AN EVALUATION OF THE WETLAND MONITORING PROGRAM OF THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

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AN EVALUATION OF THE WETLAND MONITORING PROGRAM OF THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

by

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ABSTRACT

An evaluation of the Washington State Department of Transportation (WSDOT) wetland monitoring program was conducted in response to increasing costs of monitoring, stricter standards for mitigation site development imposed by federal, state, and local agencies, and an increase in the number of sites monitored per year. The main objectives of the evaluation are to provide recommendations for a more efficient monitoring methodology, to better present the data in the annual monitoring report, and promote more effective use of the annual report within WSDOT. Recommendations for changes to the WSDOT wetland monitoring program are based on a compilation of personal interviews conducted with environmental specialists within regulatory and resource agencies, a review of two recent studies on wetland monitoring methodology, the draft *Guide for Wetland Mitigation Project Monitoring* (Horner and Raedeke 1989) upon which the current program was initially developed, and the author's observation from three years of conducting the WSDOT monitoring program.

Changes proposed for the field methodology include increasing vegetation sample plot size from 0.5 m^2 rectangular plots to 1.0 m diameter circumference plots, reducing the total number of sample plots for vegetation, conducting independent sampling of wetland and upland areas, adding stem counts of planted species, adding amphibian spawn (egg mass) surveys, and standardizing the locations, numbers, and repetition of samples taken for soil, water, and invertebrates. Recommendations for restructuring the annual report include organizing the mitigation sites by the WSDOT District in which they are located, presenting all tables, charts, and graphs with their associated site, providing more in-depth discussion of the monitoring results, and making recommendations based on those results. The annual report supplies the major source of feedback on WSDOT wetland mitigation projects and should be used to make management decisions regarding future wetland creation. The distribution of the annual report should include WSDOT landscape architects involved in wetland mitigation site design. To be the most efficient and effective in monitoring its created wetland mitigation sites, WSDOT should continue to work with federal, state, and local agencies in an effort to establish common ground on the expectations for and the focus of the monitoring program.

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1. Introduction

The very nature of the business conducted by the Washington State Department of Transportation (WSDOT) entails direct contact, and often direct conflict, with the environment. The state's ferry system, railways, and road network fall under the direction of an agency whose prime directive is "....to provide safe, efficient, dependable, and environmentally responsive transportation facilities and services."[1] According to a Washington State Department of Transportation (1990) report to the Washington State Legislature many of Washington's highways are nearing or have reached vehicle carrying capacity. Roads that were not intended to handle high volume use are becoming overburdened, a fact that has created not only the necessity for higher levels of maintenance, but an increasing demand by the public for relief from traffic congestion (Washington State Department of Transportation 1990). This relief from congestion is often provided by road widening projects and new access roads linking heavily traveled rural routes to major highways.

Most of Washington's roads were built long before wetlands' place in the landscape garnered much acclaim and hence, little consequence was placed on routing a road through wetland systems. WSDOT road construction projects projected through the end of this decade involve widening roads, adding passing lanes, adding bike paths, constructing safer road shoulders, improving highway safety (e.g. straightening

[1] WSDOT Mission Statement: "The mission of Washington's transportation system is to provide safe, efficient, dependable, and environmentally responsive transportaion facilities and services."

curves that no longer meet WSDOT standards), or adding access routes to existing highways (Rettew 1994). The majority of these types of projects entail using additional land on either side of the existing roadways. Where road project and wetland meet, there is the potential for negative impact to these environmentally sensitive areas.

Activities in wetlands are controlled by federal, state, and in some instances, local regulations. WSDOT road projects that involve the dredging or filling of a wetland will require federal permits under Section 404 of the Clean Water Act[2] and will generally require compensatory mitigation under the terms of the permit.[3] This typically involves creating a replacement wetland, or combining wetland creation with enhancement of a degraded wetland, and monitoring the progress of the site. Although compensatory mitigation cannot replace the original wetland impacted by construction activities, it is intended to balance the loss by creating a system that provides wetland functions similar to those of the original wetland. At each mitigation site the development of these functions must be monitored, an activity that entails some level of sampling water, soil, vegetation, and wildlife. Monitoring provides a systematic means of tracking the development of the wetland over time,

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[2] Refers to the Federal Water Pollution Control Act of 1972, later amended as the Clean Water Act of 1977 (33 USC 1344). Appendix A provides greater detail on Sec. 404.
[3]How compensatory mitigation came into being through the Amendments to the Federal Water Pollution Control Act of 1972 and where wetland creation and monitoring fall in the timeline of a WSDOT project are somewhat ancillary to the focus of this paper. However, the legal and temporal aspects may provide a perspective on what emphasis WSDOT places upon wetland mitigation and the monitoring program, and are therefore included as Appendix A and B, respectively.

determines compliance with the goals and objectives set for the site, and provides a critical source of feedback for future site designs.

WSDOT began its wetland monitoring program in 1988 with six created wetland mitigation sites. Several significant changes have occurred in the six years since the inception of the program. Most notable is that in this time period the number of mitigation sites have almost tripled: in 1994 twenty mitigation sites will be monitored and additional sites are likely for 1995. Another change is that the goals and objectives outlined for the mitigation sites have evolved from broad-based, generically applied standards to directives tailored to the individual wetland site. In addition, the criteria (standards of success) set for achieving those goals have become more rigorous. Monitoring costs for each site have also increased, rising by almost twenty-five percent over the past two years. The estimated cost to monitor a wetland site in 1994 is $5000.00. Total monitoring costs in 1994 for twenty sites will approach $100,000.00. Over the five years of monitoring expected for these sites WSDOT will have spent nearly 0.5 million dollars; an amount that will increase accordingly as more sites are added. The combination of increased costs, higher standards for mitigation site development, and the increase in the number of sites monitored has made it necessary to assess the monitoring program for efficiency and effectiveness.

This paper evaluates the WSDOT wetland monitoring program with a focus on its three main components: the methodology, the annual monitoring report, and the in-house (WSDOT) use of the monitoring results. The main objectives are to provide recommendations for a more efficient monitoring methodology, to better present the data in the annual monitoring report, and to promote more effective use of the report within WSDOT.

Room for improvement was found in each area. With the methodology, some changes to sampling design combined with additional sampling methods will be necessary in order to meet the more stringent requirements set forth in the goals and objectives for the newer wetland sites. Instead of employing one monitoring strategy for all mitigation sites, the rigor of the standards of success should drive the level of monitoring necessary to meet the goals for an individual site. The annual report represents the compilation of all data generated in one monitoring season. In its present format the report is difficult to follow. Minor changes would enable the reader to more readily extract specific information for any site. Also, the annual report is weakest in its analysis and recommendations section, which would provide feedback critical to the long-term success of WSDOT wetland mitigation. Finally, there needs to be better promotion of internal use of the annual monitoring report. Many of the WSDOT landscape architects and planners, those involved in the technical design of the mitigation sites, are not familiar with the annual monitoring report. The overall mitigation program loses its effectiveness if the information generated from site monitoring is not incorporated into future site design, and ultimately, furthering knowledge of what makes a successful wetland mitigation site.

2. Overview

2.1. Wetlands in Washington's Landscape

Often characterized as lands that are transitional between terrestrial and aquatic ecosystems (Cowardin et al. 1979), wetlands have been given several formal definitions. In general each definition centers on three basic characteristics that separate wetlands from other systems: 1) water is present at some time during the growing season, 2) the soils are saturated to an extent that anaerobic (without oxygen) conditions prevail, and 3) the predominant vegetation is adapted to saturated conditions (Mitsch and Gosselink 1986, Cowardin et al. 1979). Washington is host to a variety of wetland types from the alkaline vernal pools and potholes in eastern Washington to the highly acidic bogs and fens of northwestern Washington (Stevens and Vanbianchi 1993). Tidal marshes, forested riverine wetlands, sub-alpine wet meadows, and isolated lowland pools are other wetland types, all which have contributed to what has been estimated as 1.35 million acres of wetlands, (approximately 3% of Washington's total area), at pre-European settler times (Dahl 1990). Over the past two centuries losses of these unique systems in Washington State have been estimated to be between 31% (Dahl 1990) to greater than 50% (McMillan 1987) of their original area. Tidal wetlands have sustained the greatest losses, estimated at greater than 80% destroyed (Stevens and Vanbianchi 1993). Washington State is on par with the rest of the nation in wetland losses; of an estimated 221 million wetlands in the conterminous United States at the turn of the 18th century, it is estimated that 53% of the original acreage has been lost (Dahl 1990).

There is no one encompassing piece of legislation at either the federal or state level (in Washington State) that has as its primary function the regulation of wetlands (Washington State Department of Ecology 1988). Instead, various laws and ordinances from federal to local jurisdictions are used to regulate human activities in these systems. Refer to Appendix C for a listing of the primary laws/regulations pertaining Washington wetlands.

2.2. Wetland Mitigation Within WSDOT

For the purposes of this paper, the term "wetland mitigation" refers to the compensation of wetland impacts through creating, enhancing, or restoring wetlands. The terms restoration, enhancement, and creation have often been used in different ways in different parts of the country and within different state, county, and local jurisdictions (Lewis 1990). As adopted from recommendations presented by Lewis (1990) for standardizing wetland terminology, "created wetland" refers to a wetland that has been constructed in an area that has not been a wetland in recent times (100-200 years). "Wetland enhancement" refers to human activities occurring in an existing wetland for the purpose of increasing the overall value of the wetland; e.g., increasing wildlife habitat value or water quality. This may include modifying the existing contours of the wetland, reintroducing meanders to a stream that has been straightened, or the addition of different species of wetland vegetation. "Wetland restoration" is the process of returning an area that was once a wetland to its historical, or pre-disturbance condition.

All WSDOT projects involving wetland impacts follow guidelines established by the National Environmental Protection Act of 1969 (NEPA) and the 1971 State Environmental Protection Act (SEPA - a parallel to NEPA). The NEPA/SEPA process requires that a full disclosure of environmental impacts be made for any project involving federal/state actions, that all adverse environmental impacts resulting from a proposed project be evaluated, and that all practicable alternatives to avoid the impact be considered (Washington State Department of Ecology 1988). Although not specific to wetlands, both NEPA and SEPA have adopted a sequential process of mitigation (as supported by the Environmental Protection Agency - EPA), authored by the Council on Environmental Quality in 1979. These sequential steps, adapted by WSDOT and the Washington State Department of Ecology (WSDOE/Ecology) in their Implementing Agreement Concerning Wetlands Protection and Management (WSDOT and WSDOE 1993), are as follows:[4]

1) Avoid impacts altogether by not taking a certain action or part of an action;

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[4] A Memorandum of Understanding (MOU) was adopted between WSDOT and Ecology in 1988 in an effort to facilitate the environmental review of WSDOT documents and improve the coordination of activities surrounding permit application and processing. In 1993 the two agencies developed a supplement to the MOU, the Implementing Agreement between the Washington State Department of Transportation and the Washington State Department of Ecology Concerning Wetlands Protection and Management, specifically to address issues concerning wetland protection with regard to WSDOT construction projects. The section in the Implementing Agreement that addresses mitigation plans and site monitoring is given in Appendix D.

2) Minimize impacts by limiting the degree or magnitude of the action and its implementation;
3) Rectify impacts by repairing, rehabilitating, or restoring the affected environment;
4) Reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action;
5) Compensate for impacts by replacing, enhancing, or providing substitute wetland resources or environments;
6) Monitor the mitigation by systematic evaluation of the development of a constructed wetland to determine success.

Unavoidable wetland impacts are addressed in a wetland mitigation plan drawn up by a WSDOT biologist. In this document the impacted wetlands are described, the terms for mitigating the wetland impacts are proposed (which includes steps taken to avoid and minimize impacts as well as wetland creation), the prospective mitigation site is identified, and the basic design plans are given for the wetland to be constructed. This includes grading plans (wetland configuration and contours) and planting plans specifying species, quantities, and placement of the vegetation to be planted on the site. The mitigation plan also provides goals, objectives, and standards of success (criteria by which to evaluate the progress of the created wetland) for the site. Ideally the mitigation plan should dictate the level of monitoring that takes place on the individual sites. WSDOT projects that require mitigation in the form of wetland creation may take less than one year or greater than ten to go from the scoping (pre-project) phase, to the project design stage, through the permitting process, into the construction phase, and finally to the construction and planting of the wetland mitigation site. A more detailed account of this process is given in Appendix B.

3. WSDOT Wetland Monitoring Program

Wetland monitoring by WSDOT is defined as the process of tracking the development of its created wetlands over time through the systematic sampling of water, soil, vegetation, and wildlife. The goal of the wetland monitoring program is to ensure mitigation compliance as specified in the wetland mitigation plan, which has been incorporated into the terms of the permits issued by federal, state, and local regulatory agencies. To meet this goal WSDOT must show that its created wetlands have obtained or are developing 1) wetland characteristics of hydrology, hydric soils, and hydrophytic vegetation, and 2) wetland functions of flood attenuation, sediment trapping, water quality improvement, wildlife habitat, and food chain support.

Wetland mitigation sites are typically monitored for five years, a length agreed upon between the United States Army Corps of Engineers (Corps) and WSDOT, starting with the first growing season after construction of the wetland has been completed and/or the site has been planted. Monitoring occurs over a four month period beginning mid-May and continuing into early September. WSDOT mitigation sites are mostly concentrated in the region west of the Cascade Mountains, ranging from Whatcom County in the north to Wahkiakum County in the south of the state, and are located in both rural and urban settings. Mitigation sites are also located on the Olympic Peninsula and east of the Cascades.

Monitoring results are compiled in an annual report that is submitted to the Corps, EPA, U.S. Fish and Wildlife Service (USFWS), Ecology, Washington Departments of Fisheries and Wildlife (WDFW) and the Federal Highways Administration (FHWA). The report is also sent to the environmental divisions of each WSDOT district.[5] Ideally, the report should provide the regulating agencies with the information necessary to determine permit compliance as well as important feedback to WSDOT through data analysis and recommendations to be incorporated into future mitigation site designs.

WSDOT mitigation projects that require monitoring are mostly created wetlands, although a few of the more recent sites have combined wetland creation with wetland enhancement. Monitoring of a mitigation site encompasses the actual wetland and its surrounding upland buffer (a non-wetland area that may be entirely replanted or be a combination of replanted and existing vegetation). Current WSDOT monitoring protocol is modified from methodology described in *Guide for Wetland Mitigation Project Monitoring* (Horner and Raedeke 1989), a document prepared specifically to help shape the WSDOT monitoring program. As indicated in previous sections, data are collected on parameters that are indicative of the success and development of the constructed wetland. The techniques and methods

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[5] In addition to the headquarters office, WSDOT is divided into six regional districts- each district has a central office and various field stations.

currently used to monitor WSDOT wetland mitigation site, as adopted from Horner and Raedeke (1989) and summarized from the WSDOT 1993 Monitoring Report (Savage and Olds 1994), are presented below.

3.1 Current Methods

Preparation of a new mitigation site involves setting a baseline and transects, which are used to identify sampling stations for each of the monitoring tasks (see Figure 1). The baseline is established in the upland area and parallel to the wetland within each mitigation site. Transect lines are set perpendicular to the baseline and extended into the upland buffer beyond the opposite end of the wetland. During monitoring a tape measure is stretched the length of the transect. This provides reference points for the fixed stations from which all site sampling occurs.

Assessing the development of the vegetation community in the mitigation sites has been the focal point in the WSDOT monitoring program. Two plant sampling methods, line-intercept (Canfield 1941), and canopy coverage (Daubenmire 1959) are used to evaluate the occurrence and influence of plants in the mitigation site. The line-intercept method is used for woody vegetation (trees and shrubs) greater than one meter in height. All vegetation intercepting the tape measure stretched along the transect line is identified and the length of intercept is recorded (see Figure 2). The canopy coverage method provides a means to assess the herbaceous layer, defined as all non-woody vegetation and woody plants less than or equal to one meter in

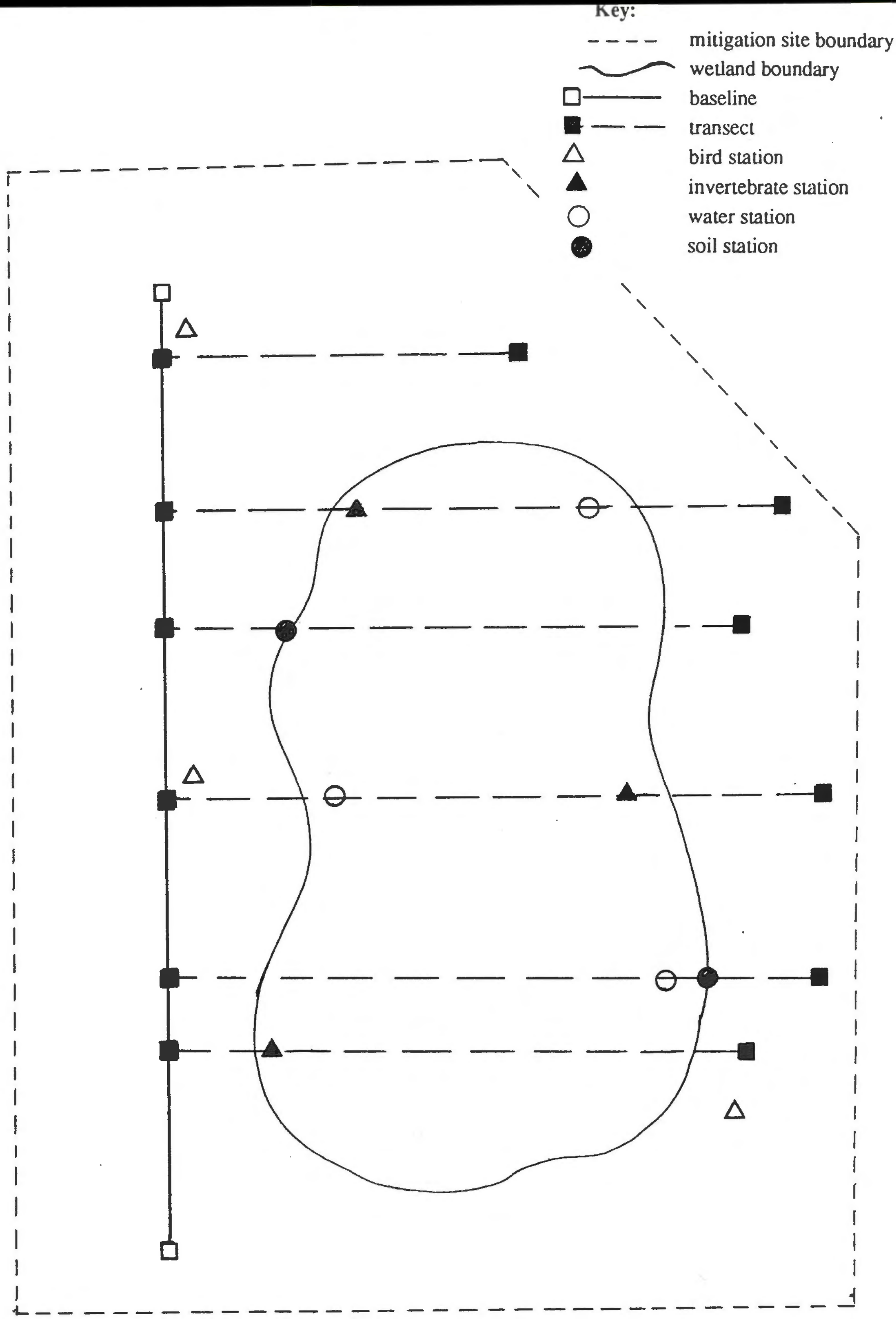

Figure 1. Baseline, transect, and sampling station placement.
(Modified from Horner and Raedeke 1989)

height. Rectangular plots measuring 0.5m^2 are established at 3m or 6m intervals (3m for transects less than or equal to 60m, and 6m for transects longer than 60m) along the transects (see Figure 3). In each plot all vegetation is identified. An estimate is made of the percent of total area within the plot that is non-vegetated and of the percent cover by each species of vegetation.

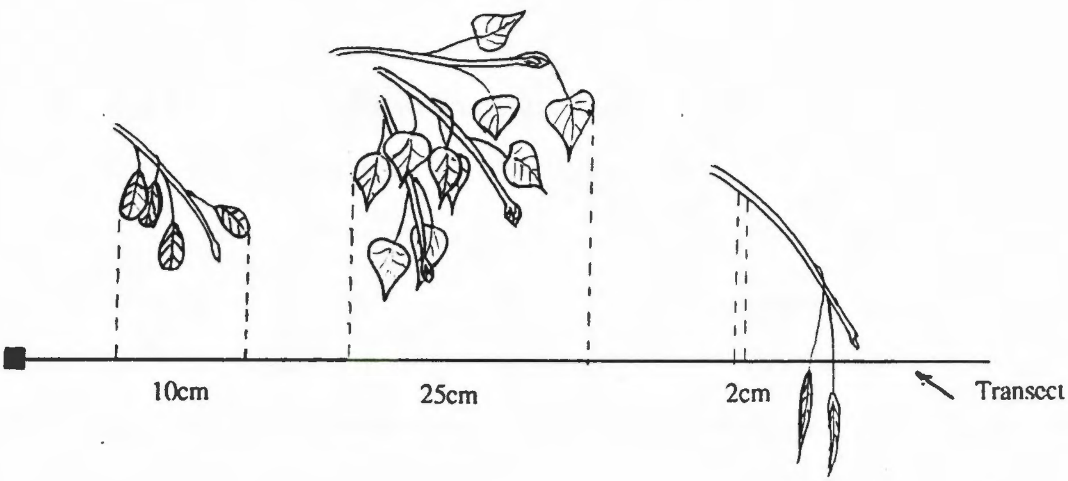

Figure 2. Line-intercept method.

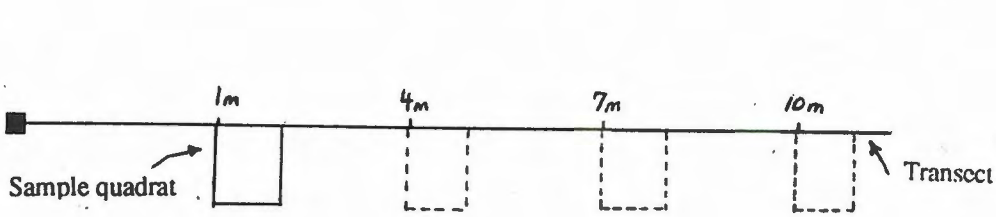

Figure 3. Canopy coverage method.

The data from the line-intercept method are computed as percent area cover. Data collected by the canopy coverage method are compiled as cumulative vegetative cover (accounts for overlapping vegetation), percent area cover by all species combined (ratio of vegetated to non-vegetated area), percent cover by individual species (a proportion of the total vegetative cover), and species richness (the total number of species sampled). The parameters used to report the results of vegetation sampling are given in greater detail in Appendix E.

Bird surveys are the primary means used by WSDOT to quantify wildlife use of a mitigation site. Three formal bird surveys are conducted annually from permanent census stations at each of the sites. The surveys take place between sunrise and noon, and are scheduled from May through June. Biologists conduct the survey by standing silently at a station for five minutes followed by five minutes of recording all bird species detected by sight or sound within 30 meters of the mitigation site. In addition to the surveys, any wildlife sign (e.g. tracks, scat), and/or sightings are recorded throughout all site visits. The bird surveys are conducted during optimal weather conditions, (i.e. little to no precipitation, and light to no wind), to ensure good visibility. The results are reported as species richness.

Benthic invertebrates (the larval form of aquatic insects residing in the substrate) are sampled on or near established transects with a standard Surber square-foot stream bottom sampler (net) in streams, and with a tube (corer) sampler in ponds (Brooks and Hughes 1988, Swanson 1978). Surber samples are taken mid-stream, and tube samples are taken in standing water approximately one meter from the shoreline. Invertebrate collection is conducted from mid-June to mid-July. Both Surber and tube samples are washed and filtered through a 0.5 mm sieve, then placed in a sample jar and preserved with alcohol for later analysis. Invertebrates are classified to order, counted, and then air dried for 3-5 minutes before being weighed. Data are reported as total individuals counted, taxa richness (number of orders identified), relative abundance (percent distribution of the taxa), and average density.

Temperature, pH, and dissolved oxygen are water quality criteria measured for each site. Measurements are made with electronic meters and all sampling is done on or near an established transect. Sampling is conducted at two or more locations, (near the inlet and outlet, if applicable), with three samples taken at each location and the results averaged. Water quality sampling is conducted during every site visit. Results are reported as a high/low range of the averages. Staff gauges (a post to which a measuring staff is attached) have been placed at some sites. The gauge is read each site visit and provides a means for monitoring changes in water level.

Soil samples are usually taken from each site during the first, third and fifth years of monitoring. Soils are analyzed for organic content and percent sand, silt, and clay. First year samples are taken from the wetland and upland area and subsequent years' samples are from the wetland area only. Soil cores are used to establish a baseline from which to document changes in soil characteristics over time.

Samples are ideally taken to a depth of 32 centimeters. Soils are characterized by hue, value, and chroma according to the Munsell soil color chart (Munsell Color 1990). Each Munsell color notation for soil matrix is given with the corresponding depth at which it occurred in the core sample.

Mitigation sites are photographed annually from permanently established photo monitoring stations as another means of documenting changes to the plant community. All slides and prints are on file at the WSDOT Headquarters in Olympia, Washington. During all visits general site conditions are noted. Presence of litter, evidence of vandalism or other signs of disturbance are recorded and WSDOT Maintenance personnel are notified as appropriate.

3.2 Evaluation of Current Methods

Overview

Three major factors were taken into consideration in the evaluation of the WSDOT monitoring program: 1) it is stated in the Implementing Agreement (Washington State Department of Transportation and Washington State Department of Ecology 1993) that a monitoring program "...must include measures of vegetation, hydrology, water quality, soils, and wildlife over time"; 2) WSDOT monitors its created wetlands out of compliance with mitigation requirements and to measure the success of the wetland in meeting the goals set for the site; and 3) the high number of mitigation sites that must be monitored within a relatively short amount of time (less than five months) limits the complexity of sampling methodology that can be undertaken.

The first factor is important in that it sets the basic sampling parameters that must be included in the monitoring. Although the current program does provide these measurements, the collection of the data is not focused. Each task, whether sampling water quality or estimating percent cover for vegetation, is seemingly isolated from the next task. The lack of continuity is apparent in the annual report where the data are reported yet very little analysis or discussion is offered to integrate the results of each task.

This is reflected in the second factor: WSDOT monitoring is motivated by the need to satisfy regulations, not research needs. The current level of monitoring reflects what have typically been general goals and broad-based objectives set in the mitigation plans developed for each site. Although by 1991 WSDOT mitigation plans were beginning to set more specific requirements for tracking the success of its created wetlands, the advent of the Implementing Agreement in 1993 provided a standard for mitigation plans to follow in which goals and objectives for the wetland mitigation site are more clearly defined.[6] Objectives now identify specific actions to take that will show a wetland

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[6]The 1993 Implementing Agreement between the Washington State Department of Transportation and the Washington State Department of Ecology Concerning Wetlands Protection and Management was drawn up as a supplement to the 1988 Memorandum of Understanding between the two agencies. The Implementing Agreement specifically adresses issues concerning wetland protection with regard to WSDOT construction projects. Refer to Appendix D for the section that gives the guidelines for wetland mitigation plans.

function is being provided by the mitigation site, and performance standards have been added as a means to evaluate whether the objectives have been attained.

To illustrate, the goals set for a wetland created in 1989 were to encourage the revegetation of native species through planting, and to create the wetland functions of flood storage, sediment trapping, food chain support, and fish and wildlife habitat. Success was to be determined by the attainment of 90% vegetative cover of the site by its fifth year.[7] In contrast, a mitigation plan developed for a created wetland constructed in 1994 gives as its goals the "successful duplication of a functioning stream system and creation of a wetland/riparian zone to enhance stream values."[8] The objectives are to "create improved habitat structure to support and enhance fish use, ...[through] providing shelter, erosion control, and areas for spawning," and to "create a wetland/riparian zone along the creek that enhances and protects stream values." The criteria given to meet these goals and objectives require measurements of invertebrate and vegetative production and documentation of the presence of in-stream habitat structures. The measurements will provide a means by which to assess whether the stream and surrounding riparian zone are providing food, shelter, erosion control, and spawning habitat. The criteria further specify distinct percent vegetative cover requirements for three

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7 SR 167: South 180th Street to SR 405, Northbound HOV Lane, L-8612, Wetland Mitigation Plan. Unpublished document prepared for Washington State Department of Transportation, 1987; pp. 9. Olympia, Washington.

8 Barbara Aberle and Scott Clay-Poole. Wetland Mitigation Plan: 208th Street SE to 164th Street SE, SR 527. Unpublished document prepared for Washington State Department of Transportation, July 1992; pp. 9. Olympia, Washington.

different vegetative zones, minimum number of vegetative species for each zone, and the percent of overall vegetative cover for each zone that must be comprised of native Washington species.

The third factor, an increased number of mitigation sites with commensurate increases in workload, is creating a situation where a limit is being reached as to what can be physically accomplished in one season by the WSDOT biologists available to conduct the monitoring. Time constraints, available work force, and monetary limits all combine to affect the level of sampling that can occur.

Problems with Current Methods

The major problems center on how to revise the sampling methodology for vegetation in a manner that will provide specific (and separate) information on wetland and upland zones, yet not entail significantly greater expenditures of time. Currently vegetation sampling is the most time intensive task, requiring a minimum of one day in the field to conduct the sampling and from an average of five to more than eight additional hours devoted to identifying plants that were not known in the field. Other problems include a lack of standardization in number and location of samples collected (soil and water), unavoidable bias in collection (invertebrates), or need for additional sampling (wildlife). In all cases more emphasis on analysis of the data and evaluation of results is needed in the annual report. The following list highlights the major areas needing change in the monitoring methods in order to satisfy the more stringent standards of success now being applied to WSDOT mitigation sites.

Vegetation:

1. Current methods combine vegetation data for upland and wetland zones; a different methodology is needed to characterize each vegetation zone.

2. A boundary must be established to distinguish between wetland and upland zones; however, standard delineation methods which require indicators of hydric soil, wetland vegetation, and hydrology cannot be easily applied to newly constructed mitigation sites. Soils may be entirely from another area or mixed with existing soil, and wetland vegetation may or may not yet be established.

3. The number of sampling plots range from 45 to 80, averaging 65 plots per site; not only are the time costs high for this level of sampling, but the degree of information yielded may be far greater than is necessary. Number of plots needs to be reduced for greater efficiency but equal effectiveness.

4. Sample plots are 0.5 m^2, which may be too small to avoid the effects of vegetation clumping.

5. There has been a lack of consistency on what constitutes bare ground. An area of ground shaded by the canopy of a tree, yet

otherwise devoid of vegetation, has been interpreted as vegetated or non-vegetated by different biologists conducting the monitoring. Hence, the areal cover of vegetation reported for a site, which is calculated by subtracting the total estimated percent of bare ground from 100%, may show greater fluctuation from year to year than is actually the case. A standard protocol is needed for reporting bare ground.

6. Inaccuracies in reporting the percent vegetative cover of a site may be further compounded by the following:

   a) total sampling area for a site is not calculated,

   b) open water areas (loosely defined in WSDOT monitoring as areas of non-vegetated water) that fall within a transect are included in bare ground calculations,

   c) transect length varies both within and between sites; there is no standard protocol for how far back from the water's edge to extend the transects.

   Therefore two sites approximately the same size that have equal areas of open water but different transect lengths may reflect vastly different values for percent cover of vegetation. Standard protocol is needed for each of the above.

7. As-built grading and planting plans have not been considered in the yearly analysis; as-built plans show the site as it was actually constructed, giving the final grading and configuration of the wetland, and the actual numbers and species of vegetation planted. Many of the more recent mitigation plans are requiring

that the percent survival of planted species be reported; the final planting list is necessary for these calculations.

Wildlife:

Current bird survey sampling methods are generating sufficient data for analysis, however these surveys are the only formal method used for assessing wildlife use of the site.

Invertebrates:

Current sampling methods are limited to sampling for pre-emergent aquatic invertebrates and presence (and quantity) or absence of taxa are affected by seasonal timing of sampling. Both factors may introduce bias resulting in an inaccurate representation of taxa.

Soil:

Soil sampling for Munsell color characterization and organic content analysis varies in the number of samples collected from each site, where the sampling takes place, and how often sampling occurs (i.e. annually, every other year, first and last year of monitoring, etc.). A standard protocol should be adopted.

More recent mitigation plans have called for measuring sediment accumulation within the created wetland, but do not specify objectives; monitoring for sediment accumulation unrelated to a specific objective may not provide useful information.

Water:

The number of water samples collected varies from site to site; a standard protocol should be followed.

Staff gauges should be installed at all sites except those that are tidal influenced. Currently measurements of water level fluctuations are only taken during late spring and summer months which is not adequate to provide an accurate picture of site hydrology.

4. <u>Developing Recommendations for the Monitoring Program</u>

Federal, state, and local agencies are involved in various aspects of issuing permits for WSDOT projects involving impacts to wetlands. The annual monitoring report provides a primary means for the agencies to evaluate whether the terms of the permits are being satisfied. Environmental personnel in the U.S. Army Corps of Engineers (Corps), Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS), Washington State Department of Ecology (Ecology), and King County Surface Water Management (SWM) were interviewed for their input on current WSDOT monitoring methods, the perceived problems with, and proposed changes to, the methods, and the content and format of the annual monitoring report. A WSDOT landscape architect involved in mitigation site design was contacted specifically for input regarding the content and format of the annual report.

In addition to the informational interviews conducted with the above named agencies, two recent EPA studies on monitoring methodology were examined for applicability to the WSDOT monitoring program. Agency comments and a summary of the two studies are given below.

4.1. Interviews with Environmental Specialists within the Regulatory and Resource Agencies

U.S. Army Corps of Engineers[9]

McAuliffe and Walker (1994) suggest that newly constructed sites should be left unplanted for at least one winter to assure that the water depths are what were called for in the site design. Water levels should then be staked at the time of site inspection. The wetland boundary on newly constructed sites may be initially established based on the water level present at that time. This point should be staked on each transect line. Sample plots should then be differentiated by whether they fall within the buffer, the wetland, or the edge where the two zones meet. Each year should be analyzed as to the change in vegetation (and water level) with relation to the original staking. This way perhaps some correlation can be made between the success of the plantings and the particular water level.

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[9] The Corps of Engineers is responsible for granting Section 10 (Federal River and Harbor Act of 1899; 33 USC 401 § 10) and Section 404 (Ammendments to the Federal Clean Water Act of 1977; 33 USC 1344) permits for construction activities in navigable waters of the state and dredge and fill activities in all waters of the state, including wetlands. Refer to Appendix A for more detail on the Corps' role in Section 10 and Section 404.

McAuliffe suggests that sites should be considered for revegetation through natural recruitment (i.e. not planting a site) only when there is a wetland system nearby that has the type and quality of plants desired in the newly created system. He cautions that high mortality of some species may be due to WSDOT attempting to jump into a successional stage that is out of sequence, that is, WSDOT is attempting to create a mature vegetative community that bypasses the earliest successional stages. He suggests that WSDOT avoid planting understory species, (species that prefer shade during early growth), and focus instead on establishing fast growing, early successional stage species such as alder, cottonwood, and willow. Planting of the understory may be phased in after the overstory has had a chance to become established. McAuliffe believes that if WSDOT can successfully establish hydrology on the site that "...the rest will follow."

McAuliffe and Walker suggest that more control is needed over the top soil that is applied to the site. Soil brought in from other areas may be a major source of invasive (undesirable) species. Water levels should be checked seasonally, not just during the summer monitoring. If the water level is monitored according to how it was initially staked out, and monthly records are made of water level fluctuations by using staff gauges, McAuliffe does not see the need for more detailed hydrology measurements. Seasonal monitoring will provide information that can then be related to the development of hydric soils on the site. Combine this data with the results of Munsell soil color designations to determine change in soil characteristics. Tests for sand/silt/clay composition only need to be done at first and final monitoring, and organic matter buildup can be monitored adequately on site visits by manual measuring.

McAuliffe and Walker say the Corps would like the annual reports (hence the data) to reflect the successional stages of the vegetation over the five year monitoring period, specifically with respect to which species are invading. This information could be analyzed with respect to the degree of saturation on site. Regarding the format of the annual report, the Corps would like to see the wetland mitigation sites grouped according to geographic location.[10] Each section should include all the data analysis and site specific information (i.e. bird surveys, soil/water charts, etc.) for those particular sites. The background, goals, objectives, and standards of success (as stated in the mitigation plan) for each site should be clearly stated in each annual report.

At the end of the final monitoring year, McAuliffe and Walker would like to conduct the close-out evaluation of the site from two angles: 1) if WSDOT didn't meet the objectives, is some level of remedial action necessary? and 2) if WSDOT got something different than what was planned, does it work? These will be taken into consideration in the overall evaluation. McAuliffe states that from the Corps' standpoint (as a regulatory agency) it doesn't do WSDOT any good not to recognize what isn't working, especially since the Corps will figure it out sooner or later. He mentions that it is important to

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[10] Author's note: geographical grouping would be most readily accomplished by grouping according to WSDOT District.

note that WSDOT is already ahead of the game because it does monitor its mitigation sites and is consistent with turning in an annual report. McAuliffe and Walker feel that it is more important that WSDOT work towards achieving stability of hydrology within its created wetlands than that it achieve a particular successional stage.

Environmental Protection Agency[11]

Storm (1994) echoes the Corps by citing the importance of separating vegetation sampling between the wetland and the upland zones. Storm suggests that sampling be set in such a way that both the wetland and the upland have permanent plots established, but that the edge between the two have fluctuating plots. This will provide a means by which to gauge changes in the vegetative edge of the wetland. Storm agrees with the Corps that the wetland boundary should be staked initially and change over time noted. Storm feels that the current level of vegetation sampling is satisfactory. She believes that it is important to identify species down to the 1% cover category and to state how many species fall under 1% vegetative cover.

Storm comments that the regulating and resource agencies, and WSDOT, seem institutionally stuck in trying to introduce out-of-step succession of vegetative communities in an effort to beat out the invasive, undesirable species. This is not to suggest that WSDOT should discontinue planting overstory species; it is important to

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[11] EPA has the authority under Section 404(c) (Ammendments to the Federal Clean Water Act of 1977; 33 USC 1344) to veto permits authorized by the Corps. Refer to Appendix A for more detail on EPA's role in Section 404.

establish a canopy for various factors such as shading and/or cover for fish, invertebrates and other wildlife. One strategy to increase the chances of survival of overstory species would be to plant larger trees instead of seedlings. A point to consider is that WSDOT (and the other agencies) must look at the limitations of developing wetlands in urban environments. Storm recommends that the annual report should reflect more of what has been learned- specifically, what worked and what didn't. She suggests that when WSDOT changes its views regarding wetland mitigation (i.e. places higher value on it) that it will find it has better attainment of its goals and objectives for the individual sites.

U.S. Fish and Wildlife Service[12]

Stellini (1994) suggests that more discussion be made of the area beyond the boundary of the wetland. Specifically, the wetland buffer and surrounding land uses, and the effect that these areas may have on the functions of the wetland. She points out that there needs to be a better accounting of area and dimensions of the site itself; the as-built site should be surveyed. She suggests that water quality monitoring (parameters) should be kept simple, that it is not realistic to try otherwise due to the constraints on the time WSDOT is able to commit to water quality monitoring. Stellini emphasizes that without recommendations for on site manipulations or corrective actions to

[12] Under the Fish and Wildlife Coordination Act of 1958, (33 USC 66.662), USFWS (and the National Marine Fisheries Service) must be consulted regarding any federally permitted projects (e.g. Sec. 404) that may have an impact on fish and other wildlife species (Office of Technology Assessment 1984). Refer to Appendix C for the primary regulations affecting WSDOT projects.

improve site functioning, or recommendations for future changes to mitigation site planning and design, WSDOT will not progress in its mitigation endeavors. More specifically, analysis that is not translated into management action is useless, and is wasted effort on the part of WSDOT.

Washington State Department of Ecology[13]

Hruby (1993) recommends conducting separate vegetation surveys for wetland and upland zones, noting that this will yield information critical to analyzing the development of the mitigation sites. He suggests that the vegetation analysis should focus on the percent areal cover of the site and that only those species registering over 5% vegetative cover of the wetland or upland zones be included in the species list. Also, each species should be listed individually by percent areal cover (instead of as a proportion of the total cover) in order to get a more accurate picture of the composition of total vegetative cover. He suggests that the parameters of cumulative herbaceous cover and percent of total herbaceous cover currently presented in the annual report are not necessary, i.e. they do not aid in the level of analysis currently applied. Hruby further suggests that too much detail is currently applied to the vegetation surveys; specifically, that the current resolution of sampling (high number of sample plots, and identification of all species, even to under 1% cover) does not match the resolution of the data collected for other monitoring tasks. Hruby

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[13]Ecology is responsible for implementing various federal, state, and local regulations regarding wetlands. Refer to Appendix C for the primary regulations affecting WSDOT projects.

points out that because hydrology is a critical factor in establishing a successful wetland, greater emphasis should be placed on monitoring the site hydrology.

Hruby recommends conducting organic content analysis only in the fifth (or final) year of monitoring, based on the assumption that organic content would likely be less than 5% on a newly constructed site. He suggests taking ten random samples from within the boundary of the wetland and mixing them together before performing the analysis. Hruby feels that bird surveys are significant and should be continued. Also, that the addition of spring amphibian egg mass surveys would provide greater depth to assessment of wildlife use of the mitigation site. Analysis of invertebrate samples should focus more on the identification of indicator species (species having the greatest sensitivity to changes in their environment) than on the percent distribution of the various taxa identified. Hruby notes that because presence or absence of different invertebrate taxa is seasonally dependent, sampling on or around the same date each year (which will not necessarily correspond to the same time of season from year to year) may be prone to error.

King County Surface Water Management[14]

Miller (1994) believes that surveying/recording as-built conditions is key to tracking the performance of the wetland mitigation project.

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[14]Local agencies share responsibility with Ecology for permits required under the State Shoreline Management Act and the Floodplain Management Program; see Appendix C.

Miller asserts that collection of data that will not be used is a waste of effort; monitoring should be tailored to the particular site. Specifically, WSDOT should do what is necessary to meet the goals and objectives set for the individual site.

Miller emphasizes that survival of planted species cannot be calculated without as-built planting plans. (The actual number and species planted are often dependent on what is available from the nursery at the time of planting, and hence may differ significantly from the original plans.) Miller suggests using the following method to estimate planted species survival in the first monitoring year. Divide the site into quarters (encompassing roughly equal areas of vegetation) and walk transects that encompass the length of the quarter. Sample a minimum of 10%, or 100 plants total for each species, (twenty-five plants per quarter if plants are evenly distributed in each area), and record each plant encountered as live, dead, or stressed. Miller thinks that if there is a high level of survival in the first year it will give a good idea of survival after five years. She also feels that it is important to keep track of the invasive and volunteer species. Miller recommends that hydrology measurements using staff and crest gauge be taken monthly throughout the year.

King County Environmental Division[15]

Richter (1994) was consulted specifically for his expertise concerning amphibians. WSDOT is considering designing some of its wetland mitigation sites specifically to provide amphibian habitat. The addition of amphibian spawn surveys to the monitoring program would provide WSDOT with a means to document the success of this endeavor.

Richter's research has shown him that amphibians are very selective in where they spawn. He sees amphibians as the critical link in a healthy wetland, citing that amphibians eat invertebrates, and fish, mammals, and birds eat the amphibians. He has found that *Ambystoma gracile* (Northwestern salamander) is a good indicator species, meaning that if this amphibian is present, then the habitat provided is of a quality that will support many other species.

Richter also states that hydrology is the driving force behind the presence or absence of amphibians, seconded only by the presence of vegetation of a specific stem diameter which will support amphibian egg masses. Richter has found that breeding Northwestern salamanders prefer water depths of 30 to 40 cm., plant stem diameters of 3 mm (e.g. a rush), and relatively stable water levels throughout the embryonic stage.

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[15]The King County Environmental Division is not linked to WSDOT as either a regulatory or resource agency.

With reference to hydrology, Richter is somewhat adamant that WSDOT wetlands cannot be everything, that it may not be reasonable to expect stormwater capacity, wildlife and emergent vegetation all in one wetland. He points out that because of the degree of water level fluctuation, flood storage and sediment trapping functions with regard to many WSDOT created wetlands (e.g., smaller, steep sided sites with open water ponds) are diametrically opposed to wildlife habitat function. WSDOT should decide which functions are most important and then target those desired functions through the objectives for the mitigation site.

Washington State Department of Transportation

Mabry (1994), a landscape architect for WSDOT, points out that the "percent herbaceous species" figure in the annual monitoring report means very little to her if she does not know the as-built conditions for vegetation. She cannot know if a particular planted species is succeeding without knowing how many were planted in the first place. Mabry points out that although she specifies quantities and species in the final plans, the contractor may need to make last minute substitutions. Knowing the final contours and grading as well as post-construction conditions of the mitigation site, (such as compacted soil due to heavy equipment on site, or vegetation planted incorrectly), is important to Mabry, as all are factors that can affect the success of the site. With this information better conclusions may be made as to whether site design, construction conditions, or plant selection are affecting the success of the planted species.

4.2. Review of Two EPA Studies of Monitoring Methodology

Two of the more recent studies on wetland monitoring methodology have been conducted by Kentula et al. (1992) and Magee et al. (1993). The central strategy presented by Kentula et al (1992) is in the comparison of created or restored wetlands to natural wetland systems. Kentula et al. (1992) outlines three assessment levels for monitoring: 1) the documentation of as-built conditions, 2) routine assessments, and 3) comprehensive assessments. The latter two differ in the level of the data acquired. Routine assessments entail visual estimation of vegetative cover, surrounding land observations, wildlife seen during the visit, and water depth taken from a staff gauge. Comprehensive assessment involves a more intensive monitoring of parameters and should not take place until the wetland has had a chance to settle somewhat; specifically that the vegetation has had a chance to become established and the substrate has stabilized (3-5 years for emergent wetlands).

Among the recommendations presented in this study are that comprehensive monitoring be done according to a standard protocol, that sources of error should be acknowledged, and that the methodology used be replicable for scientific defensibility. Kentula et al (1992) suggest that basic information concerning the created wetland include its position in the watershed; slopes, water depth, and total area; and adjacent land use. One of the central points made in this study is that the data generated from created wetlands, and its analysis, should be used to evaluate and improve the design of current or future projects.

The study conducted by Magee et al. (1993) provides a protocol by which detailed characterizations can be made of natural, created, or restored wetlands within an urban environment. Included are methods for performing general site characterizations, establishing site elevations, vegetation sampling, and soil and hydrologic characterization. The methodology is designed to be carried out in a single site visit by a crew of eight people. Data analysis focuses on characterizing the study wetland and evaluating it in comparison to a natural wetland.

The primary aspect of the Kentula et al. (1992) study incorporated into the recommendations proposed in this paper is the message that an underlying strategy is needed for any monitoring program; specifically, that the data and data analysis generated from the various monitoring tasks be applied to future wetland mitigation planning. The Magee et al. (1993) study provided useful information regarding general site set-up activities, site mapping, and baseline and transect placement.

5. Recommendations

The following recommendations for changes to the WSDOT wetland monitoring program have been compiled from feedback on the program given by regulatory and resource agencies, a review of two recent EPA studies of wetland monitoring methodology, and the author's observations from three years of conducting the WSDOT monitoring program. These recommendations have been incorporated into the existing methodology adopted from the Monitoring Guide (Horner and Raedeke 1989).

Specific methodology proposed regarding transect number and spacing, number of sampling stations and station location, number of sample plots for vegetation and plot size, and number of soil and water samples, was also developed through information garnered from the above mentioned resources. The figures given are proposed with the purpose of promoting standardization within the WSDOT monitoring program, as well as providing a means by which to most efficiently gather the level of data necessary to comply with permit and mitigation plan requirements. It is expected that refinements may be made to the proposed methodology after field testing; however, a systematic testing of the methodology and a more in-depth comparison to existing monitoring methods will be necessary to test validity.

5.1. Methods

<u>Pre-site visit preparation</u> -critical to keeping track of the tasks required for each site

1. Each site should have a checklist of specific monitoring requirements and the years in which they are to be conducted or completed should be clearly stated. This sheet will provide the

tracking system for the individual site for the duration of its monitoring.

2. Monitoring folder for each site should include:
   -final mitigation plan
   -as-built grading and planting plans
   -summary sheet listing goals, objectives, and standards of success as designated in the mitigation plan
   -aerial photographs (ideally 1st and then final year of monitoring)
   -vicinity map and directions to the site

<u>Site set-up</u>

1. Baseline
   -baseline set parallel to flow or to the longest side of the wetland and set 15-20 m into the upland from wetland perimeter (using water's edge)
   -baseline should extend at least 5 m beyond either end of wetland perimeter

2. Transects
   -transects should be established at evenly spaced intervals perpendicular to baseline
   -transects should extend at least 15-20 m into the upland beyond the wetland perimeter
   -establish 5 transects for wetland under 5 acres
   -8 transects for wetland between 5-10 acres

-add transects only as needed to adequately characterize wetland for sites greater than 10 acres

2. Wetland boundary

-mark wetland boundary (wooden stake) on established transects; use vegetation and hydrology to determine boundary

-record changes (if any) in boundary each year of monitoring

3. Mapping

-complete a summary vegetation community data sheet for each site prior to beginning the vegetation surveys (see sample data sheet, Figure 4); this information will supplement vegetation data collected through the sample plot surveys

-data sheets should include:

- -surrounding land use
- -percent area covered by open water, and herbaceous, scrub-shrub, and forested zones
- -percent cover estimates for dominant vegetation (20% or greater dominance of all species within each stratum)

-create a map for each new mitigation site; include:

baseline/transect locations and locations of bird, invertebrate, soil, and water sample stations (this is done under current monitoring program, see Figure 1, p. 12; refer to Figure 5, p. 41 for recommended change in placement of baseline, transects, and vegetation sample plots)

Vegetation Community Summary Data Sheet (complete for entire site)

Date________ Site Name________________ Observer________________

Wetland _____%
_____% open water
___% unvegetated
___% submerged aquatics
= 100%

____% vegetated
___% trees
___% shrubs
___% herbaceous
= 100%

____% unvegetated
= 100%

Upland _____% =100%
_____% vegetated
___% trees
___% shrubs
___% herbaceous
= 100%

____% unvegetated
= 100%

Dominant Vegetation (% of total vegetation)

______________________ ___%
______________________ ___%
______________________ ___%
______________________ ___%

Dominant Vegetation

______________________ ___%
______________________ ___%
______________________ ___%
______________________ ___%

Make a rough sketch of site; show open water, wetland, and upland; indicate general location of dominant wetland/upland communities. Note surrounding land use and/or give description on back.

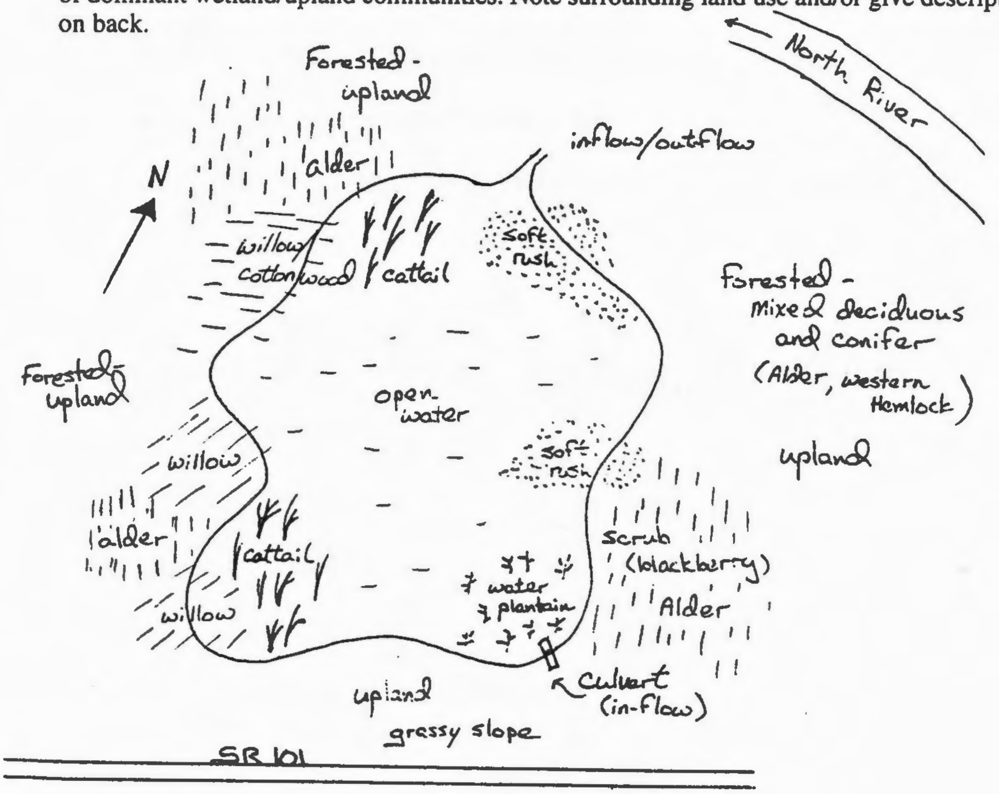

Figure 4. Vegetation community summary data sheet.
Modified from Magee, et al. (1993), and Horner and Raedeke (1989).

-use aerial photographs to make estimates of wetland area at conclusion of final year of monitoring

Vegetation

1. Continue using line-intercept method (Canfield 1941) to provide a measure of woody vegetation greater than 1 meter

2. Sample plots (see Figure 5 for recommended placement of baseline, transect, and vegetation sample plots)
-increase sample plot size from 0.5 m^2 rectangular quadrat plots to 1.0 m diameter circle plots to sample herbaceous vegetation (including emergent vegetation) in wetland and upland areas; increased plot size will help reduce affects of vegetation clumping
-15-30 plots within wetland are adequate to characterize vegetation
-locate plots tangent to transect line
-locate first wetland plot 1 m in from staked wetland boundary, transect length at that point is recorded; this becomes a permanent plot
-successive plots are located at 3 m intervals until open water (non-vegetated) equals greater than 50% of the plot area
-the number of wetland plots will fluctuate over the duration of the monitoring; tracking this will result in a better assessment of how the wetland is developing/changing

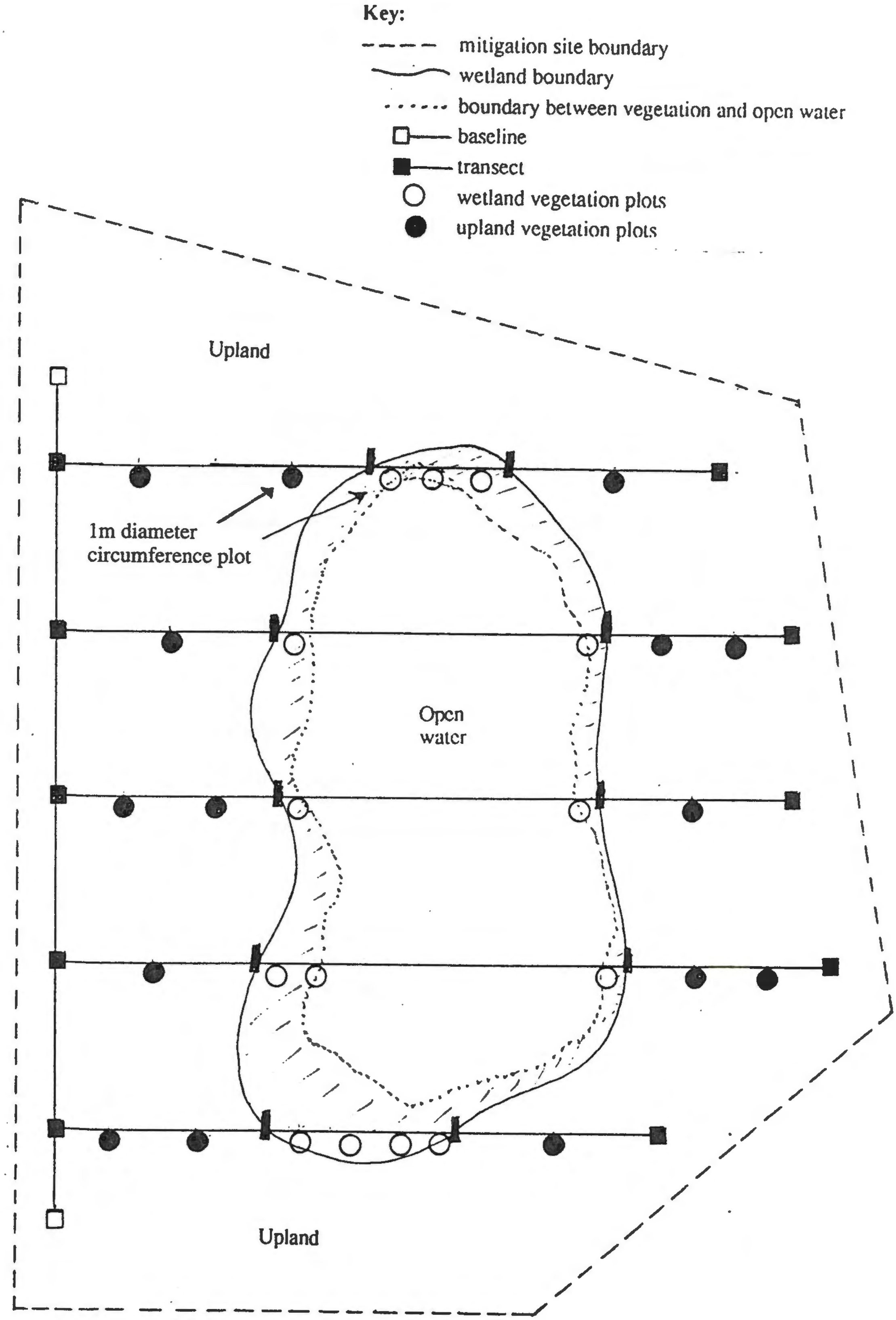

Figure 5. Recommended placement of baseline, transects, and sample plots

-15 plots in upland are adequate to characterize herbaceous vegetation community (more plots may be necessary for sites over 10 acres)

-alternate between 1 and 2 plots per transect per side so that each transect will have a total of 3 upland plots sampled

3. Assessing survival of planted species

-stem counts and visual estimation for planted emergents in the first year, and visual estimation for subsequent years

-stem counts and visual estimation for shrubs and trees in all years of monitoring

-use following method to conduct stem counts:

-divide the wetland into quarters

-walk each quarter in parallel transects lengthwise

-count 25 plants each planted species in each quarter

-record each planted species encountered as live, dead, or stressed

-percent survival for total species planted will be extrapolated from these sub-samples

4. Bare ground

-unvegetated areas will be recorded as bare ground regardless of the presence or absence of tree canopy or the presence of water at depths of 1m or less; however, note should be made if the plot is located under a canopy cover greater than 1m in height (presence or absence of water is automatically recorded)

5. Open water

-open water will be defined as any area of standing water greater than 1m depth that is either devoid of vegetation or containing only submerged aquatic vegetation.

Wildlife

1. Bird surveys

-3-5 stations per site, or as many as necessary to observe maximum area

-begin with 5 minute wait, followed by a 5 minute survey

-select stations where greatest area can be observed, yet observer is as hidden as possible (this will be difficult on most new sites)

-provide more extensive evaluation of data in the annual report; integrate results with those from the other sampling parameters

2. Wildlife sign

-note wildlife sign on all visits

-relate sign to habitat and other sampling parameters

3. Habitat structures

-record in first year, then any changes thereafter

-note root wads, stumps, downed trees, snags, rock piles and any other structures, and locations

-relate to expected or observed wildlife in evaluation

4. Amphibian spawn (egg mass) surveys -proposed addition to 1995 monitoring

   -conduct surveys March-April

   -walk perimeter of wetland; identify and measure egg mass, describe structure on which eggs are attached, and record depth from water surface and depth to substrate

Invertebrates

1. Sampling

   -maintain current collection methods: Surber net sampler for streams, tube/core sampler for ponds

   -take 3 samples per wetland; combine samples prior to identification

   -if wetland has both stream and pond components, take one set of 3 samples in each area

2. Identification

   -take a sub-sample (1/2) of the combined sample

   -identify to the taxonomic level of order

   -more specific identification to family or genus level is not necessary for the level of analysis that will be conducted, and should only be done in response to specific goals stated in the mitigation plan

Soils

1. Assessing for hydric conditions

   -take sample soil cores in years 1, 3, and 5

   -3 cores at the wetland boundary on designated transect lines

   -core to at least 30 cm.

   -use Munsell soil color classification to characterize soil; record depth for each change in soil hue/value/chroma

   -record mottle color, percent of matrix

   -note general texture of core- sand, silt, clay, etc.

2. Soil texture analysis and organic content analysis (loss by ignition method) in years 1 and 5

   -3 cores from wetland -combine

   -3 cores from upland -combine

3. Sediment accumulation

   -clear objectives should be stated, e.g.: obtaining an ideal or target accumulation rate (a function of water velocity); comparison of rates between mitigation site and a reference site; establishing a relationship between rate of sediment accumulation and some other factor such as surrounding land use, or presence or absence of vegetation in the wetland

   -recommend not monitoring for sedimentation in absence of specific goals/objectives

   -if measuring sediment accumulation is specified in the mitigation plan as a requirement, follow methods outlined in

Horner and Raedeke (1989) for sediment trap construction and placement within the wetland

Water

1. Current methods provide basic measures of water quality
   -continue to measure pH, temperature, and dissolved oxygen (DO) each site visit
   -record sampling times
   -3 sample stations: in-flow and out-flow (where applicable), and one location near mid-point of wetland; locate sampling stations on or as near to a transect line as possible
   -3 measurements at each station; results are averaged

2. Monitor water level from staff gauges on a monthly basis throughout the year

5.2 Annual Monitoring Report

In its ideal form the annual monitoring report should present the results of the summer's monitoring, provide discussion as to whether the goals and objectives for each mitigation site are being met, and give an explanation of how this is occurring. In addition, the report should provide recommendations for remedial or other necessary actions for a particular site; e.g. replacement of dead or dying plants, or closing off an access point for trespassers and/or vandals, or placement of an interpretive sign for a site in a highly urbanized area.

Currently the annual monitoring report presents the data with a moderate level of analysis, but relatively little to no discussion of the results. This may be due in part to a perception by WSDOT that reporting the data shows that the monitoring has been carried out, thereby fulfilling its obligations under the terms of the permits. A complicated sampling regime is not necessary for WSDOT to show that a created wetland is providing wildlife habitat, food chain support, flood storage, or sediment trapping functions. What is needed is a commitment to undertaking a discussion of the results. Recommendations for additions and changes to the data analysis and discussion sections of the annual report and to the report format are presented in the following two sections.

<u>Data Analysis and Discussion</u>

Vegetation

1. Report the total area sampled for the entire site as well as for the individual vegetation zones (or as required in the mitigation plan). Calculation is made by taking the total number of plots sampled and multiplying by the area of a single plot. This figure should then be related as a percent of the total area of the mitigation site. Calculations of the percent vegetative cover for a site will be more accurate when stated in terms of actual area sampled rather than for the entire site.

2. Percent vegetative cover of the herbaceous layer should be calculated for the entire area sampled and for each zone, (wetland

and upland at minimum). As described in Appendix E, percent of herbaceous vegetative cover for the area sampled is derived by subtracting the total sampled percent of bare ground (unvegetated area) from 100%.

3. Discussion of percent vegetative cover for the herbaceous layer should include percent cover by tree and shrub species for a better characterization of the site; i.e. how much overlap is there in the upland? In the wetland? Percent cover by wetland species should be discussed in relation to presence of water, depth, and seasonal fluctuation.

4. "Percent of total herbaceous cover," as currently termed in the annual report, could be more accurately renamed "relative dominance" (Lewis 1990), which would reduce confusion between this parameter and that of percent vegetative cover for the herbaceous layer. Calculated for each species, relative dominance is a measure of the abundance, or dominance of a species relative to all other species present. Relative dominance is calculated by dividing the mean percent areal cover of an individual species by the total mean percent cover of all species.

5. Relative frequency is a measure of the relative distribution of an individual species over the sampling area. It is calculated by dividing the frequency of an individual species (the number of plots containing that species divided by the total number of plots) by the sum of the frequencies of all species. Adding this parameter

to those already established in the annual report for evaluating vegetation could over time provide valuable information on the rate of spread of a planted species.

6. Relative dominance and relative frequency of species should be reported by vegetative zone. Over several years monitoring these figures could be evaluated with hydrologic data (water depth, duration, and fluctuation), or other factors such as type of soil brought on site, or site design (contours, slope). This information could be analyzed to help select planted species most likely to survive under a particular set of conditions, or which planted species can best withstand competition from invasive or undesirable species.

7. Species richness as reported in the annual report is the total number of species encountered within the sample area. This figure should be given for the wetland and upland areas and change over time noted. Species richness combined with the other parameters can be used to track invasive species and change in diversity of vegetative communities over time.

Wildlife

1. Bird surveys provide an efficient and effective means of assessing a wetland's value as wildlife habitat (Council on Environmental Quality 1972, Horner and Raedeke 1989). Current WSDOT methods generate sufficient data for evaluating habitat value. Discussion of birds should include possible relationships to habitat

structures (cavity dwellers), vegetation (availability of cover, habitat diversity, availability of forage), invertebrates (insect eaters, or bottom feeders), size of the wetland, amount of open water, and surrounding land use (urban, rural). The discussion should also mention those species positively identified as breeding on site (i.e. observations of nests or nesting activities, adults carrying food, presence of young) specific to either the wetland or upland areas. These same factors can be used to make inferences about the site's potential for providing habitat for other wildlife species.

2. If amphibian egg mass surveys are to be added to the WSDOT monitoring program, rough estimates of the adult population for each species identified can be made from the number of egg masses found (Richter and Wisseman 1990). Amphibians readily absorb chemicals through their skin, hence the fact that they are in constant contact with either water or soil makes them especially sensitive monitors of their environment (Richter and Wisseman 1990). The presence or absence of amphibians can be related to the relative stability of a wetland; in a study on amphibian distributions in the Puget Sound area of Washington State, Richter and Azous (1994) found that one of the limiting factors on amphibian species richness was a high degree of water level fluctuation. Discussion of amphibians in the annual report should be tied into results of hydrologic monitoring.

Invertebrates

Invertebrate sampling is becoming more common as a means to assess water quality (Rosenberg and Resh 1993, Resh and Jackson 1993) and the general health of riparian and other freshwater systems (Richter and Wisseman 1990). Three taxa of aquatic invertebrates are considered to be less tolerant of poor water quality than other aquatic invertebrate taxa: the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (Resh and Jackson 1993, Reice and Wohlenberg 1993). Analysis and discussion of invertebrate data should focus on the distribution of these three taxa relative to that of Chironomidae (midges, considered more tolerant of pollution), the rationale being that a relatively even distribution of the taxa reflects a non-stressed habitat while an imbalance may indicate a stressed habitat (Resh and Jackson 1993). Because this monitoring task is particularly susceptible to a high degree of error as conducted within the scope of the WSDOT monitoring program, analysis should be kept to the simplest level: taxa richness and relative distribution of taxa. Major sources of error include: seasonal variations in abundance and distribution, sample size, method of collection, and that different life stages of a single taxa can be easily mistaken for different taxa (Rosenberg and Resh 1993, Resh and Jackson 1993). Also, weight measurements should be discontinued. Current methods used by WSDOT introduce too much error for the measurements to be scientifically defensible or usable in analysis.

Soil

1. Organic content increases the water-holding capacity of a soil and aids in retention of nutrients important for vegetative growth (Horner and Raedeke 1989). Substrates rich in organic sediment will support higher densities of fish and aquatic invertebrates (Marble 1990). Medium textured soils are more conducive to seed germination and plant rooting than are extremely fine textured soils such as clay (Horner and Raedeke 1989). Because soil characteristics are relatively slow to change, soil monitoring tasks (organic content, texture analysis, and Munsell soil color classification) should be conducted only in the first and final year (typically the fifth year) of monitoring. Discussion in the final monitoring year for a particular site should relate soil texture and organic content analyses of the wetland soil to the development of the wetland vegetative community and to invertebrate taxa richness and abundance over the duration of the monitoring.

2. Rate of sediment accumulation in a wetland is principally affected by water velocity and residence time within the wetland (Marble 1990, Phibbs 1986). Marble (1990) cites the following factors which would decrease water velocity, hence increase sediment deposition: lack of outlet in the wetland, gentle gradient, shallow water depth, dense wetland vegetation, and long duration of seasonal flooding.

As mentioned in section 3.2 ("Problems with Current Methods"), monitoring sediment accumulation without a clear objective may not provide information that is particularly useful (Horner and Raedeke 1989). If sedimentation can be inferred by other means (i.e. wetland gradient, water depth, vegetation, etc.), it may not be necessary to add an additional task to the WSDOT monitoring program.

Water

Water temperature, pH, and DO content are fundamental water quality characteristics that affect fish, invertebrate, and vegetation productivity (Horner and Raedeke 1989, Marble 1990). Water quality sampling results should be discussed with reference to the parameters listed in Table 1.

Table 1. Water Quality Criteria for Fish and Invertebrate Production*

Objective	Temp. C°	pH	DO
Coldwater/salmonid fish spawning and rearing	≈13-14 C°	5.6-8.6	>7mg/L
Coldwater/salmonid fish feeding	≈15 C°	5.6-8.6	>6mg/L
Coldwater fish refuge and migration	≈15 C°	5.6-8.6	>5mg/L
Warmwater fish production	20-25 C°	5.6-8.6	≥4mg/L
Invertebrate production	<20 C°	5.6-8.6	≥4mg/L

*Modified from Horner and Raedeke (1989)

All discussion of monitoring results should clearly state potential sources of error. For example, seasonal timing of sampling will affect what data is collected in all monitoring tasks except perhaps soil sampling. Although WSDOT attempts to conduct each task within approximately the same time period each year of monitoring, it is no assurance that the actual time of season for any given year will come at the same time in subsequent years. Even changes in the time of day sampling takes place may affect bird surveys and water quality measurements.

Report Format

There are three main problem areas with the current arrangement of the WSDOT annual monitoring report. One is that the mitigation sites are listed in alphabetical order within the report rather than by WSDOT District location. This makes it difficult for any one District to readily access information specific to its wetland sites. Secondly, there is confusion generated in that the names given the mitigation sites by the WSDOT Headquarters biologists conducting the monitoring often differ from how they are known by the District. For the monitoring program, mitigation sites are typically named after their primary source of hydrology, or nearest body of water, as in Palix River, Matriotti Creek, and Ebey Slough. The Districts refer to the site by the particular project name with which it is associated; hence, the names given for the aforementioned sites are, respectively: State Route 504, Green River to Coldwater Lake, and State Route 527, 208th to 164th SE. A third problem is that tables and graphs are grouped separately from the written text, which creates a situation where the reader is forced to flip back and forth between the site discussion and the tables and graphs section for relevant data.

A relatively simple reorganization of the report will contribute greatly to its readability. Mitigation sites should be organized by District and all tables, charts, and graphs should be presented along with their associated site. Also, sites should be listed by both project and monitoring program names, and each site should be started on a new page. For the convenience of the Districts and the resource and regulatory agencies evaluating the monitoring results, a summary of the monitoring recommendations and/or any problems needing action should precede each District section.

5.3 Promotion of In-House Use of Monitoring Data

The prevailing theme from agency input and current literature on monitoring programs is: provide discussion of monitoring results, provide recommendations, and apply what is learned to future mitigation site design. Kentula et al. (1992) note that although wetland monitoring reports may be kept on file in state and federal agencies, they are rarely used. Personal communications by the author with several WSDOT landscape architects who design many of the WSDOT mitigation sites showed that this may indeed hold true for WSDOT. Lack of time, difficulty with the report layout, and being unaware of the existence of the monitoring report are several of the reasons cited for not utilizing information generated by the monitoring program.

Miller (1994) and Stellini (1994) point out that collection of data that are not used, or analysis that does not get translated into management decision, constitute wasted effort (and hence, money) for

WSDOT. This observation is underscored by the findings of Crabtree et al. (1992) in their evaluation of seventeen Department of Transportation (DOT) wetland mitigation sites in fourteen states. Crabtree et al. (1992) found that certain designs of wetlands are a recurring motif in DOT sites and that these designs inhibit the growth of wetland vegetation; more specifically, that relatively steep slopes (6:1) were common and often provided the limiting factor in the successful development of emergent vegetation. The report points out that "Most natural wetlands are nearly flat...[a] basic characteristic [which] makes possible the performance of typical wetland functions."

Crabtree et al. (1992) further state that causes of failure in mitigation sites were most directly linked to "...shortcomings or misconceptions in planning or design, or to failures of implementation, but not to gaps in the wetland information base." The WSDOT monitoring program is generating sufficient data- however, it is up to the agency to close the feedback loop.

<u>Feedback Loop</u>

One of the primary sources of feedback are the as-built plans for a mitigation site and the site conditions at the time of vegetation planting. The plans include the final grading and shape of the wetland, and the final number, species, and location of vegetation planted on site. Site conditions include noting whether the soil has been compacted, the degree and quality of topsoil, and whether anti-desiccants have been used on the planted vegetation. This information provides the foundation for evaluating the site's development over time (Kentula et al. 1992, Mabry 1994) and should be included in the monitoring report. As-built conditions may often vary from the original design, and hence may significantly affect the performance of the wetland (Kentula et al. 1992, Mabry 1994).

The monitoring report can provide estimates of percent survival of planted species in the first year. Monitoring can track the rate of change through relative dominance and relative frequency analyses for any given species over the five year span of monitoring, yielding important clues as to the potential competitiveness and/or rate of propagation for that species. Information on dominance or rate of increase by invasive vegetation may show some correlation with what topsoil (source of, or if any) was spread on the site, or site hydrology.

Monitoring data should show, at the very least, what doesn't work. For example, in the six years of WSDOT monitoring, there may be enough data to show a positive correlation between low percent cover by emergent wetland vegetation and degree of slope. Crabtree et al. (1992) found that although slopes of 6:1 were common target slopes for the emergent zone in DOT mitigation sites nationwide, they consistently produced little more than a narrow ring of emergent wetland vegetation.

If data analyses show that certain planted species consistently have low to no survival, then WSDOT should cease planting those species or switch strategies; e.g., stagger the timing of plantings by planting shade loving vegetation after faster growing, sun-tolerant species have had a chance to get established. If the data continue to reflect low survival rate, yet the message from the resource or regulatory agencies are to continue planting those species, then meetings should be held between WSDOT and these agencies to discuss what are realistic goals.

To illustrate, in comparisons of vegetation composition between created and natural wetlands in Oregon, Kentula et al. (1992) found that 54% to 81% of the species occurring were common to both groups. However, only 0% to 7% of those occurring in created wetlands correlated with the species planted for that wetland. According to Kentula et al. (1992), this suggests that either the species planted were inappropriate for the particular wetland or that the volunteer species (naturally occurring) should be included in future site design planting lists.

The monitoring report should be used to advise management of potential or ongoing problems on a site. For example, monitoring can usually pick up high mortality of planted species within the first monitoring year. Most landscape contractors guarantee the survival of their plantings for three years and must replace dead plants if they are notified within that time period. However, if no action is taken by WSDOT within the appropriate time frame, the agency may be saddled with additional replanting costs in order to meet the percent vegetation cover requirements specified in the mitigation plan. Hence, avoiding unexpected additional costs should be a motivating factor for utilizing information within the monitoring report.

Costs

The number of WSDOT mitigation sites requiring monitoring has more than tripled in a span of six years, with the greatest increase in sites occurring between 1993 and 1994 (from 13 sites to 20 sites). Monitoring costs have risen by over $1000.00 per site over the past year: cost in 1993 was approximately $3900.00 per site while the estimated cost for 1994 is $5000.00 per site. Total monitoring costs for 20 sites in 1994 will approach $100,000.00. Over the five years of monitoring expected for these sites WSDOT will spend nearly 0.5 million dollars; an amount that will increase accordingly with additional sites.

With budget pressures increasing and environmental costs rising, (whether directly or through more stringent regulations), WSDOT like other agencies must be ever persistent in figuring ways to keep costs down. McAuliffe (1994) of the U.S. Army Corps of Engineers mentioned that if WSDOT could show its wetland mitigation sites to be consistently successful, it may be possible to reduce the number of years WSDOT is required to monitor each site. For example, three years of monitoring instead of five, but staggered over a five year (or longer) period, would be considered. At current annual monitoring costs, dropping two years of monitoring translates to a 40% reduction in monitoring costs per site. At very least, applying information generated from the monitoring program to future wetland mitigation site design will serve to establish WSDOT's credibility in this particular arena, as well as make good economic sense.

6. Conclusion

Wetland creation, enhancement, and restoration will figure prominently within WSDOT throughout the next decade. As the state's population continues to grow, the commensurate increase in highway congestion will intensify the call for WSDOT projects such as road widening. Rural roads reaching traffic load capacity will spur demands not only for additional vehicle lanes, but also for new access roads to trunk routes. Although WSDOT is committed to minimizing wetland impacts, the nature of these projects is such that, when wetlands are involved, there oftentimes are few alternatives to impacts through filling.

As the scientific community's understanding of wetlands increases, and the role wetlands play in water quality, nutrient cycling, flood attenuation, and wildlife habitat becomes more widely accepted, the call for WSDOT to be more sparing in its impacts to wetlands and to be consistently successful in its endeavors to balance wetland losses will become more persistent. This is already reflected in the more stringent mitigation requirements requested by federal and state agencies, and increasingly, local governments. These agencies will be looking more closely at WSDOT to make sure that WSDOT's compensatory mitigation efforts are successful. The annual monitoring report will also come under greater scrutiny. With each year of data collection, outside expectations rise for WSDOT to show that it is applying what it has learned from monitoring, following its own recommendations, and taking a pro-active stance in dealing with sites that are not meeting the standards that have been set for them.

The recommendations presented in this paper are offered as a means towards increasing the efficiency and effectiveness of the current WSDOT monitoring program. Changes and additions proposed for the methodology are targeted to meeting the newest WSDOT mitigation requirements without adding more time demands to a program that is already operating near capacity. Proposed recommendations for changes to the annual monitoring report are directed both at making the information more accessible to the reader and underscoring the report's potential for use as a management tool. Recommendations for promoting in-house WSDOT use are based on current monitoring costs and WSDOT's need to establish credibility with regulatory and resource agencies regarding wetland mitigation.

At the conclusion of the 1994 monitoring season WSDOT will have accumulated seven years of monitoring data and will have a total of eight mitigation sites that have completed five years of monitoring. This accumulation of data should provide sufficient information with which to make good assessments of what does and doesn't work for the mitigation sites. At this point it may be useful for WSDOT and the various agencies to meet to discuss future strategies for the monitoring program. For example, the issues of trying to create later successional stage wetlands, or battling the persistent problem of invasive species encroachment and competitiveness should be evaluated in light of what is realistic to expect of a created wetland in five years. Also, the possibility of extending the length of the monitoring period, (e.g., from five years to eight or ten years), but reducing the number of times WSDOT has to conduct the monitoring per site should be considered by WSDOT and the permitting agencies. In all cases, a good monitoring program strategy will entail all agencies working in concert with each other.

It is important that the WSDOT monitoring program remain flexible; further refinements to the methodology may be necessary in the future if (or as) mitigation requirements change. Time constraints will become a limiting factor if the total number of sites monitored in one season continue to increase. Potential budget restrictions may also become a factor affecting the WSDOT monitoring program. To be the most efficient and effective in monitoring its created wetland mitigation sites, WSDOT should continue to work with federal, state, and local agencies in an effort to establish common ground on the expectations for and the focus of the monitoring program. There should be a consensus on where the emphasis of monitoring is placed, developed out of a realistic assessment of what can be achieved. Ultimately, WSDOT must make a commitment to its own monitoring program, recognizing that although the monitoring is motivated out of the need to comply with permit terms, WSDOT has both an obligation and a responsibility as a state agency to providing the best product possible.

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APPENDIX A

History and Policy Leading to Compensatory Wetland Mitigation

Historically, wetlands have been viewed primarily as wastelands with little regard given them other than the practicality of converting them to agricultural lands, an activity that continues to be the primary cause of wetland losses (The Conservation Foundation 1988, Mitsch and Gosselink 1986). The draining of wetlands for conversion to other uses was routinely encouraged from early 1800s through the mid- to latter part of this century (Mitsch and Gosselink 1986). In 1906 and again in 1922, Congress directed the United States Department of Agriculture to conduct surveys of wetlands for the express purpose of identifying areas suitable for conversion to agricultural lands (Horwitz 1978, Mitsch and Gosselink 1986). Beginning in 1934 a few wetlands gained protection through the mandatory sale of Migratory Bird Hunting and Conservation Stamps (duck stamps) to waterfowl hunters, the proceeds of which went towards the acquisition of migratory bird habitat (Office of Technology Assessment 1984). However, it wasn't until the early 1970s that wetlands gained any specific recognition as a resource to be protected (The Conservation Foundation 1988) or widespread acknowledgment as having beneficial environmental functions.

The primary legislators of wetland protection have been the Rivers and Harbors Act (RHA) of 1899 and the Amendments to the Federal Water Pollution Control Act (FWPCA) of 1972, later amended as the Clean Water Act (CWA) of 1977. Although recent years have seen the inception of State programs and local ordinances that regulate activities in sensitive areas, including wetlands, these two federal statutes continue to be the first defense against impacts to wetland areas.

Until the United States Army Corps of Engineers (Corps) revised its permitting authority in 1968 to include consideration of environmental factors, protection of wetlands under the RHA of 1899 was more happenstance than intent. Section 10 of the RHA gives the Corps responsibility for the authorization (permitting) of all activities that could obstruct or alter navigable waters of the United States (Horwitz 1978, WSDOE 1988). The jurisdiction of the Corps was limited by the definition of navigable waters: "...those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce," (Want 1984, 33 CFR §329.4 (1982)).

Navigable waters "subject to the ebb and flow of the tide" refers to those areas within the mean high water mark of tidal zones and the ordinary high water mark within freshwater zones (33 CFR §329.4 (1982)). Wetlands extending beyond these marks, or not connected to navigable waters were not covered under the Corps' jurisdiction. Pressure from environmentalists along with a general increase in concern nationally over the limitations of wetland protection influenced the Corps to revise its Section 10 permit regulations in 1968 to include environmental factors such as pollution, aesthetics, conservation, ecology, and fish and wildlife in its consideration of permit requests (Horwitz 1978, Want 1984). Although not specifically targeted as such, the revision did have the effect of extending protection of wetlands somewhat; however, the jurisdiction of the Corps was still bound by the definition of navigable waters. It was not until the enactment of the Amendments to the FWPCA of 1972, (hereafter referred to as the Clean Water Act, or CWA), which was spurred in part by the continuing concern by environmentalists and some federal agencies over the restrictive bounds to wetlands protection (Want 1984), that the Corps authority was expanded to include all waters of the United States, including wetlands (Horowitz 1978).

Congress directed both the Corps and the Environmental Protection Agency (EPA) to develop the environmental guidelines for Section 404 of the CWA (known as the Section 404 (b)(1) Guidelines, or "the Guidelines"). The primary authority of the Corps encompasses issuing permits and the enforcement of their conditions. The EPA is responsible for enforcing compliance with the Guidelines regarding unpermitted activities in wetlands. In addition it has the authority under Section 404 (c) to veto permits authorized by the Corps. (United States General Accounting Office -GAO 1988, Kruczynski 1990).

The goal of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters" (33 USC 1344). Section 404 of the Act, which regulates the discharge of dredged or fill material into waters of the United States (40 CFR 230.1 (1980)) provides the primary legislative means with which to control use of wetlands (United States General Accounting Office 1988). In its definition of waters of the United States, Section 404 of the CWA encompasses the definition of navigable waters given in Section 10 of the RHA, as well as inter- and intrastate waters (i.e. lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds), and all wetlands adjacent to those waters as described (40 CFR §230.3 (s)). Wetlands are defined in this section to mean "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" (40 CFR §230.3 (t)). Although both the CWA and the RHA involve regulating the discharge of dredged and fill material, in addition to its greater geographical scope Section 404 of the CWA differs from Section 10 of the RHA in that the focus of the former concerns regulating water pollution, while the latter regulates navigation (Want 1984).

With the initial passage of the CWA the Corps showed reluctance to expand its jurisdiction to the new definition of waters of the United States; more specifically, it did not interpret them to mean anything different from the Corps' definition of navigable waters (Kruczynski 1990). The Corps was challenged on this point in the landmark case *NRDC v. Calloway* (Want 1984, cites 392 F. Supp. 685 (D.D.C. 1975)) in which the Corps was forced to expand its jurisdiction to include the Section 404 definition. In revising its Sec. 404 Regulations, the Corps included a public interest review which involved opening to agency consultation any permit decision regarding activities in wetlands made by the Corps (Want 1984, Kruczynski 1990). Agencies consulted included the Soil Conservation Service (SCS) the National Marine Fishery Service (NMFS), United States Fish and Wildlife Service (USFWS), and various state agencies. As outlined in Kruczynski (1990), the review process entitled the agencies to make recommendations which would then be taken into consideration by the Corps before a final decision was made on a Sec. 404 permit. Any agency disagreeing with the final decision was able to elevate authority, (i.e. appeal the decision), the threat of which was usually enough to cause the Corps to reassess its stance on the permit in question. However, the process of elevating authority was difficult and agencies began to opt for a return of some environmental benefit by agreeing to the replacement of impacted wetlands, or as it became known, compensatory mitigation.

The year 1981 ushered in a new presidential regime. One of the first actions of the new president upon taking office was to establish the Presidential Task Force on Regulatory Relief (Andrews 1984). Targeting what were viewed as the regulatory excesses of the CWA, the Task Force effectively gutted the power of the state and federal agencies, and that of the EPA especially, by shortening the agency review period for permits and by making it extremely difficult and time consuming overall to pursue an appeal of a Corps decision (United States General Accounting Office 1988, Kruczynski 1990). In view of their reduced voice resulting from the regulatory relief measures, agencies found that it was far easier to compromise on the conditions of a permit than to appeal its legitimacy, and it was not long before mitigation came to mean minimizing adverse impacts to wetlands, regardless of available alternatives (United States General Accounting Office 1988, Kruczynski 1990). Although the reduced regulatory role of the Sec. 404(b)(1) Guidelines was successfully challenged in 1984 by the National Wildlife Federation (Kruczynski 1990), the stage had been set for viewing mitigation as a means to obtain a permit for any project that would have some impact on a wetland; it is here that compensatory mitigation became firmly entrenched within Section 404 of the CWA.

In its report to the House of Representatives regarding the Corps' administration of the Sec. 404 program, the United States General Accounting Office (1988) established that there were differences between the Corps and the EPA (and other resource agencies) in their interpretation of the Sec. 404(b)(1) Guidelines. Specifically the GAO finds that the resource agencies believe the Corps has greater range of authority to protect wetlands than it chooses to exercise. Three major areas of difference cited are: 1) the Corps tends to be more conservative than the EPA or USFWS in its delineation of wetland boundaries (i.e. the Corps applies more rigid standards); 2) the Corps tends to rely on the applicant to determine whether any practicable alternatives exist to an action or actions, and 3) the Corps usually considers each permit individually, and finds it hard to develop criteria that would judge cumulative environmental impacts, while the EPA finds that its recommendations are often not followed with regard to cumulative impacts. The EPA, in its interpretation of the Sec. 404(b)(1) Guidelines, supports NEPA's sequential process of mitigating for environmental impacts (Washintong State Department of Ecology 1988, Kruczynski

1990), maintaining that minimization of impacts through seeking alternatives cannot be overridden by willingness to provide compensatory mitigation (United States General Accounting Office 1988, Kruczynski 1990). The difference in interpretation is important in that it is the Corps that authorizes Sec. 404 permitting of those WSDOT projects affecting wetlands and hence sets the lead on the terms of mitigation.

It is further pointed out in the United States General Accounting Office (1988) report that basic differences exist regarding permitting decisions by the Corps. Specifically, "...the resource agencies are charged with protecting the resource without consideration of the other factors that comprise the public interest, while the Corps must balance many factors in the public interest in making decisions about permit applications." I believe the Corps' stance underscores how WSDOT views its responsibility towards wetland mitigation in the overall picture of its transportation responsibilities. The priority of this agency is to provide safe, efficient, and effective transportation for the public, and mitigating for impacts to wetlands is simply one of the many parts to a complicated puzzle.

APPENDIX B

WSDOT Process: Project Scoping, Design, and Permitting

Scoping is, as the name implies, the pre-project phase; it is WSDOT's initial response to a current or projected transportation need. In this stage a prospectus is developed that includes the basic project design, a rough timeline for completion, and projected project costs. What makes the scoping phase so critical is that, despite the fact that the project planning is in its infancy, it is at this point that the budget must be set and then approved for funding. The requirement for funding approval at so early a date creates the potential for problems later on, not the least of which is the unplanned, or underplanned costs of environmental impacts. It is not uncommon for mitigation costs to run as high as 18% of the total project budget (Washington State Department of Transportation 1992) yet the scoping phase does not currently involve a preliminary biology report, which would bring to the agency's attention the potential for adverse impact to environmentally sensitive areas. Recognizing that the lack of incorporating a biological evaluation into the scoping process contributes to the potential for delays and unforeseen costs later on in the project, WSDOT is reassessing the scoping phase.

With approval of funding the project moves into the design phase. This phase includes wetland inventories, permit application, preparation of environmental impact statements, and the final design report. It is also the stage at which federal, state, and local agencies become involved in the project process. The following paragraphs summarize the path a typical WSDOT project involving wetland mitigation must take to get to the "Ad" or, construction phase of the project.

One of the earliest tasks during the design phase is to inventory the proposed project site for wetlands. The wetland inventory is considered in conjunction with the project proposal and the project design is then modified to avoid or minimize wetland impacts to the extent possible. An informal review of the project is conducted with all resource agencies affected, typically: the Corps, Ecology, USFWS, and Washington Department of Fisheries and Wildlife (WDFW). Project design may be further modified, incorporating comments from the reviewers.

When the project design is close to finalized, a biology report for the project area is written and submitted to the resource agencies as well as to the WSDOT district initiating the construction project (WSDOT is divided into six districts statewide). This report discusses the area in terms of impact to endangered plants or wildlife (if applicable) and to wildlife (including fish) in general. Recommendations are made for reducing impact to fish bearing streams (if applicable) and to other wildlife. A wetland report is developed concurrent with the biology report. The wetland report is a formalization of the wetland inventory; all wetlands within the project area are formally delineated and mapped, and wetland impacts are described in detail.

Application for various permits is occurring throughout the process of finalizing the project design. Typically these include Sec. 404 (Corps), Hydraulic Project Approval (WDFW), and any permits required under the Shoreline Management Act. In addition, approval must be sought under the Coastal Zone Management Act if the project involves shorelines of the state (refer to Appendix C). When the project design is finalized a wetland mitigation plan is written. The mitigation plan is developed through a collaborative effort between WSDOT biologists, landscape architects, hydrologists, and other WSDOT specialists as needed. This document defines the wetland functions that will be lost to impacts from project construction and states how they will be replaced. The mitigation plan provides the construction and planting plans for the wetland to be created, and the goals, objectives, and the standards of success by which to evaluate the wetland's development.

Once the final mitigation plan is delivered to the Corps, the Corps makes a determination on the permit, publishes a public notice of the preliminary decision and requests Sec. 401 Certification from Ecology. Comments from the resource agencies and the public are solicited for thirty days. The Sec. 404 permit application is approved upon determination that all local permits have been approved, that the project has met the requirements set under the CZMA (if applicable), and that a Sec. 401 water quality certification has been issued. The WSDOT road project may then proceed to the construction phase.

Construction of the wetland replacement project will be initiated as fits the individual contractor's time table. The contractor has the grading and planting plans for the site that were developed in the final mitigation plan. Grading plans provide the configuration of the site and its slope, and planting plans designate the specific species and quantities of plants as well as where they are to be planted within and surrounding the wetland. Soils and plant materials may be removed from the impacted wetland and used in the created wetland. Wetland monitoring commences with the first growing season after the mitigation site has been planted. WSDOT mitigation sites are typically monitored for five consecutive years.

APPENDIX C

Table 2. Summary of primary regulations pertaining to Washington State's wetlands*

Regulation	Reason for Permit or Action	Implementing Agency
Federal River and Harbor Act - Section 10 -- 1899 33 USC 401 § 10	Permit required for construction activity in navigable waters of the state	U.S. Army Corps of Engineers
Federal Clean Water Act - Section 404 -- 1972/1977 33 USC 1344	Permit required for dredge and fill activities in all waters of the state, including wetlands.	U.S. Army Corps of Engineers/ Environmental Protection Agency
Federal Clean Water Act - Section 401 -- 1972/1977 FWPCA § 401 RCW 90.48.260, WAC 173-225	Certification that water quality standards have been met; necessary before federal permit approval	Washington State Department of Ecology
Federal Coastal Zone Management Act -- 1972 16 USC 1451, RCW 90.58	A notice that proposed activity is consistent with state coastal zone management plan; necessary before federal permit approval	Washington State Department of Ecology
Executive Order 11990 - 1977	Established protection of wetland and riparian systems as an official policy of federal government	All agencies
National Environmental Policy Act (NEPA) -- 1969	Federal process requiring full disclosure of potential environmental impacts	Usually the federal agency issuing the permit
State Environmental Protection Act (SEPA) -- 1971 RCW 43.21	State process requiring full disclosure of potential environmental impacts	Usually the local agency issuing the permit, certification, or other approval
State Shoreline Management Act -- 1971 RCW 90.58, RCW 36.70	Permit required ensuring that proposed activity complies with local shoreline master plan	Local jurisdiction/Washington State Department of Ecology
State Hydraulic Code -- 1949 Hydraulic Project Approval RCW 75.20.100-140	Permit required for all activities below the ordinary high water mark of waters of the state	Washington Department of Fisheries/ Washington Department of Wildlife
State Flood Control Zone Act -- 1935 Floodplain Management Program, EO 11988	Permit required ensuring that proposed activity is consistent with state or local floodplain management program	Local jurisdictions with approved programs, or Washington State Department of Ecology

*Modified from Washington State Department of Ecology's Wetland Regulations Guidebook (1988)

APPENDIX D

Taken from the Implementing Agreement between the Washington State Department of Transportation and the Washington State Department of Ecology Concerning Wetlands Protection and Management.

WSDOT Guidelines For Wetland Mitigation Plans

The Washington State Department of Transportation (WSDOT) has developed these guidelines to provide format and contents requirements for wetland mitigation plans (WMP) and reports. The guidelines apply in the preparation of mitigation plans associated with regulatory agency permit requirements.

Agencies responsible for project review and permit certifications are developing guidelines for wetland mitigation reports, plans, and monitoring. The Department of Ecology, the U. S. Army Corps of Engineers (Corps), and the Environmental Protection Agency mitigation plan guidelines were considered in the preparation of these guidelines. WSDOT Wetland Mitigation Plan Guidelines are intended to meet the requirements of each of these regulatory agencies.

If wetlands are encountered in a project, the following activities are normally required: 1) a wetland report is prepared, identifying the location and value of wetlands in the project vicinity; 2) alternatives that would reduce or eliminate impacts to wetlands by changes in location or design of the project are analyzed; 3) a mitigation site is selected that will satisfy requirements for acreage needed for unavoidable wetland impacts; and 4) a wetland mitigation plan is written.

The Preliminary Wetland Mitigation Plan is prepared as the first action in the process of developing a WMP, followed by internal review and resource agency review. The Final Wetland Mitigation Plan is provided to agencies as part of the permit process. These guidelines explain the elements of mitigation plans and detail the essential coordination required.

I. Develop Preliminary Wetland Mitigation Plan

The Preliminary Wetland Mitigation Plan is a draft document for use in early coordination with in-house and resource agency staff. In this document, the project is described, the measures that will be taken to avoid wetlands and reduce impacts are discussed, and the measures proposed to compensate for the impacts are described.

Following are the elements of the Preliminary Wetland Mitigation Plan:

A. Description of the Project

Provide a brief outline of the project proposal, including the following site information:

1. Project name, short description, and location.

2. Wetland information. Include who conducted the delineation (e.g., WSDOT biologist, consultant), which manual was used (1987 or 1989), methodology (routine, intermediate, problem, or disturbed), date(s) field

work was performed, data sheets used to establish the wetland boundary and general findings.

3. Vicinity map. U.S. Geological Survey (USGS) Quadrangle (1:1200), National Wetlands Inventory Map (NWI), or other will suffice. Range, Township, and Section should be shown.

4. A large scale site map (not smaller than 1:400) and aerial photo if available.

B. Assessment of the Impacted Wetland

Description should be provided of the type and quantity of wetlands that would be impacted. Address vegetation (including canopy structure, indicator status, percent cover and wetland classes) hydrology (water depths, average seasonal flows and/or duration of saturation), soil characteristics, and functions and values. Impacted wetlands should also be rated according to the Department of Ecology's Washington State Wetlands Rating System, and include a qualitative description of how the wetland functions in the landscape.

This information is available in the Wetland Biology Report prepared for the project.

C. Evaluation of Mitigation Alternatives

The Preliminary Wetland Mitigation Plan should document all early project design changes made to avoid and minimize impacts to wetlands. This information is needed for both Preliminary and Final Wetland Mitigation Plans and demonstrates to reviewing agencies that WSDOT has avoided and minimized impacts to the extent practical. It should follow the mitigation sequence adopted by WSDOT and show how the development of the project design has:

1. Avoided the impact altogether by not taking a certain action or part of an action

2. Minimized impacts by limiting the degree or magnitude of the action and its implementation, using appropriate technology, or taking affirmative steps to avoid or reduce impacts

3. Rectified the impact by repairing, rehabilitating, or restoring the affected environment

4. Reduced or eliminated the impact over time by preservation and maintenance operations during the life of the project

5. Compensated for the impact by replacing, enhancing, or providing substitute resources or environments.

Mitigation steps should be tracked and recorded throughout the project planning and design process. This information can then be incorporated into the Final Wetland Mitigation Plan.

D. Mitigation Project Goals, Objectives, and Performance Standards

Goals are broad statements that define the intent or purpose of the proposal.

Objectives are the direct actions necessary to achieve a specific goal. These should be measurable. Wetlands perform numerous important functions. However, if an objective of the mitigation is to create a function it must be one that can be accurately measured in the field, such as percent cover of wetland vegetation. Water quality improvement is an example of wetland function that is difficult to use as a measurable performance standard.

Performance standards are specific criteria used to evaluate whether the goals and objectives have been met. These must be developed on a site-by-site basis. Performance standards should provide target criteria to be met each year, or every other year, based on reasonably paced progress toward measuring final success.

Describe the long-term goals of the mitigation project. Specifically, identify objectives in the following terms:

1. Size and classification of wetlands to be created, restored, enhanced, or preserved
2. Functions and values to be created, restored, enhanced, or preserved
3. Number of years it is likely to take for the long-term establishment of the proposed functions and habitats
4. The measurable performance standards that will be used to determine if an objective has been met.

E. Description of the Proposed Wetland Mitigation Site

1. Describe pre-construction conditions existing at the proposed site, including vegetation, wildlife and wetlands. Provide a description of the plant community, its cover, classes and structure, and make special note of exotic species and other management concerns that may affect site viability. Wetlands present at the mitigation site must be delineated, assessed and their location indicated on the site map using the format described for a Wetland Report.
2. Explain how hydrology will be provided for the proposed wetland mitigation, including expected seasonal water level fluctuations, seasonal depth to groundwater, or surface water source and water quality.
3. Describe soil classification and series at the site and any soil testing that has been done. Describe amenities that may be needed to improve the soil conditions at the site.
4. Describe how the planned mitigation will fit in the landscape. Discuss

the location of the site in relation to its position in the watershed or adjacent upland or wetland habitats or other water resources.

F. Proposed Site Plans

Prepare a general grading and revegetation plan, including:

1. The shape and contour of the mitigation project. Provide sufficient information so that water depths, open water areas, boundary areas, and other features can be visualized. Seasonal ground water and the sources of hydrology for the site should be evident.
2. A list of plants to be used and general planting plan to illustrate the planting concept for the site. Reviewers need to know what species will be planted, in what proportions, and their general locations.
3. Information on the construction sequence and schedule.
4. Steps to be used to minimize damage to surrounding buffers or wetlands during site construction.
5. Methods for controlling invasive species.
6. A description and map of the plant communities which make up the wetland buffer, if a buffer is included in the mitigation design.

H. Maintenance Plan

Describe planned maintenance activities including erosion control and protection of plant materials from herbivores, repairing vandalism, and other activities that may be required over time to ensure that the site viability is maintained.

I. Contingency Plan

A contingency plan is required and must outline the steps that will be taken if performance standards are not met.

G. Mitigation Site Monitoring

A monitoring plan collects the data necessary to measure the success of the mitigation in meeting goals and performance standards established for the site. In the Preliminary Wetland Mitigation Plan, state that monitoring will be conducted for a period of 5 years or longer, if necessary, and that an annual report will be issued by WSDOT to the U.S. Army Corps of Engineers, Department of Ecology, and other federal, state and local resource agencies. A monitoring program must include measures of vegetation, hydrology, water quality, soils, and wildlife over time. Headquarters Biology conducts the actual monitoring and issues the *WSDOT Wetland Mitigation Monitoring Report*, which is sent to regulatory agencies each year.

II. Coordination

The Preliminary Wetland Mitigation Plan is intended to be reviewed internally by WSDOT Districts, Headquarters Design, Maintenance, and Right of Way staff before circulating to outside agencies. WSDOT District Environmental Managers should coordinate the appropriate review within the District.

The outside agency review follows the internal review. Comments and suggestions made to the Preliminary Wetland Mitigation Plan by outside agencies should be considered in the preparation of the Final Wetland Mitigation Plan.

III. Final Wetland Mitigation Plan

The Final Wetland Mitigation Plan is completed after the Preliminary Wetland Mitigation Plan has been circulated to agencies. It incorporates comments from agencies and the public (and comments from draft environmental documents, if applicable). The Final Wetland Mitigation Plan is the document of record.

IV. As-Built Plans

Within a month of construction and planting completion, as-built plans should be sent to the lead agency, including an as-built topographic survey, plant species and quantities used, photographs of the site, and notes about any changes to the original approved plan. Also list the contractor's responsibility concerning plant replacement, fertilization and irrigation, protection from wildlife, and contingency plan requirements.

Examples of Goals and Standards of Success

The following are examples of possible goals, objectives, and performance standards that could be used in a mitigation report.

Example 1

Goals

The goal of this mitigation is to create 12 acres of wetland by converting existing pasture land to a productive, functional native wetland system. The wetland is intended to have the following functions: wildlife habitat, food chain support, flood storage, water quality improvement, and sediment and nutrient trapping.

The goal of the pond and emergent area is to provide food, open water, and nesting habitat for waterfowl and shorebirds, and habitat and food for aquatic-dependent and other species.

Objective # 1:

Creation of a wetland system that has vegetation structure and species diversity similar to those found in natural wetland systems located in the vicinity.*

Performance Standards:

After 1 year:

Wetland has 35-50% survival of planted species. Recruitment of native species is expected and should increase the overall areal coverage of wetland plants.

After 3 years:

Wetland has 75% survival of facultative or wetter species, or is replaced by a native, naturally colonizing plant community at 75% or greater cover. At least 75% of the species are the same as those found at the reference site.

After 5 years:

a. Wetland has about 35-50% scrub/shrub.

b. Wetland has about 25-35% emergent.

c. Wetland has about 10-20% riparian.

d. Shrub/scrub wetland is 90% native species.

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*Note: In this example the wetland systems located in the vicinity are being used as reference sites.

e. Emergent wetland has about 75% native species.

f. Emergent community must have at least 3 species with 20% coverage each.

g. Scrub/shrub community must have at least 2 species of 30% cover each.

h. Wetland has 90% vegetative coverage by predominantly native species.

i. At least 80% of the wetland plant species are the same as those found at the reference site.

Objective #2:

Provide wildlife support by increasing wildlife cover, forage availability, and vegetative class interspersion. The open water area will provide water/support for aquatic-dependent and other species.

Performance Standards:

After 3 years:

At least 3 wetland classes will be established (emergent, scrub-shrub, open water).

After 5 years:

Wildlife cover and forage species should be established equal to percentages listed for vegetative structural and species diversity. A quantitative increase in species diversity should be observed, based on visual estimates.

Example 2

Goals

The goal of the wetland mitigation project is to create a functional self sustaining forested wetland linked with the adjacent ecosystems that provides a continuous forested corridor along a side channel of the North Fork of the Stillaguamish River. In general, the created wetland system is expected to provide the following functions and values: fish and wildlife habitat, food chain support, flood storage and attenuation, and sediment and nutrient trapping.

Contour grading and vegetation establishment will alter the existing site conditions from predominantly wet pasture to a forest/scrub-shrub/emergent wetland system. The resulting change in habitat structure and increased complexity should result in habitat that can be utilized by forest and wetland dependent wildlife species. Reestablishing a forested connection with adjacent habitats will extend a wildlife corridor through this area. The increase in edge habitat created between pasture land and forested wetland will benefit species that utilize the ecozone between habitat types.

Objectives/Performance Standards

Objective # 1

Upgrade wildlife habitat by the addition of proposed native species plantings.

Objective # 2

Increase habitat complexity and diversity as compared to existing agricultural land use by increasing vegetation structure and edge.

As the mitigation site vegetation matures, the conditions of the site will change from a system dominated by pasture grass to a complex scrub-shrub and forested wetland interspersed with the existing emergent wetland areas. It is expected that this type of habitat would support forest and wetland species. A wildlife corridor will be extended by completion of a forested link with the adjacent wetland systems which are associated with the Stillaguamish River.

Performance Standards

After 3 years:

a. Woody vegetation will cover approximately 30% (±5%) of the site with 1/2 trees and 1/2 scrub-shrub.

b. Measurement of the cover of woody vegetation will be used as an indicator of an increase in habitat structure and complexity. It is expected that habitat structure will change from a single layer of vegetation to multiple layers over time, as trees and shrubs mature.

After 5 years:

a. Cover of trees will be 15%.

b. Cover of scrub/shrub will be 50%.

c. There will be at least 250 lineal feet of edge boundary between scrub/shrub and tree species.

d. The corridor to the Stillaguamish system will be 100′ wide and show no human disturbance.

APPENDIX E

Current Parameters Used by WSDOT to Report the Results of Vegetation Sampling

Data from the canopy cover method are used to generate the figures for herbaceous canopy cover, percent vegetative cover, and percent of total herbaceous cover. Data from the line intercept method are represented as percent canopy cover.

1) **Herbaceous canopy coverage** is the percent areal cover within a sample plot of all individuals of a single species in the herbaceous layer. Coverage is assigned a coverage class number which represents a percentage spread, i.e. 1=0-5%, 2=5-25%, 3=25-50%, 4=50-75%, 5=75-95%, and 6=95-100%. Mean canopy coverage is calculated for each species by summing the midpoint values of all the coverage classes recorded for that species and dividing by the total number of plots. Mean canopy coverage for all species is summed and reported as cumulative herbaceous cover. These figures are used primarily to provide a three dimensional characterization of the site and may exceed 100% because of overlapping canopies of different species within a plot.

2) **Percent vegetative cover** reflects the proportion of ground covered by the herbaceous layer relative to the proportion of bare ground. This areal cover value is calculated by subtracting the mean coverage of bare ground (the sum of the midpoint values divided by total number of plots) from 100%.

3) **Plant species richness** is the total number of species encountered on a site using both line intercept and canopy cover methods.

4) **Percent of tree and shrub canopy cover** is reported as the percent area cover of woody vegetation greater than one meter tall. The percent canopy cover is calculated by summing the line intercept lengths for an individual species and dividing by the total length of all the transects sampled. The sum of percent cover for all trees and shrubs on a site may exceed 100% due to layering of the canopies of different species.

5) **Percent of total herbaceous cover** is the proportion of the cumulative herbaceous cover (mean canopy coverage divided by the cumulative herbaceous cover) provided by a single species, or a group of species which could not be separated in the field. When the percents of total herbaceous cover for all species are summed, the total will equal 100%.