covered much of the substrate. It appeared that if spawning occurred in these gravels, fry would most likely suffocate from the sediment layer. It is therefore unlikely that the reach of North Creek adjacent to the proposed site is a productive salmon-spawning area.

Restoration of spawning habitat could occur if cattle access to the creek was eliminated.

Table 3. Summary of wetland functions on the site of the proposed Regional Stormwater Detention Facility.

WETLAND FUNCTION	WETLAND TYPE			
	Riparian	**Open Water**	**Flooded Emergent**	**Wet Pasture**
Wildlife Habitat	Small mammal, songbird and beaver habitat; resident and anadramous fish spawning and rearing habitat	Waterfowl resting and foraging habitat; fish rearing habitat	Waterfowl nesting and foraging habitat	raptor and song bird foraging areas; small mammal habitat
Surface/Groundwater Interaction	Groundwater discharge area	Groundwater discharge area	Groundwater discharge area	Groundwater discharge area
Hydrologic	Stormwater conveyance	Stormwater storage; conveyance	Stormwater storage	Stormwater storage
Water quality improvement	Sedimentation; streambank stabilization	Sedimentation; nutrient/ pollutant removal	Sedimentation; nutrient/ pollutant removal	Sedimentation; nutrient/ pollutant removal

WILDLIFE HABITAT

Wildlife habitat in the wetland basin is high, despite the disturbed nature of the site. The high wildlife values can be attributed to the large size of the wetland, the spatial diversity of habitat types and the presence of flowing and ponded water.

Bird Species Diversity and Abundance

Forty-three bird species were observed at the North Creek wetland (Table 3). Bird population levels were highest during fall and early spring when large flocks of waterfowl overwintered and migrated through the area (Figure 1). In April, flocks of over 100 waterfowl, including mallards, widgeon, teal, and geese were present. Other migrating birds included a flock of American pipits in the open meadow during fall migration, and a flock of red-winged blackbirds perched in the willows and spirea near the pond during spring migration.

The number of bird species at the site was highest during the spring breeding season (May - July) (Figures 2 and 3). The most common breeding songbird species were the barn swallow, marsh wren, common yellowthroat, savannah sparrow, and song sparrow. Less common breeding songbirds included the yellow warbier, willow flycatcher, Bewick's wren, and red-winged blackbird. We observed a small number of waterfowl during the spring (May and June) breeding season. No waterfowl nest sites were located, although ducks and geese were expected to nest in the dense emergent wetland vegetation or in the pond.

Some bird species foraged and perched at the site and apparently nested in nearby habitat. A red-tailed hawk and a northern harrier were seen flying over the site several times, and may nest in the upland forest west of North Creek. Great blue herons and downy woodpeckers were observed foraging and perching at the site, and were also likely to nest in adjacent habitat.

Bird Habitat Use

The primary habitat types at North Creek were: (1) emergent wetlands and open meadows of reed canarygrass and soft rush; (2) riparian zone of deciduous trees and shrubs lining North Creek; and (3) open water of the pond with surrounding shrubs and emergent vegetation.

Emergent Wetlands

Emergent wetland meadows provided nesting habitat primarily for marsh wrens, common yellowthroats, and savannah sparrows (Table 4). Marsh wrens preferred reed canarygrass wetland habitat, whereas savannah sparrows nested in drier soft rush meadows. Rufous hummingbirds, barn swallows, and violet-green swallows foraged over meadows.

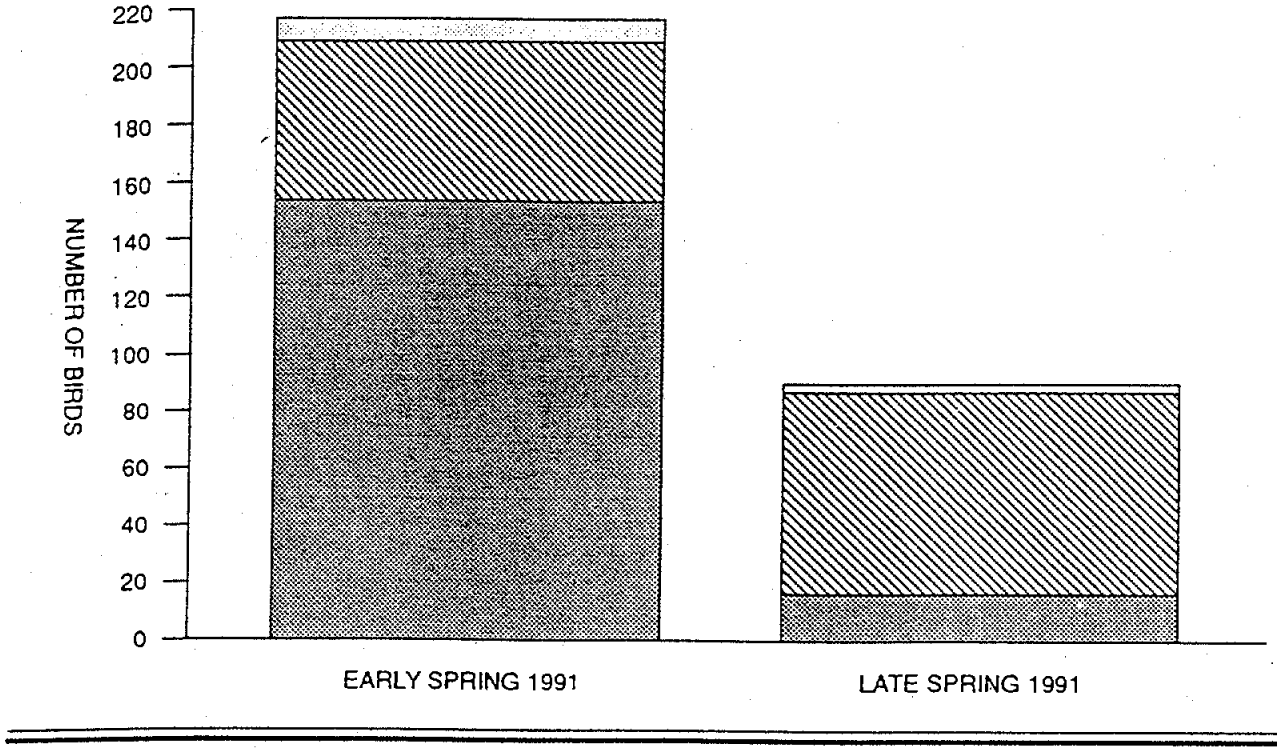

Figure 2.
Relative Bird Abundance at North Creek During Early Spring and Late Spring 1991

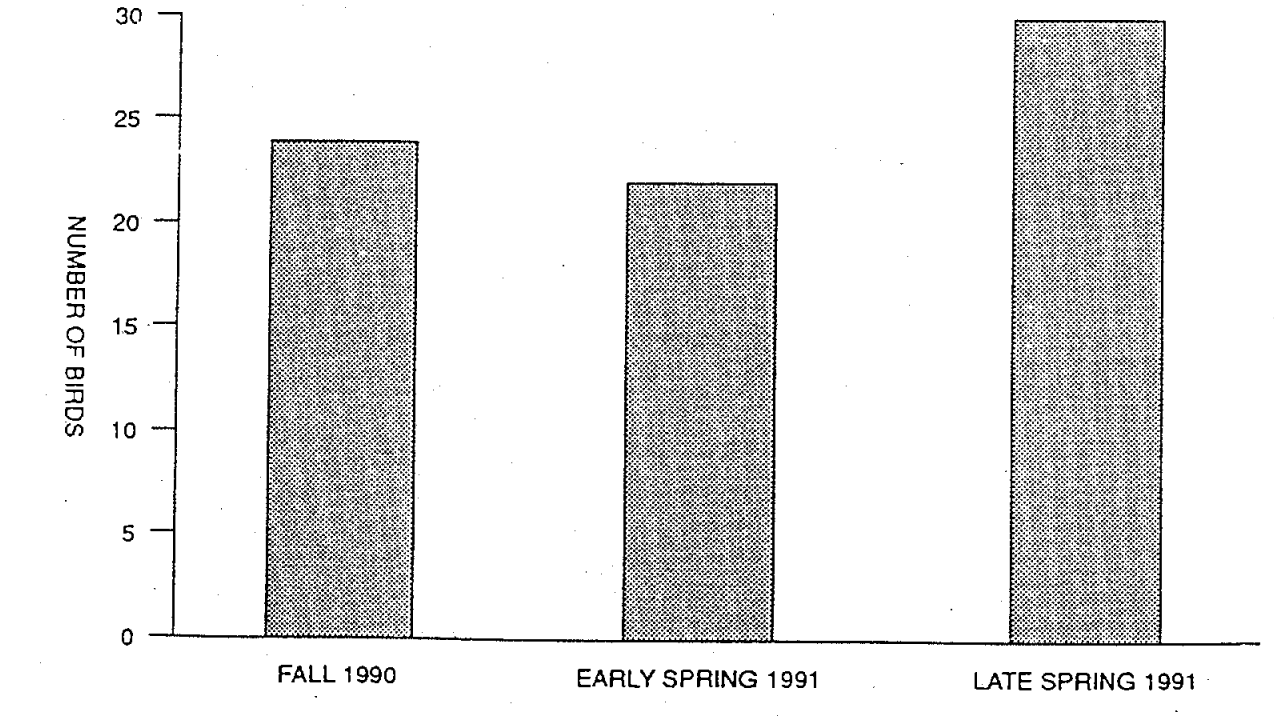

Figure 3.
Number of Bird Species Observed at North Creek Wetland During Surveys Conducted During Fall 1990 and Spring 1991

Table 4. Presence of bird species observed at North Creek wetland by habitat types during surveys conducted in fall 1990 and spring 1991.

	Habitat Type		
Bird Species	*Emergent Wetland*	*Riparian Zone*	*Pond*
Canada goose	*F,P*		*F,P*
Mallard	*F,P*		*F,P*
Gadwall	*F,P*		*F,P*
American widgeon	*F,P*		*F,P*
Blue-winged teal	*F,P*		*F,P*
Cinnamon teal	*F,P*		*F,P*
Green-winged teal	*F,P*		*F,P*
Northern harrier	*F*		
Red-tailed hawk	*F*		
Great blue heron	*F,P*	*F,P*	*F,P*
American coot			*F,P*
Killdeer	*F,P*		
Common snipe	*F,P*		
Rufous hummingbird	*F*	*F,P*	
Northern flicker		*F,P*	
Downy woodpecker		*F,P*	
Eastern kingbird			*F,P*
Willow flycatcher		*F,P,B*	*F,P,B*
Barn swallow	*F*		*F,P*
Violet-green swallow	*F*		*F,P,B*
Tree swallow	*F*		*F,P,B*
Steller's jay		*F,P*	
Black-capped chickadee		*F,P*	
Bushtit		*F,P*	
Bewick's wren		*F,P,B*	
Marsh wren	*F,P,B*		*F,P,B*
American robin		*F,P*	
Golden-crowned kinglet		*F,P*	
Ruby-crowned kinglet		*F,P*	
American pipit	*F,P*		
Cedar waxwing		*F,P*	
Yellow warbler		*F,P,B*	
Yellow-rumped warbler		*F,P*	
Common yellowthroat	*F,P,B*		*F,P,B*
Red-winged blackbird			*F,P,B*
Black-headed grosbeak		*F,P,B*	
Evening grosbeak		*F,P*	
Purple finch		*F,P*	
House finch		*F,P*	
American goldfinch		*F,P,B*	
Rufous-sided towhee		*F,P,B*	
Savannah sparrow	*F,P,B*		
Song sparrow		*F,P,B*	

Willow shrubs scattered throughout the open meadows enhanced vegetation diversity and improved habitat for breeding songbirds. One small willow shrub isolated in the middle of the wetland was used by several bird species for foraging, nesting, and territorial defense.

The open meadow was used by large overwintering flocks of waterfowl, including Canada geese, American wigeons, and green-winged teal, foraging and roosting at the site. Several common snipe and killdeer were flushed from emergent wetland vegetation during spring migration but were not sighted during the breeding season (May-June).

Riparian Zone

The riparian strip of deciduous trees and shrubs along North Creek supported a diversity of bird species (see Table 5) by providing cover, food resources, and a corridor for migration. The most abundant bird species along North Creek was the song sparrow, that nests and forages in the dense willows and other shrubs. Willow flycatchers, Bewick's wrens, rufous-sided towhees, and yellow warblers also nested along the densely vegetated corridor.

Small flocks of songbirds regularly foraged in the red alders and willows lining North Creek. During fall, a mixed flock of black-capped chickadees, ruby-crowned kinglets, golden-crowned kinglets, bushtits, and yellow-rumped warblers was observed feeding and flying along the corridor. Cedar waxwings and a rufous hummingbird were seen foraging in the area during spring.

American robins, black-headed grosbeaks, and Steller's jays were seen perched in the tall red alders along North Creek. A downy woodpecker and a northern flicker were observed several times foraging along the corridor, and may have nested in the upland forest west of North Creek. Several large snags were present at the conjunction of North Creek and Nickel Creek; the snags did not appear suitably decayed for cavity-nesting birds, but will provide important wildlife resources in the future.

Open Water

The small pond and surrounding wetland vegetation at the south end of the wetland provided valuable habitat for waterfowl and wading birds. Ducks and geese observed in the pond included Canada geese, mallards, gadwalls, American wigeons, blue-winged teal, cinnamon teal, green-winged teal, and American coots. No waterfowl nest sites were located at the pond, but ducks and geese are expected to nest in the pond or in the dense emergent vegetation surrounding the pond.

Barn swallows were common at the site, foraging over the open water and meadows. Barn swallows most likely nested in barns and sheds at adjacent farms. Violet-green swallows and tree swallows were also observed foraging over the pond and open wetland meadows, and may have nested in trees and shrubs near the pond.

A variety of songbirds nested in the shrubs and emergent wetland vegetation surrounding the pond. A pair of red-winged blackbirds nested among the cattails north of the pond. Common yellowthroats, marsh wrens, and song sparrows were common, nesting in the reed canarygrass, spirea, and willow shrubs adjacent to the pond. An eastern kingbird was observed only once perched in a willow shrub at the edge of the pond; it apparently nested elsewhere.

Non-Avian Wildlife

Census methodology was limited to daytime visual observations of wildlife use of the North Creek wetland. The technique was most appropriate for determining bird use of the site. Presence of mammals, reptiles and amphibians were recorded, but few quantitative data were collected in this study.

Based on direct observations and analysis of the wildlife habitat, twelve species of mammals probably use at the site (Table 5). A nearby resident reported the occurrence of a black bear at the site. Coyote scat was located along the south side of Nickel Creek and in the emergent wetland east of Penny Creek. Evidence of a raccoon foraging on crayfish was found along North Creek and near Nickel Creek. Muskrat tracks were observed in the mudflats along the edge of the pond. Black-tailed deer, striped skunk, moles, voles, deer mice, and eastern cottontails, although not directly observed, probably utilize habitat on the project site.

Several beaver dams were located along North Creek and unnamed Creek. One beaver lodge was located at the south end of the wetland near the pond, and a second beaver lodge may occur along North Creek. Beavers were very active at the site, and recently created a another shallow pond by enlarging a channel from North Creek and establishing a grass dam in the open meadow.

Five species of herpetofauna were expected to use the site (see Table 5). Amphibians potentially occurring at the site included the northwestern salamander, long-toed salamander, red-legged frog and bullfrog, all of which require open water for reproduction. Garter snakes are common in the Pacific Northwest and were also expected to inhabit the site.

WATER QUALITY AND QUANTITY FUNCTIONS

The wetlands on the project site perform important hydrologic functions that benefit North Creek and the surrounding watershed. This wetland not only provides a site for groundwater discharge, but also stores floodwaters, augments low flows, and improves water quality.

Table 5. Mammal, amphibian, and reptile species observed at or likely to occur at the North Creek wetland.

Common Name	Scientific Name
Pacific water shrew	*Sorex bendirii*
Vagrant shrew	*Sorex vagrans*
Townsend's mole	*Scapanus townsendii*
Coyote	*Canis latrans*
Raccoon	*Procyon lotor*
Striped skunk	*Mephitis mephitis*
Black-tailed deer	*Odocoileus hemionous*
Beaver	*Castor canadensis*
Deer mouse	*Peromyscus maniculatus*
Creeping vole	*Microtus oregoni*
Muskrat	*Ondatra zibethicus*
Eastern cottontail	*Sylvilagus floridanus*
Northwestern salamander	*Ambystoma gracile*
Long-toed salamander	*Ambystoma macrodactylum*
Red-legged frog	*Rana aurora*
Bullfrog	*Rana catesbeiana*
Garter snake	*Thamnophis* spp.

The North Creek wetlands appear to be sites of groundwater discharge. The slopes on the east and west sides of the wetlands contain many seeps and springs where groundwater surfaces.

The wetlands on the project site function to control stormwater runoff from adjacent sites, and provide flood storage to North Creek. During peak flows, waters entering the wetland are slowed. As storm inputs decline, water absorbed by the wetland soils and retained in the wetland basin are gradually released. This reduces the peak flood flows downstream from the wetland. The value of the wetland to flood control of North Creek is further evaluated in engineering reports (KCM 1992).

The wetlands augment low flows in North Creek as groundwater discharge sites and by releasing storm waters gradually after major storm events.

Wetlands improve the water quality of runoff that flows through them by collecting sediments and associated pollutants. In addition, plants can absorb dissolved nutrients from surface water and immobilize them in tissue. While quantitative assessments of this function have not been made and would be difficult to measure on this site, the site hydrology and topography suggest that this may occur at moderate to high rates.

RECREATION

Recreation activities in the wetland basin apparently include duck hunting, bird watching, and nature walks. The potential recreation value of these wetlands for these activities appears moderate to high.

V. IMPACT ANALYSIS

The stormwater detention facility will result in alteration of the current hydrology. Possible impacts from increased flooding include alteration of plant species distribution, alteration of wildlife habitat, and increased sedimentation within the wetland.

HYDROLOGIC CHANGES

As identified in the Draft Design Report (KCM 1992), wetland areas below 220 feet elevation will receive increased flooding during storm events as a result of stormwater detention in the wetland (Table 6 and Figure 4). As proposed in Alternative D, the 1.25-year storm event would result in a maximum increase in flood depth of 0.2 feet compared to the No-Build Alternative, flooding an additional 9 acres. The duration of the flood peak will last several hours longer compared to the No-Build Alternative, and the water level will remain somewhat elevated (up to 0.6 feet) for up to ten days longer than would occur without the facility (Figures 5 and 6).

During a 5-year storm event, Alternative D would result in increased flood depths of up to 1.7 feet, flooding an additional 16 acres of wetland. Following a 25-year storm, flood depths would increase approximately 2.0 feet above the No-Build Alternative, flooding about 22 acres more of the site than would occur without the facility (Figure 7). The duration of the peak flood depth would increase about 12 hours. Water levels would remain up to 0.6 feet above the No-Build Alternative for periods as long as 14 days. In a 100-year storm, flooding elevations would rise an 1.9 feet above those that would occur if no facility were built. This flooding would inundate an additional 21 acres of wetland.

ALTERATION OF PLANT SPECIES DISTRIBUTION

Wetland areas that would receive prolonged flooding of up to 0.6 feet of water for periods as long as 21 days are primarily limited to existing ditches, stream channels, and open-water areas located in the southern portion of the site. These areas are generally unvegetated with water depths up to several feet. The total area impacted by this flooding is about 7 acres. Since these areas are typically unvegetated, little impact to wetland vegetation is likely.

Plant communities in other areas of the wetland are not expected to be impacted because of the short duration and infrequent nature of the flooding. In addition to being adapted to saturated soils, all wetland plants in the basin are tolerant of minor flooding and frequently occur in riparian floodplain environments. Since all areas of the wetland basin experience saturated soils throughout much of the growing season (March - November), the periods of additional flooding that these areas would receive will not alter the soil moisture regime or plant-rooting environment.

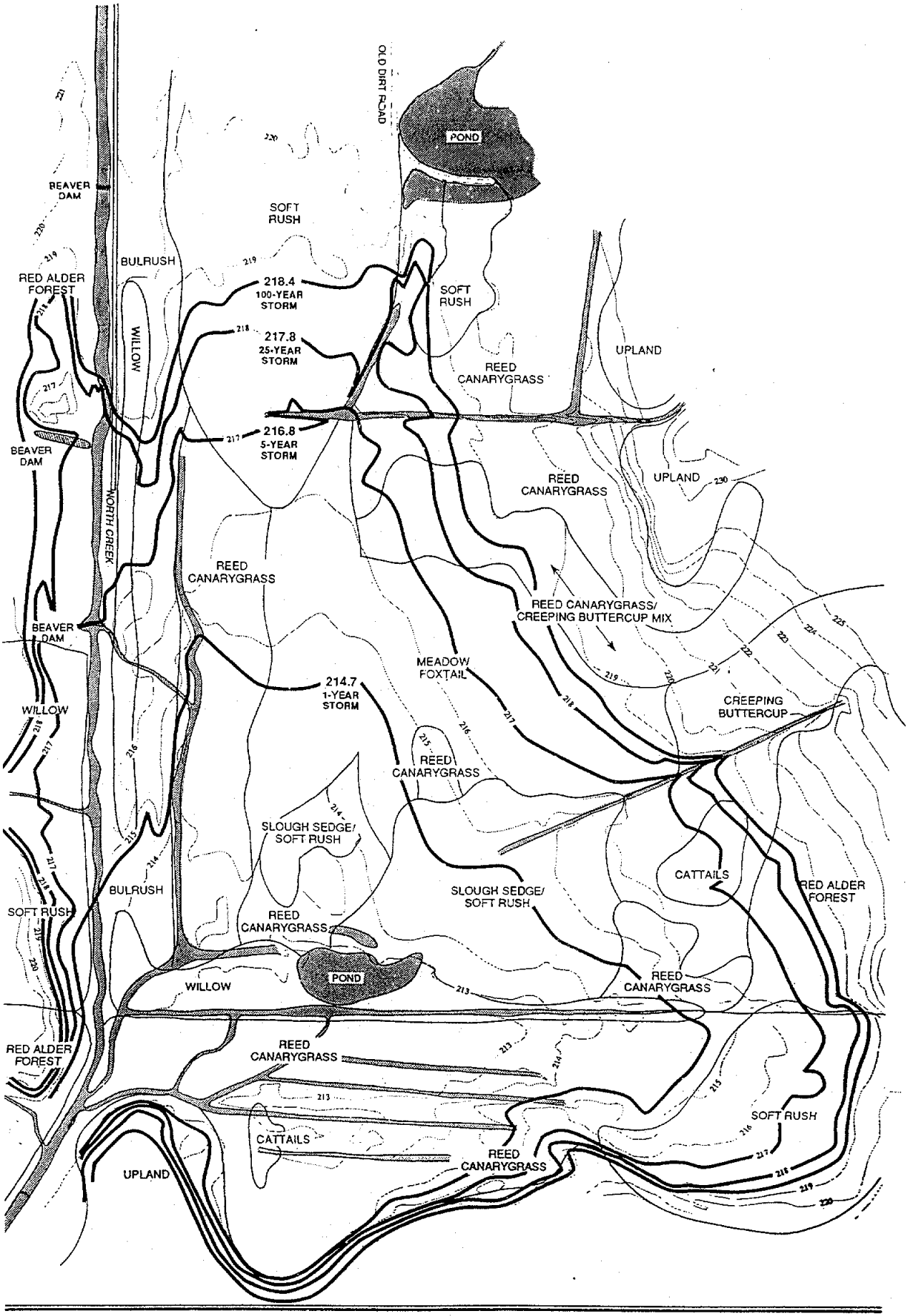

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Figure 4.
Area of Flooding at the Proposed North Creek Regional Detention Facility

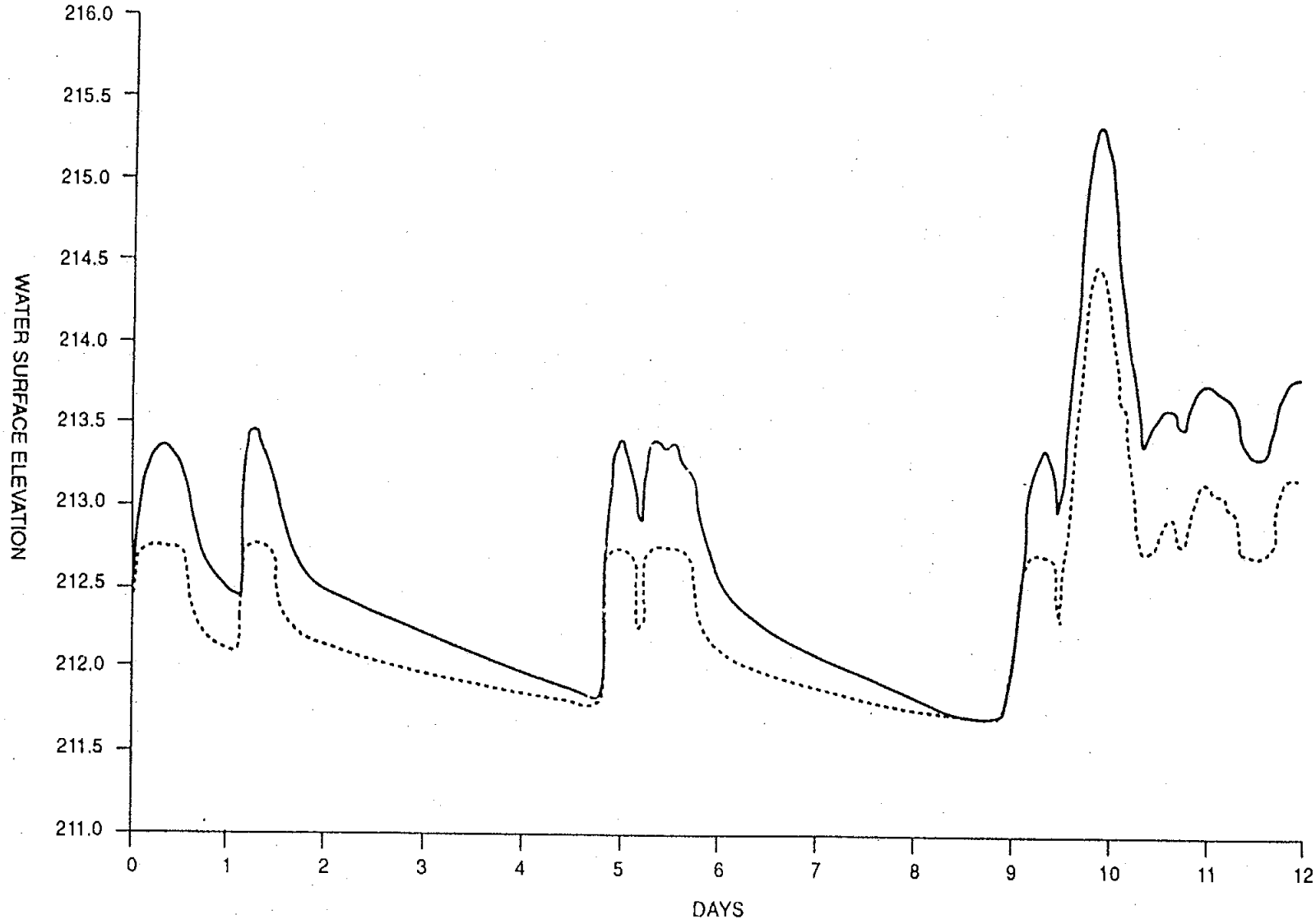

Figure 5.
Estimated Water Surface Elevations at the Proposed North Creek Regional Detention Facility Following Several Small Storms

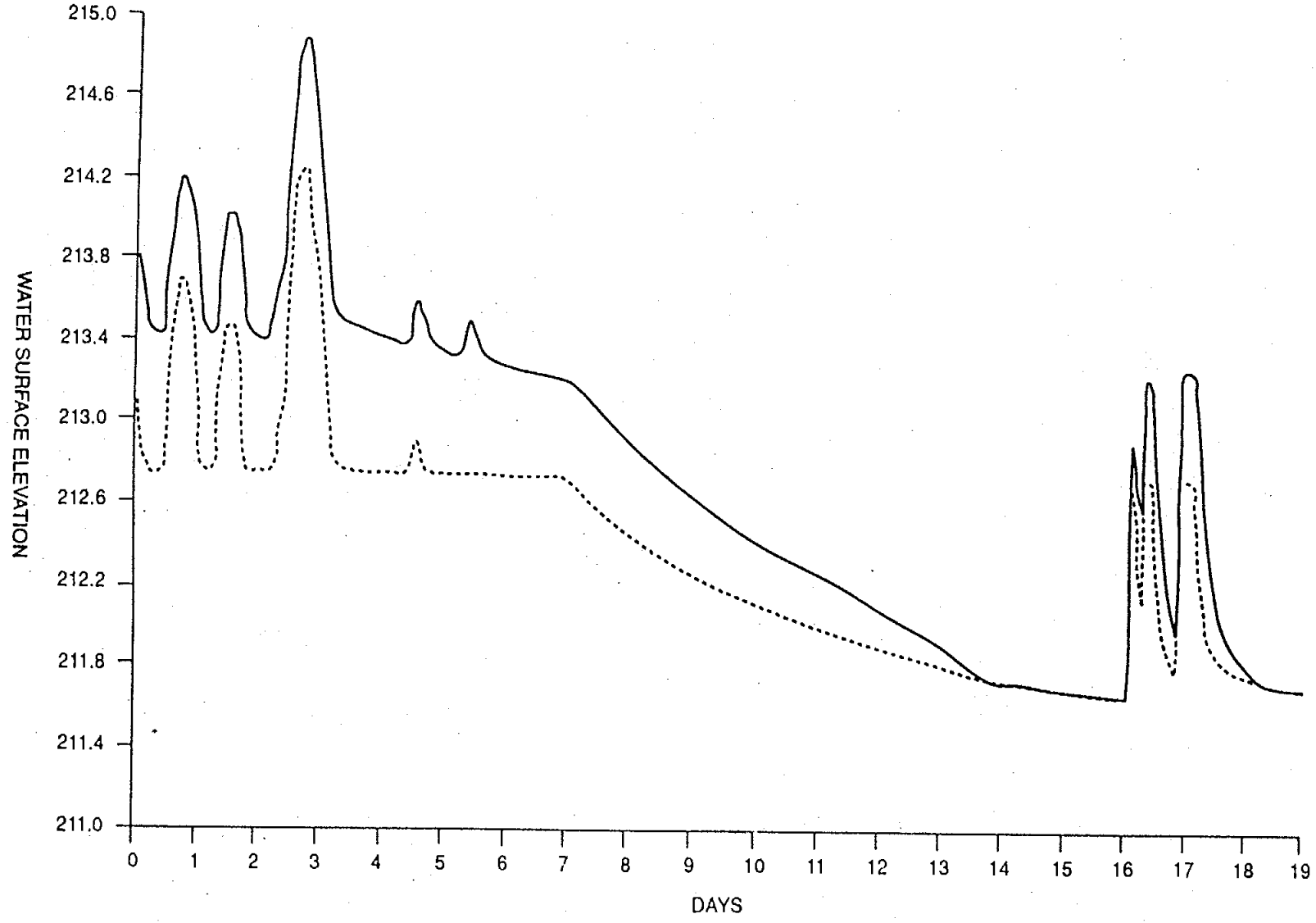

Figure 6.
Estimated Water Surface Elevations at the Proposed North Creek Regional Detention Facility Following the Annual Storm

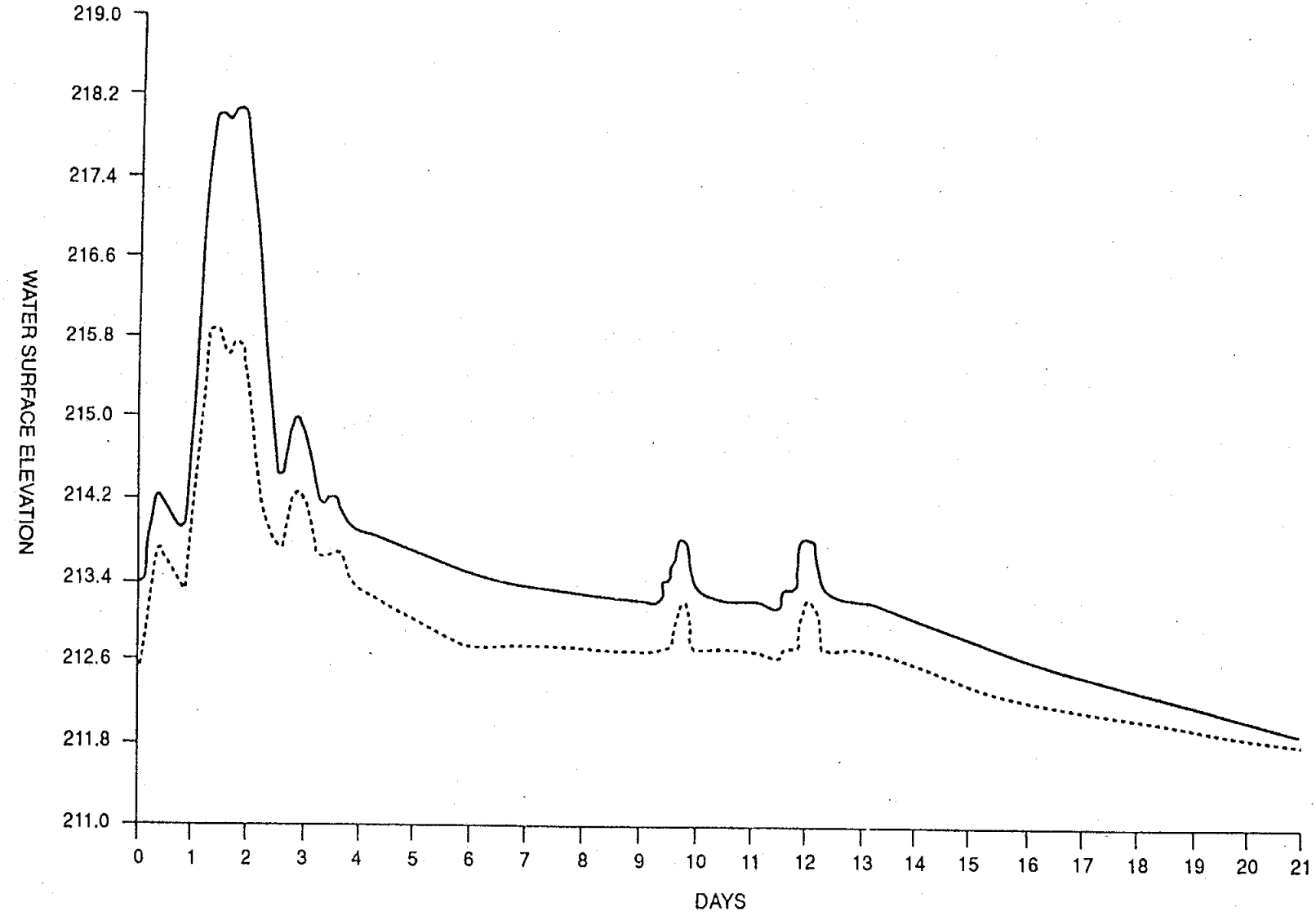

Figure 7.
Estimated Water Surface Elevations at the Proposed North Creek Regional Detention Facility Following the 25-Year Storm

Table 6. Anticipated Flooding at the proposed North Creek Regional Detention Facility (Base elevation is 211 feet)

Event Frequency (years)	No Facility			Alternative D		
	Elevation (feet)	Area flooded (acres)	Depth (feet)	Elevation (feet)	Area Flooded (acres)	Depth (feet)
1.25	214.6	20	0-3.6	214.7	24	0-3.7
5	215.1	28	0-4.1	216.8	44	0-5.8
25	215.8	34	0-4.8	217.8	56	0-6.8
50	216.2	38	0-5.2	218.1	59	0-7.1
100	216.5	41	0-5.5	218.4	62	0-7.4

The wetland vegetation in areas which would receive additional flooding is unlikely to be significantly affected because of the relatively short duration of the flooding, the time of year it occurs, and the tolerance of existing vegetation to flooding.

In general, a few days of flooding has little effect on most plants, especially plants adapted to wetland conditions (Niering 1989). In addition, if flooding takes place during the winter months when plants are largely dormant, little or no damage is likely to occur, even to non-wetland species (Bedinger 1978). Because most of the precipitation in the Pacific Northwest occurs during the late fall and winter (November through March), the impact of flooding generally occurs during time periods when it has little impact on vegetation.

Although no immediate changes in the plant communities are expected, some minor alterations in plant distribution might occur over time. Areas that receive flooding for several days longer than under current conditions—primarily ditches along the fringes, open water and a few small depressions—may experience a gradual change to species better suited to slightly longer periods of flooding. Plants that have a competitive advantage in flooded habitats, such as cattails and small-fruited bulrush, may increase their coverage in these areas. However, these changes, if they occur, are not expected to be significant.

Significant changes in the distribution and abundance of wetland plant species are expected to result from the removal of cattle from the wetland (see below). Since this could occur concurrent with the development of the detention facility, it will be difficult to attribute long-term changes in vegetation to impacts caused by the facility vs. naturally occurring successional changes, because of the removal of grazing impacts.

ALTERATION OF WILDLIFE HABITAT

The changes in site hydrology will result in minor alterations to wildlife habitat. Increased flooding and soil saturation will temporarily reduce the habitat for some small mammals, while habitat conditions for waterfowl and amphibians may be slightly increased.

Periodic flooding will temporarily force upland species out of flooded wetland areas to adjacent upland buffers. Development of a stormwater facility in the basin will increase the area of temporary flooding, and thus displacement will occur over a larger area. During the relatively infrequent larger storm events, small mammal populations may be temporarily reduced. These animals could experience increased predation during migration from flooded areas, and find inadequate amounts of accessible habitat. However, these infrequent, periodic reductions of small mammal populations are not expected to result in long-term effects on predators, such as coyote and hawks.

Additional flooding of the basin could result in minor increases in habitat for waterfowl and amphibians. Flooding could enhance open-water areas for waterfowl and amphibians to feed and maintain a diversity of emergent plants for nesting, especially along the fringe of open water and emergent habitats. If major storm events occur during late spring nesting, fledgling rates of some waterfowl that nest in the wetland would be reduced by flooding of nest sites. However, since most large storm events in this region occur prior to waterfowl nesting (May - June), these impacts would be very infrequent.

The detention facility would reduce the velocity of flood flows in the North Creek Channel. This reduction in flood velocity could decrease the likelihood of beaver dams washing out during storms, and thus enhance the area for beavers. Continued use of the stream by beaver should enhance the rearing habitat available to fish, though some loss of spawning ground may occur due to sedimentation behind beaver dams.

INCREASED SEDIMENTATION

During storm events, flood water velocities in North Creek will decline and likely result in increased sedimentation within the wetland. Since runoff associated with the annual storms and the initial runoff from larger storms will remain channelized in North Creek, much of the sediment load will continue to bypass the wetland.

Contaminants typically associated with sediments carried by stormwater runoff include heavy metals and nutrients. Heavy metals accumulate over time as a percentage of inputs and are retained from year to year (Giblin 1985). Continued urbanization of the North Creek watershed will continue to increase the load of heavy metals carried by the stream, unless adequate on-site control is implemented. Heavy metals deposition in the wetland would thus continue to increase with or without the proposed stormwater detention facility.

Since sediments from most storm events (those less than the annual) will bypass the wetland as channel flow, accumulation rates in the wetland are likely to be relatively low. Although

increased concentrations of metals are often found in wetlands which receive stormwater runoff, these concentrations, even in very urbanized areas, rarely reach toxic levels and significant impacts are not expected.

REMOVAL OF GRAZERS

Management of the project site will likely include the removal of horses and cattle within much of the wetland area. Removal of these animals will improve habitat diversity and water quality.

Pasture grasses and soft rush occur on much of the northern part of the wetland. These grasses, including many non-native species, are maintained because of their ability to tolerate grazing. Removal of cattle will result in a natural pattern of vegetation succession, including the gradual replacement of non-native meadow communities to communities dominated by native trees, shrubs, and emergent wetland plants. As this occurs plant diversity and the number of native plant species will likely increase.

Removal of the horses and cattle will improve the water quality of North Creek since these animals appear to contribute nutrients and organic matter to North Creek in the form of manure-derived runoff. These nutrients increase algal growth and reduce the water quality of the stream. As cattle and horses move through the stream they damage stream banks, increasing erosion and siltation; they may also damage salmon-spawning habitat.

VI. CONCLUSIONS AND RECOMMENDATIONS

The North Creek wetland provides significant habitat for a variety of wildlife species. All of the wildlife observed at the site are common to western Washington and are typical for wetlands found in the region (Richter and Wisseman 1990). No threatened or endangered species were observed during the wildlife surveys.

Many wildlife species observed at the site are ecologically dependent upon riparian and wetland vegetation for breeding and foraging habitat. The most important habitat elements at the site were the areas of open water, the dense emergent vegetation adjacent to the open water, and the corridor of riparian trees and shrubs along North Creek.

Beaver activities have affected the wetland ecosystem, adding habitat diversity to the site. Beavers have recently established more dams and created small ponded areas at the wetland, providing significant additional habitat for wildlife requiring open water for reproduction and foraging.

The site has undergone significant human alterations, including diking, ditching, farming, peat mining, and grazing. The proposed stormwater detention facility will result in further wetland alteration, but this is not expected to have significant adverse environmental impacts on the wetland. Increases in the periodic flooding of the basin is expected to occur primarily during winter and early spring and will occur only during larger storms. Habitat use by wildlife would not be significantly reduced or affected by flooding. Flood events during late spring may inundate some waterfowl and songbird nest sites; however, most significant flooding would occur during the late fall and winter prior to the breeding season (May - June). If flooding were to destroy nests, most species would likely renest.

Changes in hydrology and the removal of cattle from the project site would result in a long-term improvement of the wildlife habitat of the wetlands. Removal of cattle will allow development of more native and diverse plant communities dominated by native vegetation. Increased flooding, particularly below the 212 foot contour may create minor amounts of seasonal open water which could provide additional waterfowl habitat.

MITIGATION

Since significant adverse impacts to wetlands are not expected, compensatory wetland mitigation should not be implemented at this time. However, because there is some element of uncertainty associated with the design and operation of the facility, mitigation should include a 5-year monitoring program to verify that no significant impacts are associated with the facility.

A monitoring program should be developed and reviewed annually. This program should be modified as required to address issues if they emerge as apparent problems. This monitoring program should include the following:

- Observations of wildlife usage (during the breeding season and during flood events)
- Documentation of changes in vegetation patterns
- Review of hydrographs and flooding in the wetland
- Observations of sedimentation, (such as fresh sediment deposits following storm events)
- Annual reports and agency review.

If, as a result of this monitoring, significant environmental problems are found, appropriate mitigation should be designed and implemented.

Restoration of the wetland could improve the functional value of the wetland, particularly the wildlife habitat. Potential enhancement and restoration features could include:

- Providing artificial nest baskets in the open water or adjacent emergent vegetation for nesting waterfowl (Doty et al. 1975; Marcy 1986).

- Planting wetland shrubs and trees in the open meadows to increase vegetation diversity and provide foraging and nesting sites for wildlife.

- Planting aspen and alder along the North Creek riparian area to provide foraging sites for beavers and other wildlife.

- Maintaining and creating snags, or establishing nest boxes for cavity-nesting wildlife (Mitchell 1988).

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Appendix A. Presence and relative abundance of bird species observed at the North Creek wetland during surveys conducted during fall 1990 and spring 1991.

Bird Species	Fall 1990 9/12, 10/4	Early Spring 1991 4/11	4/12	Late Spring 1991 6/4	6/5
Canada goose		11	10		8
Mallard	*	7	20	4	8
Gadwall	*				
American widgeon		29	6	3	4
Blue-winged teal					1
Cinnamon teal				1	
Green-winged teal	*	61	4		2
Ducks		28	130		
Northern harrier				1	
Red-tailed hawk	*		1		
Great blue heron		1	1	1	1
American coot		1			
Killdeer		1			
Common snipe	*	2	3		
Rufous hummingbird		1	2	3	1
Northern flicker	*				
Downy woodpecker	*				1
Eastern kingbird					1
Willow flycatcher				1	2
Barn swallow	*			9	24
Violet-green swallow	*	5	7	4	5
Tree swallow					2
Steller's jay	*				
Black-capped chickadee	*	3	1		1
Bushtit	*	2			
Bewick's wren	*			1	2
Marsh wren	*	7	13	8	11
American robin	*	1	4		1
Golden-crowned kinglet	*	1			
Ruby-crowned kinglet	*			1	
American pipit	*				
Cedar waxwing				4	2
Yellow warbler				1	2
Yellow-rumped warbler	*				
Common yellowthroat		4	6	10	16
Red-winged blackbird		25	8	1	4
Black-headed grosbeak	*				1
Evening grosbeak	*				
Purple finch					1
House finch	*				
American goldfinch				3	1
Rufous-sided towhee	*	1			1
Savannah sparrow		1	4	7	3
Song sparrow	*	9	9	5	6
Total		201	229	68	112

* indicates bird species present in undetermined numbers.

- Ducks = mixed-species flocks of ducks, including wigeons, teal, and mallards.

As engineering proposals are developed, these actions will be incorporated into project plans to mitigate for identified project impacts to wetlands.