Anthropogenic Wetlands on Transmission Line Rights-Of-Way

A Feasibility Study

Final Report

Submitted to:

Seattle City Light

Submitted by:

Beak Consultants Incorporated

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ANTHROPOGENIC WETLANDS ON TRANSMISSION LINE RIGHTS-OF-WAY

A FEASIBILITY STUDY

FINAL REPORT

Submitted to:

City of Seattle
City Light Department
Distribution Division

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1.0 INTRODUCTION

In 1984 Seattle City Light (City Light) embarked upon a program of integrated vegetation management on its powerline rights-of-way. As part of that program, City Light has funded the present study of the feasibility of creating wetlands on their rights-of-way with the purpose of limiting tree growth.

Two major objectives were identified for this study:

- To determine the feasibility of creating wetlands to suppress tree growth beneath rural powerlines given technical, environmental, social and economic constraints.
- To provide recommendations and conceptual plans for wetlands that would be feasible.

BEAK originally planned to consider potential sites for wetlands creation on City Light's Skagit right-of-way and Cedar Falls right-of-way. The Cedar Falls corridor was dropped from consideration during the feasibility study for two reasons. First, the Cedar Falls right-of-way is relatively narrow (averaging 50 ft.), making it difficult to construct a wetland without influencing adjacent properties. Second, the right-of-way is shared by a municipal water supply pipeline. The presence of the pipeline would make it virtually impossible to construct a wetland without conflicts.

The study was divided into five different tasks, as follows:

Task 1. Identify and discuss critical elements that will play a role in determining the feasibility of developing wetlands.

Task 2. Determine sites suitable for wetland development by screening existing inventory data from City Light rights-of-way.

Task 3. Identify and describe wetlands that would be suitable for controlling tree growth under the site conditions present on City Light rights-of-way.

Task 4. Conduct a final feasibility analysis addressing all critical elements.

Task 5. Prepare a final report.

Critical elements developed under Task 1 are described in detail in Section 2.0. Threshold values were assigned to various elements where appropriate (i.e., maximum slope on which wetlands can be built) and these were applied in Task 2 to inventory data collected for the Skagit right-of-way in 1985. This screening process is described in Section 3.0. Some elements could not be handled by screening and had to be discussed in the context of the right-of-way as a whole. These are addressed in Section 4.0.

Creating new wetland areas or expanding existing wetlands did not prove to be a cost-effective tool for vegetation control on City Light rights-of-way. (Detailed cost analyses for wetlands construction are presented in Section 4.0 and Appendix D.) Wetland communities already existing on the rights-of-way are effectively controlling problem tree growth. Under guidance from City Light, the second major objective of this study shifted from the presentation of conceptual wetland designs to a discussion of maintaining existing wetlands to insure continued tree control in these areas (presented in Appendix E). The recommendations presented in this discussion should be applicable to existing wetlands on all City Light rights-of-way.

2.0 DISCUSSION OF CRITICAL ELEMENTS

The feasibility of establishing wetlands on powerline rights-of-way is influenced by a number of critical elements. The first task of the study was to consider all possible elements and develop a list of those that are applicable to City Light rights-of-way. The list should include all aspects of potential concern, including physical limitations, social constraints, possible environmental impacts, biological limitations and costs.

A draft list of critical elements was developed by BEAK and submitted to City Light for review in January 1986. A final list was prepared subsequent to City Light review, and the screening process described in Section 3.0 was attempted using that list. During the screening, BEAK discovered that certain elements could not effectively be used with the inventory data, and the list of elements was revised further to reflect this. The following section describes the final list of elements as it was utilized during the screening.

2.1 Physical Limitations

Slope Right-of-way spans with slopes in excess of 10 percent are considered to be too steep to allow wetland development within reasonable cost limitations. In the screening process, all spans with slopes greater than 10 percent were eliminated from consideration.

Topography Right-of-way topography is an important consideration, even within the slope limitation discussed above. Irregular or undulating terrain would make effective wetland development difficult. The inventory data do not address topography, however, and topographic maps are typically not of sufficient scale and detail. For these reasons, topography was dropped from the

list of elements. It is a factor that should be considered as part of any site-specific proposal, but it cannot be determined from existing information.

Position on Slope This element was intended to serve as an indicator of soil moisture and water availability, but Position on Slope could not be determined from the inventory data. Rather than pursue the time-consuming task of reviewing topographic maps, BEAK opted to use existing vegetation as an indicator of soil moisture. This process is described in detail under Dominant Vegetation (Section 2.4). Position on Slope was dropped from the list of critical elements.

Width of Right-of-Way This element was eliminated once the Cedar Falls right-of-way was dropped from consideration. The width of the Skagit right-of-way does not vary appreciably, therefore width did not need to be considered.

Accessibility Access to a particular site can have a major impact on the cost of wetland construction, particularly if heavy equipment is needed. This element was utilized in the screening, and spans with no access or restricted access were eliminated.

Water Source The presence or absence of a source of surface water was considered in conjunction with Dominant Vegetation. All areas that do not presently support wetland vegetation were eliminated from consideration unless a suitable source of water was recorded in the inventory data.

Watershed Size Watershed size was originally considered as an indicator of the availability of water, but other elements, such as Water Source and Dominant Vegetation, proved easier to use and more reliable. Watershed Size was dropped from the list of critical elements.

Soil Permeability and Depth Soil type was recorded in the inventory data, but the U.S. Soil Conservation Service soil types used in the inventory do not supply sufficient information on permeability and depth to be used in the screening process. As with other site parameters, Dominant Vegetation was used as an indicator, and Soil Permeability and Depth was dropped from the list. Any site-specific proposal should include soil testing to determine these parameters, but they will not be directly addressed in this study.

2.2 Social Constraints

Right-of-Way Ownership Most of the Skagit right-of-way is on easement and very little is owned by the City of Seattle. Fee-ownership by the City was initially used as a requirement for further consideration of a span, but this reduced the list of potential wetland sites to an unrealistically small number. It was decided that ownership would not be considered at this time, but would be addressed by City Light on a site-specific basis.

Multiple Use of the Right-of-Way and Adjacent Lands Several right-of-way spans support existing uses that either preclude the need for vegetation control or would conflict in some way with the development of wetlands. All spans supporting the following uses were eliminated during the screening process: agriculture (cropland and pasture), community wells or watersheds, urban uses (paved or landscaped), and developed recreational sites. The data were also screened for wells and watersheds on adjacent lands, which would conflict with wetland development.

Current Regulatory Constraints Regulations and laws will affect the feasibility of developing wetlands on a county or state basis, but will not impact

one span more than another. This element was not used in the screening, but it is discussed in the final analysis as it relates to wetland development on the whole.

Future Regulatory Constraints A number of cities and counties are in the process of developing wetland regulations. Those regulations that are proposed are discussed in a manner similar to Current Regulatory Constraints.

Water Rights Water rights may be required for some wetland projects, but this is a relatively straight-forward process and will not affect the overall feasibility of wetland development. This element is discussed briefly in the final analysis, but it was not considered in the screening.

City Light Policies and Procedures City Light currently has a policy prohibiting water impoundments on their fee-owned rights-of-way, but the purpose of this study is to determine if that policy should be revised. Other City Light policies affect specific design criteria of wetlands, and these are considered in a general manner in the final analysis.

2.3 Environmental Impacts

Water Quality Federal, state and local laws will require the maintenance of water quality during the construction and active life of any created wetlands. The impact of this on feasibility is discussed in the final analysis.

Fisheries Most streams in western Washington support commercial and/or sport fisheries in their lower reaches. Modification of fish-bearing streams, particularly salmon streams, is an environmentally sensitive issue and permits

for such activity are difficult to obtain. Therefore, any span requiring the alteration of a salmon stream for wetland development was eliminated.

Human Health The primary human health concern associated with wetlands is mosquitoes. State law requires landowners to control mosquitoes on their property, and any wetland in close proximity to a residential development could present management problems. This element was not considered in the screening, but general guidelines for site-specific development are given in the final analysis.

Cultural Resources This element could not be addressed in the screening, but it will be discussed in the final analysis.

Wildlife and Plant Impacts Wildlife and plant impacts were screened manually (without the use of the computer), with particular consideration given to threatened and endangered species.

Tower and Pole Impacts It was assumed that a water source could only be used to create a wetland on the span in which it occurred because flooding of adjacent spans would also require flooding of the intervening tower. The technical feasibility of flooding towers or saturating the soils of the tower bases should be considered on a site-specific basis with City Light Engineers.

2.4 Biological Limitations

Dominant Vegetation Existing vegetation was used as a key indicator of soil moisture and potential for wetland development. Each species in the inventory was assigned a wetland indicator status (Reed 1986a,b) based on its known ecological range relative to soil moisture (see Appendix B). The dominant species recorded in the inventory were then used to classify the spans along a

moisture gradient from wetland to upland. All upland spans and transitional spans (those supporting upland and wetland species) which did not have a source of water available were eliminated, as it was assumed that wetland development would be too difficult on these sites. Transitional spans with surface water present and wetland spans were considered for wetland development and/or enhancement.

Wetland Stability and Structure This element is considered in detail in Section 4.0 It was not considered in the screening process.

2.5 Cost Restrictions

General cost limitations were implicit in some of the other screening elements, but the detailed cost analysis was done after all biological, technical and social factors were considered.

3.0 SCREENING FOR WETLAND SUITABILITY

The computer based screening analyzed those critical elements for which there are data in the existing right-of-way inventory, and for which specific, unambiguous thresholds could be established (i.e., select all sites with slope equal to or less than 10 percent). Supplemental screening was required in order to address fisheries utilization and impacts to plants and wildlife. Outside sources of information were consulted for both elements, and the computer inventory was appended to include this information for further screening. The screening was conducted in a step-wise, sequential format, with each element reducing the number of sites considered in the next step. The screening was conducted in the order as discussed below and shown in Figure 1.

Slope All mapping units, hereafter referred to as "spans", with slope listed as equal to or less than 10 percent were selected. A total of 267 spans met the slope criteria. The upper limit for practical consideration of a span as a potential wetland is closer to 4 percent because earth-moving costs and impacts become considerable on steeper slopes, but the inventory lumped all spans with slopes of 10 percent or less. The 267 spans retained for further consideration probably include spans that are still too steep for wetlands, but the exact number could not be determined.

Multiple Use of Right-of-Way Screening for this element eliminated an additional 74 spans with existing agricultural use, and 7 spans with urban use, thus reducing the total to 186 spans. Several other conflicting multiple uses occur on the right-of-way, but spans supporting these were eliminated by the previous element.

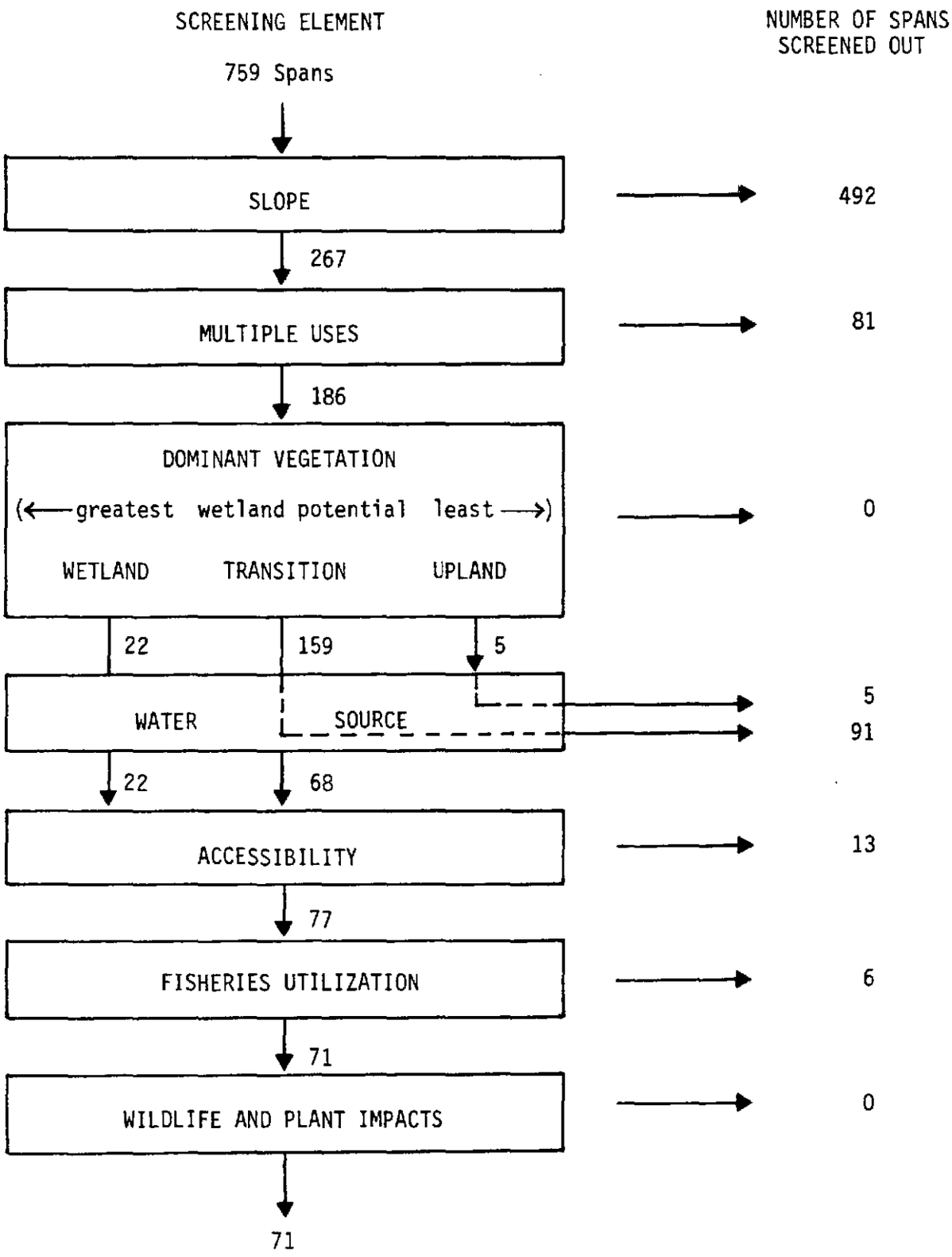

Figure 1. Stepwise sequential procedure used for screening right-of-way spans.

Dominant Vegetation Each species listed in the right-of-way inventory was given a wetland indicator status (WIS) based on U.S. Fish and Wildlife Service lists of wetland plants for the region (Reed 1986a) and the state (Reed 1986b). These are listed in Appendix B. The WIS of the dominant species in each span was then used to classify the span along a moisture gradient. This resulted in the identification of three major categories or groupings of spans:

1. Wetland, as indicated by the presence of obligate (OBL) wetland species. These represent sites that warrant examination to determine if the existing wetlands could be expanded, or if forested, whether or not the wetland nature of the site could be enhanced to preclude tree growth. Twenty-two spans were included in this group.

2. Transition, as indicated by the presence of facultative species [i.e., facultative wetland (FACW), facultative (FAC), and facultative upland (FACU)]. This grouping included 159 spans.

   The transition category was further divided into spans without trees (7 spans), and spans with trees (152 spans). The spans without trees warrant examination to determine if the absence of trees is due to wet soil conditions, and to determine if these plant communities could be expanded by manipulation of site conditions.

   The transition spans with trees warrant examination to determine if the site conditions could be manipulated to increase the soil moisture to the point where trees would be excluded (i.e., inundation). The presence of facultative wetland species indicates that marginal wetland conditions already may exist in these areas and enhancement of wetland conditions may be feasible.

3. Upland, as indicated by the lack of wetland obligates or any of the facultative wetland species. These sites represent the greatest right-of-way management problem areas, and areas with potential for wetland creation only if suitable water sources are available. Only five spans are included in this category.

No spans were eliminated due to dominant vegetation. All 186 were carried through to the next element where the type of vegetation and presence or absence of water were screened in combination.

Water Source Water source was screened in combination with dominant vegetation type as shown in Table 1. All wetland spans were retained regardless of whether or not the inventory data indicated the presence of water. All upland sites were eliminated because none had a source of water on the span. Spans supporting transitional vegetation were also eliminated if they did not contain a source of water, except for 7 spans at the moist end of the transitional gradient (as indicated by dominant species) which were retained even though they did not have open water sources. In all, a total of 90 spans were retained for further consideration following the water source screen.

Accessibility The spans selected above were characterized as to their accessibility, based on the access codes in the right-of-way inventory data base. Of the 90 spans selected above, thirteen spans have no maintenance road or are inaccessible by truck. These were eliminated.

Fisheries The streams identified as potential sources of water on the right-of-way were checked against the Washington State Department of Fisheries Stream Utilization Catalog to determine fisheries use. Thirteen of the streams support salmon populations. Of these, ten represent the only source of water

Table 1. Characterization of water sources in the different vegetation groupings. Table values are the number of spans in each category.

Water source	Vegetation Groupings*		
	Wetland	Transition	Upland
Wetland	2	17	0
Drainage, creek or stream	0	15	0
Bog	0	1	0
Pond	0	1	0
Other possible source	0	10	0
No water source	3	117	5

*See text for discussion of vegetation groupings.

Wetland - Spans with dominant vegetation with one or more species given a WIS rating of obligate.

Transition - Spans with dominant vegetation with a WIS rating of facultative wetland or facultative upland.

Upland - Spans with dominant vegetation with no species rated as facultative wetland or obligate.

for the given span and would require alteration as a part of wetland development. Four of these spans have no access and have already been eliminated. The remaining six spans with access were also eliminated.

Wildlife and Plant Impacts None of the dominant plant species identified in the right-of-way inventory are listed as threatened or endangered by the U.S. Fish and Wildlife Service. Similarly, no species of special interest listed by the State of Washington were found among the dominant species in the inventory. Several species of state interest could occur on the right-of-way even though they were not listed in the inventory, but they presently receive no legal protection and would not alter the overall feasibility of developing wetlands. The history of disturbance and herbicide spraying on the right-of-way makes it unlikely that any of the federally-listed or state-listed species would be found there, but site-specific field checks should be done prior to development in any span. The list of species of special concern is contained in Appendix C. This list also includes two species that are candidates for the federal list. They presently have no official status, but they could in the future. The right-of-way should also be checked for these species prior to development.

There are no threatened or endangered animals known to inhabit or likely to inhabit the right-of-way. The bald eagle, a federally-listed threatened species, could nest and/or roost in the vicinity of the right-of-way, but the lack of trees on the right-of-way would preclude its presence there. The presence of bald eagles in the vicinity of the right-of-way would not affect the feasibility of developing wetlands, but it could affect the timing of construction. Nesting and winter roosting areas are both susceptible to noise impacts from heavy equipment and activities should be planned accordingly. The Washington State

Nongame Data System maintains records on all known bald eagle nest and roost sites and these should be consulted prior to any construction on the right-of-way.

4.0 EVALUATION OF NON-SCREENING ELEMENTS

A number of elements affect the entire right-of-way in a similar manner and could not be used to eliminate some spans in favor of others. They have bearing on the feasibility of developing wetlands, however, and warrant consideration.

Current Regulatory Constraints Wetlands are protected by specific counties in western Washington under county ordinances, by the State of Washington under the Shorelines Management Act, and by the U.S. Army Corps of Engineers (COE) under Section 404 of the Clean Water Act. The following is a brief discussion of each level of regulation.

The entire Skagit line is within Snohomish, Skagit and Whatcom Counties. These counties do not presently have ordinances to protect wetlands. However, King County does and is likely that the King County ordinance will serve as a model for future ordinances in the other three counties, so it will be discussed here.

The King County Sensitive Areas Ordinance (1979) is designed to protect existing wetlands from development impacts. Any action requiring approval from the County (i.e., building permit, grading permit, re-zone, etc.) that would affect a wetland must be reviewed and approved first by the County. The County uses the definition of "wetland" employed by the COE (King County 1979), and does not distinguish between created and natural wetlands; all are treated alike. If similar ordinances were enacted in the other counties, City Light would have to receive approval of any wetland project that proposed to alter an existing wetland. Once a wetland has been created, City Light could not alter it without additional approvals. This could present a serious conflict with

future maintenance activities on the right-of-way and other future uses of the right-of-way. Consequently, any wetland constructed by the City will have to be considered permanent from a planning perspective. This does not make the overall proposal infeasible, but it may reduce the number of sites where it may be acceptable.

The Washington State Shorelines Management Act regulates development in all wetlands associated with streams with a mean annual flow in excess of 20 cubic feet per second and lakes of 20 acres or more in size. Each county or city in the state has developed a Shoreline Management Master Plan which specifies any restrictions that may apply to a given water body and outlines the steps necessary to obtain approval for alteration or development. In most cases, wetland development or enhancement would be consistent with shoreline management policies and would be approved. Time is the only consideration here, as it takes approximately 120 days to receive a shorelines permit if one is needed.

The COE regulates dredging and filling of wetlands and the release of foreign substances into wetlands associated with "waters of the United States." In western Washington, this includes most rivers and creeks upstream to the point that the mean annual flow is 5 cubic feet per second or less. Enlargement or enhancement of a wetland could be approved by the COE with little difficulty, but alteration or filling of the same wetland later could be difficult. This should be dealt with in a manner similar to the county ordinances discussed above.

The Washington State Department of Ecology (DOE), Dam Safety Division, reviews and approves construction plans and drawings for any dam that would impound 10 acre-feet or more of water. It is unlikely that an impoundment of

this size would ever be created on the right-of-way. If an impoundment of this size were needed, the procedure for receiving state approval is relatively straight-forward if sound engineering principles are followed during design.

The Washington State Departments of Fisheries and Game issue Hydraulics Project Approvals for any work below the high water mark in "waters of the State." Virtually every surface water body in western Washington falls into this category. The agencies' primary concern is the protection of fisheries resource. As noted in Section 3.1, spans requiring the modification of salmon-bearing streams were already eliminated from consideration. Impacts to resident fish will still have to be minimized on the remaining streams, but this should not be difficult. The need for Hydraulics Project Approvals will have little impact on the overall feasibility of developing wetlands.

Future Regulatory Constraints As noted above, wetland management regulations vary between counties. Currently, King County has the most restrictive management guidelines. Snohomish County is in the process of developing wetland guidelines, and may use the King County system as a model. It is likely that Snohomish County, and possibly Skagit and Whatcom Counties, will eventually adopt regulations similar to the King County guidelines. The Puget Sound Water Quality Authority (1986) is simultaneously in the process of evaluating the importance of wetlands to water quality in Puget Sound. Several alternatives have been proposed that would result in increased control and regulation of wetlands. The DOE has also been exploring the feasibility of developing a wetland regulation program at the state level.

Future regulations are likely to be attempts to preserve all existing wetlands, natural and created. There is also a high likelihood that buffers

similar to those required under the Shorelines Management Act would be required around wetlands. This would seriously affect the feasibility of creating new wetlands on a narrow ownership like the right-of-way because the buffers would extend onto adjacent properties. Impacting adjacent land use could result in landowner conflict that would be unacceptable to City Light.

Water Rights Water rights are controlled by the DOE. A water rights application is required for any water diversion. The DOE reviews applications to determine if it is a consumptive or non-consumptive use (in this case we assume use would be classified as the latter), if there are any stream restrictions (i.e., open or closed streams, minimum flow requirements), or other senior water rights which would prevent the issuing of additional water rights in the area. These are reviewed on a county-by-county basis. Water rights would adversely affect the feasibility of developing wetlands only if a previous water right had been issued for a specific water body, thereby precluding the City from utilizing it.

City Light Policies and Procedures One of the objectives of the current study has been to determine if it is feasible to create wetlands on City Light rights-of-way, and if so, what are the relevant policies and guidelines of right-of-way management that may need to be revised to accommodate wetland creation. As noted previously, the creation of wetlands on rights-of-way apparently does not conform to SCL Policy and Procedures (see Appendix A). Flooding and created water bodies are not permitted on rights-of-way. If creation of wetlands is found to be feasible, City Light will have to resolve these policy issues internally.

Water Quality The creation of wetlands would have the potential for negatively affecting water quality during construction. Once established, wetlands should improve water quality through bio-filtering of runoff and removal of excess sediment and nutrients. Water quality would be addressed from a regulatory perspective during the permitting process described above. It should therefore be considered from a technical standpoint during design, with particular attention paid to control of sedimentation during construction and rapid re-stabilization of disturbed soils. These are all routine matters and should have no bearing on the feasibility of the proposal.

Human Health Mosquito control is a concern of the Washington State Department of Social and Health Services (DSHS). State General Sanitation Rules and Regulations require all wetlands to be "maintained by their owners free from the breeding of mosquitoes." As a practical matter, DSHS does not concern itself with a particular wetland unless neighboring landowners make formal complaints to the agency. Mosquitoes are not a serious problem in western Washington as a whole, but they can become a local nuisance. The most effective means of mosquito control is still the use of chemical insecticides, but this would be contradictary to the two basic incentives for constructing wetlands, which are to reduce the use of pesticides and reduce maintenance costs. The rural nature of most of the right-of-way will reduce this as a potential problem, but it could occur in isolated cases. It will not affect the overall feasibility of creating wetlands.

Cultural Resources Impacts to cultural resources are expected to be small or non-existent for two reasons. First, cultural sites in western Washington are typically concentrated along large water bodies (Puget Sound and the major rivers), in natural meadows (i.e., Tacoma prairies), and along major overland

trails and mountain passes. The Skagit right-of-way encounters very few such areas. Most of the right-of-way was cleared through dense coniferous forest where prehistoric and historic resources are unlikely to be found. Second, the disturbance of initial construction and regular maintenance would have disturbed most sites on the right-of-way. Cultural resources will therefore have little impact on the feasibility of developing wetlands even though ground-moving activities will be involved. As a precaution, however, any span proposed for development should be field surveyed by a professional archaeologist familiar with the history of the region.

Costs Creating wetlands on the right-of-way would involve earth contouring and grading to create level, low-lying areas. This may be done to remove hummock areas in existing wetlands, level areas adjacent to existing wetlands or level gentle slopes (0.5%) and create berms or dikes to retain water. Appendix D presents costs for wetlands development projects in the King County region and a cost estimate for one area on the right-of-way that appears to be a good candidate for manipulation. Cost estimates for earth-moving operations range from $8,000-$12,000/acre. Earth removal from the site would be an additional cost of $12,000/acre. Revegetation costs would depend on the method or combination of methods used. Cost estimates for hydroseeding range from $3,000/ acre with a grass seed mix to $6,000/acre for a wildflower/shrub/grass mix. Planting with one-year liner stock would cost $9,000/acre. Recommended native plants to use for revegetation and their sources are listed in Appendix F.

City Light's current costs for tree removal on the Skagit right-of-way average $480/acre, based on costs accrued from January through September 1986,

the time period during which most of the right-of-way tree removal work is done. The average removal cycle per span for deciduous trees is three years, resulting in an average cost of $160/acre/year for tree removal on the Skagit right-of-way.

If one considers a wetlands creation project which requires no removal of soil from the site, with average costs of $12,000/acre for earth moving (this is the most common figure quoted for actual 1986 wetlands construction projects, Gaynor, pers. comm., November 1986) and revegetation costs at $6,000/acre (rarely would a wetland area be reseeded with only a grass seed mix), an average cost of $18,000/acre would result. The payback period for the investment in this project, based on 1986 City Light tree removal costs, would be 112 years, assuming no interest on the investment or maintenance of the area after construction.

Wetland Stability and Maintenance The two most important factors to consider in conjunction with this element are that the Skagit right-of-way already supports wetland vegetation on most of the moist, level sites, and that any efforts to enlarge or enhance these areas would result in ground disturbances that would at least temporarily encourage the invasion of problem species (i.e., red alder). The BEAK team visited representatives of the 71 spans that emerged from the screening process, and discovered that most of them currently support dense communities of spirea and other scrub-shrub wetland species. Tree invasion of these spans is limited to scattered individual alders and cottonwoods, mostly on small hummocks and along the sides of the access road. A re-examination of the inventory data verified the impression gained in the field; that the most serious alder control problem is on steeper, upland spans with

little potential for wetland development (Table 2). This supports the hypothesis that wetlands can control tree invasion, but it reduces the feasibility or need for creating new wetlands on the Skagit right-of-way. Tree invasion in existing wetlands is limited for the most part to the types of areas that will occur in all wetlands, and control of tree invasion can be cost-effectively handled through several traditional measures. Elimination of these problem areas, particularly the hummocks, would be very expensive and would provide relatively little benefit. It would also result in more ground disturbance and temporarily increase tree invasion rather than suppressing it. BEAK recommends that established communities of low-growing vegetation which are already providing control of tree invasion be managed and enhanced through subtler means than earth moving or complete alteration of plant communities. Suggestions for accomplishing this in existing wetlands are contained in Appendix E.

Table 2. Alder density in relation to percent slope on the Skagit right-of-way.

	Alder Density	
Percent Slope	< 200 Stems/Acre	> 200 Stems/Acre
level	47 spans	4 spans
< 10%	118 spans	7 spans
10-30%	94 spans	13 spans
> 30%	130 spans	35 spans
TOTAL	389 spans (87%)	59 spans (13%)

5.0 CONCLUSIONS

The creation of inland freshwater wetlands is technically feasible (Milligan 1985; Adumus 1986; Wolf et. al. 1986), and conditions favorable to wetlands creation exist on City Light rights-of-way. The existing wetlands could be improved and/or expanded and wetlands could be created in other areas if impoundments were constructed for water retention. But, the high costs of these manipulations, in view of the minor tree control problem in these areas, prevents wetland expansion or creation from being a cost-effective tool for vegetation control on City Light rights-of-way.

Western Washington has lost a considerable amount of wetlands habitat, especially in developing areas. Protection of wetland communities is presently regulated by local, state and federal agencies. It is important for City Light to consider right-of-way maintenance practices in the wetland areas in view of right-of-way vegetation control and preservation of the integrity of wetland communities. It is equally important for the private landowners leasing their property to the City to understand the value of wetlands on the rights-of-way and the regulations protecting wetlands. Appendix E, which discusses preferred maintenance practices in wetland areas, is applicable to both City Light maintenance crews and private landowners along the right-of-way.

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Appendices

APPENDIX A

SEATTLE CITY LIGHT RIGHT-OF-WAY USE GUIDELINES

Appendix A. Seattle City Light Right-of-Way Use Guidelines (from Department Policy and Procedure DPP 500, p.132, March 2, 1984).

Use No.	Use Name	Policy	Comments
C6	Catch basins	Permitted	Not within 15 feet of poles or towers
C14	Culverts	Permitted	Not within 25 feet of poles or tower footings
C16	Cut and Fills	Permitted	Not over tower footings, Cannot undermine towers
D1	Dams	Permitted	Complete engineering review required
D2	Detention ponds	Permitted	Fencing and/or signs may be required
D3	Ditches	Permitted	Not within 25 feet of tower footings or poles
F3	Flooding	No	Prevents access
L1	Lakes	No	Risk of drowning, limits access
P9	Ponds	No	Risk of drowning, limits access
R4	Reservoirs	No	Risk of drowning, limits access

APPENDIX B

WETLAND INDICATOR STATUS FOR
PLANT SPECIES FOUND ON THE
SKAGIT AND CEDAR FALLS RIGHTS-OF-WAY

Appendix B. Wetland Indicator Status (WIS) for Plant Species Found on the Skagit and Cedar Falls Rights-of-Way.

Scientific name	Common name	Spp. Symbol	WIS T/E
TREES:			
Abies procera	Noble fir	Ap	5*
Acer glabrum	Douglas' maple	Ag	3
Acer macrophyllum	Big-leaf maple	Am	4
Alnus rubra	Red alder	Ar	3
Betula papyrifera	Paper birch	Bp	4
Picea sitchensis	Sitka spruce	Ps	3
Pinus contorta	Lodgepole pine	Pl	3-
Pinus monticola	W. white pine	Pw	4
Platanus spp.	Sycamore spp.	Pz	4*
Populus tremuloides	Quaking aspen	Pq	3*
Populus trichocarpa	Black cottonwood	Pt	3*
Prunus pensylvanica	Bird cherry	Pp	4*
Prunus spp.	Cherry spp.	Pz	4*
Pseudotsuga menziesii	Douglas fir	Pm	5*
Robinia pseudo-acacia	Black locust	Rp	5*
Sorbus aucuparia	Europ. mtn. ash	Sa	4*
Thuja plicata	Western red cedar	Tp	3
Tsuga heterophylla	Western hemlock	Ts	4-
Landscape conifer - short		Lb	
Landscape conifer - tall		Lc	
Landscape deciduous - tall		Ld	
Landscape deciduous - short		Le	
SHRUBS:			
Acer circinatum	Vine maple	Ac	4+
Arctostaphylos uva-ursi	Kinnikinnik	Au	4-
Berberis nervosa	Cascade Oregon-grape	Bn	5*
Cornus nuttallii	Pacific dogwood	Cn	4*
Cornus stolonifera	Red-osier dogwood	Cs	2
Corylus cornuta	Hazelnut	Cc	4*
Crataegus douglasii	Black hawthorn	Cd	3
Cytisus scoparius	Scotch broom	Cb	5*

Appendix B. Continued.

Scientific name	Common name	Spp. Symbol	WIS T/E
Gaultheria shallon	Salal	Gs	4*
Holodiscus discolor	Ocean-spray	Hd	5*
Ledum groenlandicum	Labrador tea	Ll	1
Linnaea borealis	Twin flower	Lb	4-
Oplopanax horridum	Devil's club	Oh	3
Physocarpus capitatus	Pacific ninebark	Pc	3+
Rhus spp.	Sumac	Rh	4*
Ribes spp.	Gooseberry	Rq	4*
Rosa spp.	Rose	R	3*
Rubus discolor	Himilayan blackberry	Rd	4-
Rubus laciniatus	Evergreen blackberry	Rl	4*
Rubus parviflorus	Thimbleberry	Rt	4*
Rubus spectabilis	Salmonberry	Rs	3
Rubus ursinus	Pacific blackberry	Ru	4*
Salix spp.	Willow	Sx	3*
Sambucus racemosa	Red elderberry	Sr	4*
Sorbus sitchensis	Sitka mtn. ash	Sc	4*
Spiraea douglasii	Harkhack spirea	Sd	2
Symphoricarpos albus	Common snowberry	Sw	4
Vaccinium parvifolium	Red huckleberry	Vp	4*
HERBACEOUS, GRASSES AND OTHER PLANTS			
Athyrium felix-femina	Lady-fern	Af	3
Blechnum spicant	Deer-fern	Bd	3
Braenia schreberi	Water-shield	Bs	1
Carex obnupta	Slough sedge	Co	1
Carex spp.	Sedge	Cx	1*(most are 1)
Chrysanthemum leucanthermum	Oxeye daisy	Cl	5*
Cirsium arvense	Canadian thistle	Cr	4+
Digitalis purpurea	Foxglove	Dp	4*
Epilobium angustifolium	Fireweed	Ea	4
Equisetum spp.	Horsetail	Eh	3*
Eriophorum chamissonis	Chamisso's cotton-grass	Ec	1
Fragaria spp.	Wild strawberry	Fx	5*
Gramineae	Undifferentiated grasses	Gr	6
Hypericum perforatum	Klamath weed	Hp	5*
Hypochaeris radicata	Hairy cats-ear	Hr	5*

Appendix B. Continued.

Scientific name	Common name	Spp. Symbol	WIS T/E
Juncus effusus	Soft rush	Je	2
Lactuca muralis	Wall lettuce	Lm	4*
Lysichitum americanum	Skunk cabbage	La	1
Plantago lanceolata	English plantain	Pl	4+
Polystichum munitum	Sword-fern	Pm	4*
Prunella vulgaris	Self-heal	Pv	4+
Pteridium aquilinum	Bracken-fern	Bx	4
Ranunculus repens	Creeping buttercup	Rr	2
Scirpus spp.	Bulrush	Sx	1*(most are 1)
Sparganium emursum	Simplestem bur-reed	Se	1
Tanacetum spp.	Tansy	To	5*
Typha latifolia	Common Cat-tail	Tl	1
Urtica dioica	Stinging nettle	Ud	2*
Veronica americana	American brooklime	Va	1
Musci	Unknown moss spp.	Mz	6

WIS = Wetland Indicator Species

1 = Obligate (OBL). Always found in wetlands under natural (not planted) conditions (frequently greater than 99 percent), but may persist in nonwetlands if planted there by man or in wetlands that have been drained, filled, or otherwise transformed into nonwetlands.

2 = Facultative Wetland (FACW). Usually found in wetlands (67-99 percent frequency), but occasionally found in nonwetlands.

3 = Facultative (FAC). Sometimes found in wetlands (34-66 percent frequency), but also occurs in nonwetlands.

4 = Facultative Upland (FACU). Seldom found in wetlands (1-33 percent frequency) and usually occurs in nonwetlands.

A positive (+) or negative (-) symbol was used with the Facultative indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).

5 = Nonwetland (UPL). Occurs in wetlands in another region, but not found (less than 1 percent) in wetlands in the region specified. If a species does not occur in wetlands in any region, it is not on the list.

6 = Assigned to genus without species named (i.e., Salix spp., Ribes spp.) if too many species are in the genus, or genus has a wide moisture gradient. Information is needed on species or species associations to assign a WIS.

* = If this symbol appears next to a number, the particular species was either not reviewed, not considered, its status could not be agreed upon by the reviewing committee, or the species did not appear on the list. In this case, the wetland indicator status was assigned from Raedeke Associates field experience plus natural history information from Hitchcock and Cronquist (1976), and others.

T/E = Threatened, endangered, and sensitive vascular plants of Washington. List is from the Washington Natural Heritage Program and includes plants that are given federal, state and county protection status. To date (6/17/86) none of the species listed in the inventory are threatened, endangered, or sensitive. Field surveys will help verify this.

APPENDIX C

ENDANGERED, THREATENED AND SENSITIVE PLANTS OF KING, SNOHOMISH AND SKAGIT COUNTIES

Appendix C Table 1. Endangered, Threatened and Sensitive Vascular Plants of King County, Washington as of May, 1985.

Status		Scientific name	Common name
Federal	State		
C	PE	Arenaria paludicola (U)	Swamp sandwort
-	S	Campanula lasiocarpa	Alaska harebell
-	S	Carex comosa*	Bristly sedge
-	T	C. pauciflora*	Few-flowered sedge
C	E	Castilleja levisecta (L)*	Golden indian paintbrush
-	S	Cimicifuga elata	Tall bugbane
-	S	Gentiana douglasiana	Swamp gentian
-	S	Lobelia dortmanna	Water lobelia
-	S	Lycopodium inundatum*	Bog clubmoss
-	T	Pleuricospora fimbriolata	Fringed pinesap
-	S	Puccinellia nutkaensis	Alaska alkaligrass

Codes:

Federal = Federal status: Plants that are candidates on the 1980 Federal Register, Notice of Review (and 1983 Supplement), are marked with a "C." A dash indicates no federal status.

State = State status

PE = Possibly extinct or extirpated in Washington. Taxa in this group are all high priorities for field investigation. If found, they will be assigned a status category.

T = Threatened

E = Endangered

S = Sensitive

(U) = Unverified (i.e., uncertain identification).

(L) = Likely occurrence in county.

(*) = Habitats may occur on the project site.

Source: Washington Natural Heritage Program. 1984. Endangered, threatened and sensitive vascular plants of Washington. Department of Natural Resources, Olympia, Washington. 29pp.

Appendix C Table 2. Endangered, Threatened and Sensitive Vascular Plants of Snohomish County, Washington as of May, 1985.

Status		Scientific name	Common name
Federal	State		
-	S	Botrychium boreale	Northern grape-fern
-	S	B. lanceolatum	Lanced-leaved grape-fern
-	S	B. lunaria var. onondagense	House moonwort
-	S	Campanula lasiocarpa	Alaska hairbell
-	S	Carex comosa*	Bristly sedge
-	T	C. pauciflora*	Few-flowered sedge
-	S	C. stylosa	Long-styled sedge
-	S	Coptis asplenifolia*	Spleenwort-leaved goldenthread
-	S	Dodecatheon pulchellum var. watsonii	Few-flowered shooting star
-	S	Dryas drummondii	Yellow mountain-avens
-	S	Fritillaria camschatcensis	Indian rice, Black lily
-	S	Lobelia dortmanna	Water lobelia
-	S	Montia diffusa (U)*	Branching montia
-	S	Plantago macrocarpa (L)*	Alaska plantain
-	T	Platanthera chorisiana*	Choriso bog-orchid
-	S	Ranunculus cooleyae	Cooley's buttercup
-	S	Saxifraga debilis	Pygmy saxifrage
-	S	S. integrifolia var. apetala (L)	Swamp saxifrage
-	S	Utricularia intermedia*	Flat-leaved bladderwort

Codes:

Federal = Federal status: Plants that are candidates on the 1980 Federal Register, Notice of Review (and 1983 Supplement), are marked with a "C." A dash indicates no federal status.

State = State status

T = Threatened

E = Endangered

S = Sensitive

(U) = Unverified (i.e., uncertain identification).

(L) = Likely occurrence in county.

(*) = Habitats may occur on the project site.

Source: Washington Natural Heritage Program. 1984. Endangered, threatened and sensitive vascular plants of Washington. Department of Natural Resources, Olympia, Washington. 29pp.

Appendix C Table 3. Endangered, Threatened and Sensitive Vascular Plants of Skagit County, Washington as of May, 1985.

Status		Scientific name	Common name
Federal	State		
-	S	Botrychium boreale (L)	Northern grape-fern
-	S	B. lanceolatum (L)	Lanced-leaved grape-fern
-	S	B. lunaria var. onondagense (L)	House moonwort
C	T	Calamagrostis crassiglumis (L)	Thickglume reedgrass
-	S	Carex comosa*	Bristly sedge
-	T	C. pauciflora (L)*	Few-flowered sedge
-	S	C. scirpoidea var. scirpoidea (L)	Canadian single-spike sedge
C	E	Castilleja levisecta	Golden indian paintbrush
-	S	Erythronium revolutum	Pink fawn-lily
-	S	Fritilaria camschatcensis (L)	Indian rice, Black lily
-	S	Gentiana glauca (L)*	Water-avens, Purple aven
-	S	Lobelia dortmanna	Water lobelia
		Loseleuria procumbens	
-	S	Lycopodium dendroidem (L)	Treelike clubmoss
-	S	L. inundatum (L)*	Bog clubmoss
-	T	Ophioglossum vulgatum (L)*	Adder's-tongue
-	S	Plantago macrocarpa (L)*	Alaska plantain
-	T	Platanthera chorisiana (L)*	Choriso bog-orchid
-	S	Puccinellia nutkanesis	Alaska alkigrass
-	S	Ranunculus cooleyae (L)	Cooley's buttercup

Status		Scientific name	Common name
Federal	State		
-	S	Saxifraga debilis	Pygmy saxifrage
-	S	S. integrifolia var. apetala (L)	Swamp saxifrage
-	S	Sedum lanceolatum var. nesioticum	Lanced-leaved stonecrop

Codes:

Federal = Federal status: Plants that are candidates on the 1980 Federal Register, Notice of Review (and 1983 Supplement), are marked with a "C." A dash indicates no federal status.

State = State status

T = Threatened

E = Endangered

S = Sensitive

(U) = Unverified (i.e., uncertain identification).

(L) = Likely occurrence in county.

(*) = Habitats may occur on the project site.

Source: Washington Natural Heritage Program. 1984. Endangered, threatened and sensitive vascular plants of Washington. Department of Natural Resources, Olympia, Washington. 29pp.

APPENDIX D

METHODS OF WETLANDS CONSTRUCTION AND 1986 COST ESTIMATES

17 November 1986

Marty Vaughn
Beak Consultants, Inc.
11911 N.E. 1st Street, Suite 303
Bellevue, WA 98005

SUBJECT: Feasibility of Creating Wetlands on Seattle City Light Transmission Line Rights-of-Way

Dear Marty:

Please find below a compilation of our recent wetland creation experience as directed to the above named project.

In brief, creating wetlands is expensive, particularly if extensive grading is required. We have generally found that wetland creation is a result of several incentives and goals--compliance with regulations, mitigation, habitat enhancement, aesthetic improvement and public education, to name the several we have encountered. Taken as a whole, these goals justify the initial cost of wetland construction.

Although the cost of controlling tree growth on rights-of-way may not provide enough impetus to build wetlands, the following information may be useful in situations where the requirements and goals are a great enough incentive for creating wetlands on Seattle City Light lands.

METHODS OF CONSTRUCTING WETLANDS AND A VALUATION OF COSTS

In the past, wetlands have been looked upon as bad drainage areas--flat, low-lying places where water collects and stands. To create a wetland, then, is to create a flat, low-lying area--in relation to the surrounding terrain--that collects and holds water. The primary method used to accomplish this involves earth contouring and grading to form, in essence, a basin. Completion of a wetland construction, after grading operations, includes planting and/or reseeding of the disturbed area.

The methods described below have been employed in recent wetland creations, notably the 140th Avenue N.E. Stream Relocation project in Bellevue, the Bird Sanctuary at the Bloedel Estate, Bainbridge Island, and at the Klahanie Housing Development in Issaquah.

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The descriptions of each procedure are simplified and idealized to facilitate comparison and evaluation. For a specific proposed wetland project, consideration and adjustment of required construction methods and values is anticipated to determine the project's feasibility.

Table 1 is a valuation matrix for working out various combinations of construction procedures and comparing their relative costs. The costs for each procedure are approximated from actual 1986 prices for similar wetland creation work and are as described below. (See Attachment A at end of this letter.)

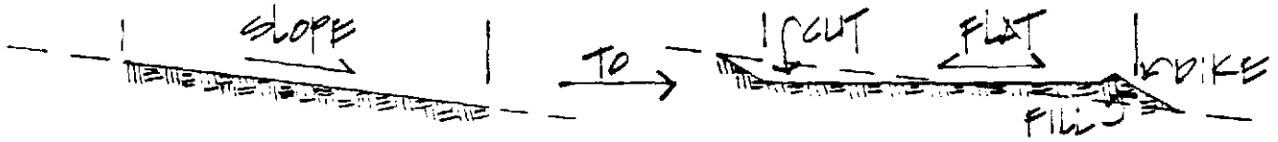
METHODS:

1. Grading, Cut and Fill On-site: Regrade 2 percent slope to 0 percent (approximately 2340 cubic yards) with bulldozer, grade-all, backhoe or other similar heavy equipment; create a downslope dike as required to impound water; equalize cut and fill soil quantities to eliminate soil removal requirements.

   Approximate 1986 Cost: $ 12,000/ACRE

   Note: Each 2 percent increase in slope will increase the per acre cost by $ 12,000. Example: To regrade a 4 percent slope to 0 percent will cost approximately $ 24,000 in 1986 dollars.

FIGURE 1.



GRADING CUT & FILL ON SITE
NOT TO SCALE

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2. Soil Removal from Site and Disposal: Remove excavated soil from grading operations as described above from site; haul by truck in approximate 4 to 5 mile round trips to disposal site.

   Approximate 1986 Cost: $ 12,000/ACRE

   Note: Soil quantity for disposal is based upon excavation of 2 percent slope to 0 percent or 2340 cubic yards, as described above. Each 2 percent increase in slope will increase soil amount and removal cost by $ 12,000 per acre. Example: To remove soil excavated from a 4 percent slope to create a 0 percent basin will cost approximately $ 24,000 in 1986 dollars.

3. Revegetation with One-year Liner Stock: Replant all areas disturbed by grading operations with native wetland tree and shrub species as one-year liner stock, 18 - 24 inch height; plant liners at 3'-0" oncenter triangular spacing. (See Appendix F in main text for plant material list and sources.)

   Approximate 1986 Cost: $ 9,000/ACRE

   Note: Reduction or increase in oncenter spacing of liners is directly proportional to cost; adjustment will be required for spacing other than 3'-0" oncenter as specified in this description.

4. Seeding with Wildflower/Shrub/Grass Seed Mix: Hydroseed all areas disturbed by grading with a mixture of native wetland wildflowers, shrubs and grasses at a rate of 50 pounds per acre. Hydroseeder simultaneously applies mulch, tackifier and 20-10-10 fertilizer at following rates:

   a. Mulch (Silva-mulch or equal).....2000 lbs./acre
   b. Tackifier (J-tac or equal)..... 45 lbs./acre
   c. Fertilizer (20-10-10)..... 220 lbs./acre

   Approximate 1986 cost: $ 6,000/ACRE

   Note: Changes in above application rates and specific seed mix will require adjustment of cost. Seeding may be done as sole revegetation method or in combination with planting liner stock as described above in #3.

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5. Seeding with Grass Seed Mix: Hydroseed all areas disturbed by grading with grass seed mix of bentgrass, fescue, ryegrass, and white dutch clover at rate of 65 pounds per acre. Hydroseeder simultaneously applies mulch, tackifier and 20-10-10 fertilizer at following rates:

a.	Mulch	2000 lbs./acre
b.	Tackifier (J-tac or equal)	45 lbs./acre
c.	Fertilizer (20-10-10)	220 lbs./acre

Approximate 1986 cost: $ 3,000/ACRE

Note: Changes in the above application rates and specific seed mix will require adjustment of cost. Seeding may be done as the sole revegetation method or in combination with planting liner stock as described above in #3.

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VALUATION OF CONSTRUCTION METHODS/APPLICATION AND FEASIBILITY

TABLE 1. Values of common wetland creation scenarios likely to be employed on Seattle City Light Rights-of-Way. All figures represent thousands of 1986 dollars.

CONSTRUCTION METHOD	VALUE	SITUATION 1	2	3	4
Grading, Cut & Fill On-site-- 2% to 0%	12	12	12		
Soil Removal from Site-- 2% to 0%	12		12		
Revegetation-- Liners	9	9		9	
Seeding, Mix #1-- flow/shrub/grass mix	6		6	6	
Seeding, Mix #2-- grass mix	3	3			3
TOTALS		24	30	15	3

Examples shown valued above are:

Situation 1--A 2 percent sloping site is regraded to a 0 percent basin and all cut and fill remains on-site; disturbed area is revegetated with wetland plants in liners and is overseeded with a grasses seed mix. (If the site slope were 4 percent, the value for grading would double to 24; if 6 percent, triple to 36, etc.)

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Situation 2--A 2 percent sloping site is graded to 0 percent and all excavated soil is removed from the site and disposed; the disturbed area is hydroseeded only with a wildflower/shrub/grass seed mix. (If the site slope were 4 percent, the value for grading and removal of soil would be doubled to 24; if 6 percent, tripled to 36, etc.)

Situation 3--The site is revegetated with liner shrub stock and overseeded with a wildflower/shrub/grass seed mix. This situation could occur where an already wet, low-lying site is changing use; example: pasture land or farm fields reverting to feral, unused acreage.

Situation 4--The site is hydroseeded with a grasses seed mix. This situation could occur where, again, a wet, low-lying site is changing use from pasture or farm field, is small and is surrounded or bordered by desirable and aggressive wetland plant species, i.e. Spiraea douglasii, that will encroach upon and eventually revegetate the site. The seeding in this case is a quick and essentially temporary cover, possibly designed to retard undesirable species, i.e. Alnus rubra, by including nitrogen-fixing forbs, such as clover or birdsfoot trefoil.

An alternative to this situation would be hydroseeding with a wildflower/shrub/grass mix to increase diversity and perhaps speed the successional revegetation with shrubs. However, this alternative doubles the cost.

Submitted by: Peggy Gaynor Principal

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ATTACHMENT A, COSTS AND PRICES FOR WETLAND CONSTRUCTION & REVEGETATION

GRADING, Cut & Fill Onsite:

From actual construction projects costs, 1986: $5.00-6.00 per cubic yard

GRADING, Cut & Remove from Site including Disposal:

From actual wetland construction project costs, 1986: $10.00-11.00 per cubic yard

PLANT MATERIAL: The following costs are from the bid tabulation for 140th Avenue N.E. Stream Relocation project, Bellevue, Washington, 20 May 1986.

A. Trees, 10 - 12 foot height, in place, per each:

Estimate:	$140.00
Bidder #1:	$100.00
Bidder #2:	$ 88.00
Bidder #3:	$380.00

B. Trees, 12 - 14 foot height, in place, per each:

Estimate:	$100.00
Bidder #1:	$150.00
Bidder #2:	$180.00
Bidder #3:	$375.00

C. Trees, 14 - 16 foot height, in place, per each:

Estimate:	$250.00
Bidder #1:	$250.00
Bidder #2:	$400.00
Bidder #3:	$422.00

D. Trees and Shrubs, 5 - 9 foot height, in place, per each:

Estimate:	$ 23.00
Bidder #1:	$ 30.00
Bidder #2:	$ 28.00
Bidder #3:	$190.00

E. Trees and Shrubs, 6 - 8 foot height, in place, per each:

Estimate:	$ 65.00
Bidder #1:	$ 30.00
Bidder #2:	$ 30.00
Bidder #3:	$190.00

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F. Shrubs, 24 - 36 inch height, in place, per each:

Estimate:	$ 16.00
Bidder #1:	$ 20.00
Bidder #2:	$ 6.50
Bidder #3:	$ 50.00

G. Shrubs and Ground Covers, 1 gallon container, in place, per each:

Estimate:	$ 5.60
Bidder #1:	$ 4.00
Bidder #2:	$ 5.50
Bidder #3:	$ 25.00

H. Ground Cover, 4 inch container, in place, per each:

Estimate:	$ 2.00
Bidder #1:	$ 3.25
Bidder #2:	$ 4.50
Bidder #3:	$ 7.00

I. Seed Mix as follows, 1.15 pounds per 1000 square feet installed:

	Percent by Weight
1. Wildflowers--Applewood Seed Company #8044, Moist Mixture.....	12
2. *Shrubs--	
a. Rosa nutkana (Nootka rose).....	20
b. Vaccinium parvifolium (red huckleberry) or Vaccinium ovatum (evergreen huckleberry).....	28
3. Grasses--Lolium multiflorum (annual ryegrass).....	40

Estimate:	$110.00
Bidder #1:	$ 60.00
Bidder #2:	$120.00
Bidder #3:	$160.00

* In final construction, shrub species were unavailable. Wildflower seeds were substituted for shrub seed; species included were Lupinus polyphyllus (bigleaf lupine), Monarda sp. (beebalm), and Mimulus guttata (yellow monkeyflower).

J. Seed Mix as follows, 1.5 pounds per 1000 square feet installed:

		Percent by Weight
1.	Pennfine Perennial Ryegrass	34.44
2.	Pennlawn Red Fescue	24.88
3.	Cascade Chewings Fescue	24.86
4.	Derby Perennial Ryegrass	14.60

Estimate: $ 30.00
Bidder #1: $ 60.00
Bidder #2: $ 60.00
Bidder #3: $200.00

PLANT MATERIAL: The following are material only costs for native wetland plant material from Newell Wholesale Nursery, P.O. Box 372, Ethel, WA 98542; 985-2460, Fall 1986 - Spring 1987.

One-year Liners (18" - 20") of: Salix sp., Cornus stolonifera, Alnus rubra, Symphoricarpus alba, Rosa nutkana, Rubus parviflorus, Ribes sanguineum, Physocarpus capitatus, Spiraea douglasii, Rubus spectabilis.....$ .35/each.

Two to Three-year Liners (18" - 24") of: Sambucus racemosa, Amelanchier canadensis, Rosa rugosa.....$ .75/each.

Collected specimens of:
Oplopanax horridum (devil's club), 3'-4' height.....$ 3.50/each.
Lysichitum americanum (skunk cabbage), mature bulb.....$ 3.50/each.

TERRA ASSOCIATES, Inc.
Geotechnical Consultants

WETLAND MODEL AND FEASIBILITY ANALYSIS FOR GENERATING WETLANDS ALONG CITY LIGHT RIGHT-OF-WAY

The general working model for site manipulation to create a wetland involves earth-moving to create a low berm to impound water. A suitable site must have a water supply, a slope of less than 5% to 8%, and an impermeable soil layer relatively near the surface. The following discussion will address the available soils information and generate a wetland model which can be used to analyse projected costs.

On the spans identified by the critical element screening for the right-of-way in Snohomish County there are a total of 15 different soil types. Some of these soils are in existing wetlands, while others with high permeability and greater depth would require soil ammendment to reduce the rate of infiltration to make them suitable to retain water behind a berm long enough into the growing season to control tree regeneration.

Of the soil types included, the Tokul series soils are the best suited for manipulation to create water impoundment and wetlands. The Tokul soils are characterized as having a depth of 20 to 40 inches over an impermeable hard pan or glacial till. A seasonal perched water table develops between November and May. It is this perched water which can be trapped behind a berm and retained to extend the period of saturated soil conditions into the late spring long enough to inhibit tree regeneration and growth.

Other soils somewhat similar in nature are the Alderwood series, Mckenna Gravelly Silt Loam, Norma Loam and Pastik Silt Loam. These soils, however, are deeper and better drained and in general, water availability is lower. Included within these map units are often smaller low and less well drained areas which can support wetland type vegetation.

Soil types Everett Sandy Loam, Greenwater Loamy Sand and Winston Gravelly Loam are generally less suitable for consideration because they are deep and well drained. While they may be subject to periodic flooding along water courses, there is rapid infiltaration and standing water does not remain for long. Soil ammendments would be necessary to create an impermeable layer to retain water in an impoundment long enough into the spring to inhibit tree regeneration.

The remaining soil types, Mukilteo Muck and the Custer Fine Sandy Loam are

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Mailing Address: P.O. Box 3338 • Redmond, Washington 98073

generally found in low, poorly drained areas which are existing wetlands unless the site has been altered to provide drainage. The Bellingham Silty Clay Loam is also found in low-lying areas with poor natural drainage but within the area has mostly been put into use as pasture or agricultural crop land. These existing wetlands as a general policy probably should not be disturbed to avoid the risk of disturbing the existing water regime.

This analysis of the soil types along with the critical element screening suggests that there is a limited number of spans which should realistically be considered for study as suitable for possible manipulation to create wetlands. Existing wetlands should not be disturbed and it is probably not easily feasible to work to create wetlands on the better drained soils. The Tokul series soils are the best candidates for manipulation to generate wetlands.

For the purpose of developing a wetland model which can be used to develop a cost analysis, the section of right-of way between span D14/25N and D15/35N, covering a distance of 6325 feet, has been selected for having an appropriate topographical configuration, an available water source and Tokul series soils. This stretch of the right-of-way turned up in the critical element screening and after a site visit it appears to be well suited for manipulation to create wetlands.

The north end of this study area is at Getchel Road and it extends south from the road for a distance of 6325 feet. It includes a naturally ocurring wetland as part of the Lake Martha-Lake Cassidy watershed. Soils on the section are the Tokul series gravelly loams and the Mukilteo Muck in the wetland. There are no well-defined streams or water courses in the area although there is a high water table and general seepage through the upper soils in a south easterly direction toward Lake Martha and Lake Cassidy. The topography of the area is gently undulating with a downward slope from Getchell Road to the wetland. At the south end of the wetland the study area ends where the land rises more steeply and there is a rather distinct transition from the lower wet areas and the better drained uplands.

Within the area, spirea is one of the dominant species throughout and there are cattails scattered in isolated low pockets. At present the alder appears to be reasonably well controlled although there is some seedling establishment and sprouting at the base of previously cut stumps. The adjacent lands to the east support a second-growth mixed conifer forest with scatterred alder and big-leaf maple. To the west, alder is the dominant tree species. Soils off the right-of-way in the forest are generally about two to three feet in depth above the glacial till whereas on the right-of-way, soils are one and one half to two feet in depth over the till. The surface topography over most of the area is hummocky. With relatively minor elevational differences above the water table alders can become established alongside cattails.

There is a well established gravel and dirt road running parallel along the right-of-way with more recently developed side roads providing access to towers. At the north end there has been road building across the right-of-way associated with new developments on either side.

Where soil disturbance has removed the surface soils, exposing the glacial

till plants have been slow to become reestablished while in areas where the disturbance has been less severe leaving some soil in place, dense alders are becoming established.

Creation of a wetland will involve movement of soils to create a berm to impound water covering the area of earth removal. The existing topography is such that it would not be feasible to generate large areas of wetland covering more than one span and extending across the entire width of the right-of-way. Rather a more feasible scale will be on the order of that illustrated in the model illustrated in Figures 1 and 2. In this model the wetland is being created by excavating soil and using it to create a berm with the wetland being created over the area from which the soil has been excavated.

For the purpose of this analysis a uniform slope has been assumed, whereas in actuality even over the relatively short distances of this model there is considerable fluctuation which would affect the volume of soil necessary to be moved and the area which could be inundated.

The model on the two per cent slope constructed as shown with a four foot high berm would create a wetland area of 10200 square feet or about one-quarter acre. A similar berm on a five per cent slope would back up water over 5100 square feet or approximately one-twelfth of an acre. Estimated costs for the necessary earth work are $1850 on the two per cent slope and about $1400 for the five per cent slope or about $8000 per acre and $11700 per acre of wetland created, respectively. These costs are tabulated on Table 1.

In addition to the area of potential wetland produced, there will be disturbed soils outside the area of innundation which would be potential seed bed for alder regeneration. These include the berm and the upper limits of the created wetland as outlined on Figures 1 and 2 and would amount to an area of approximately 5760 square feet on the two per cent slope and 3520 square feet on the five per cent slope. Thus for each acre of wet land created approximately 0.5 acre and 0.6 acre of disturbed area which would have to be treated to prevent alder establishment.

With the scale of wetlands being created in this model there do not appear to be significant conflicts with Seattle City Light Right-of-way use guidelines as listed in Appendix A. Some economies could be realized on a site-specific basis where new access roads are being considered with the roadway construction being used to create the berm.

TABLE 1

Estimated Costs to Construct Berm for Wetland Creation
(2% slope)

Layout and Planning	$200
Earth-moving ($4.50/cu.yd. X 260 cu.yd.)	$1170
Compaction of soil in berms ($0.64/cu.yd. X 260 cu.yd)	$166
Quarry rock for spillways ($21.00/cu.yd. X 3 cu.yd.	$ 63
Mobilization	$250
Total	$1849

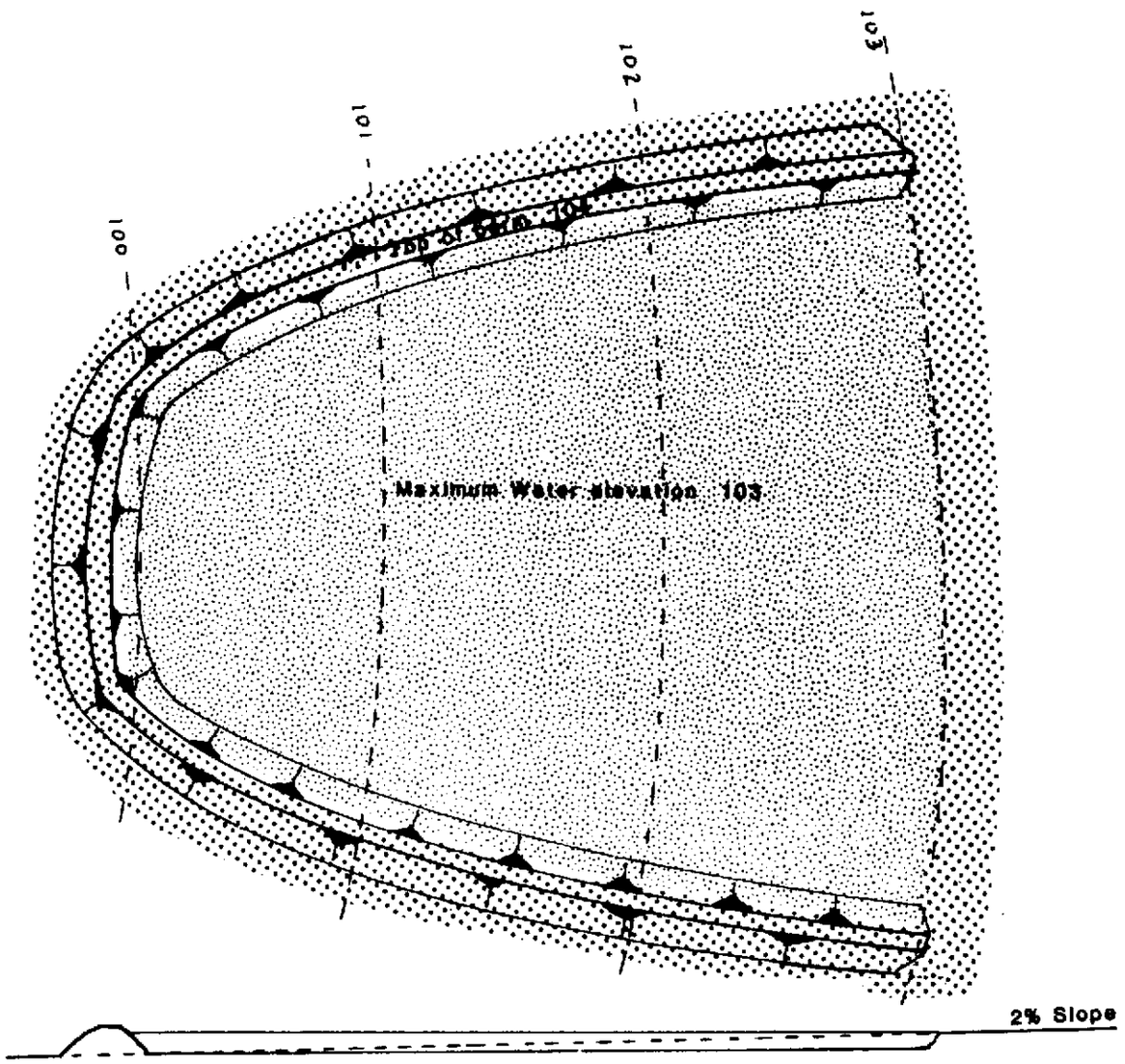
Area of wetland created	10200 sq.ft. = .25 acre	
Estimated cost per acre		$8039
Area of disturbed soil outside of created wetland	5760 sq.ft.	
Area of disturbed soil per acre of wetland created	0.5 acre	

Table 1 (cont)

Estimated Costs to Construct Berm for Wetland Creation
(5% slope)

Layout and Planning		$200
Earth-moving	($4.50/cu.yd. X 175 cu.yd.)	$788
Compaction of soil in berms	($0.64/cu.yd. X 175 cu.yd.)	$112
Quarry rock for spillways	($21.00/cu.yd. X 2 cu.yd.)	$42
Mobilization		$250
	Total	$1392

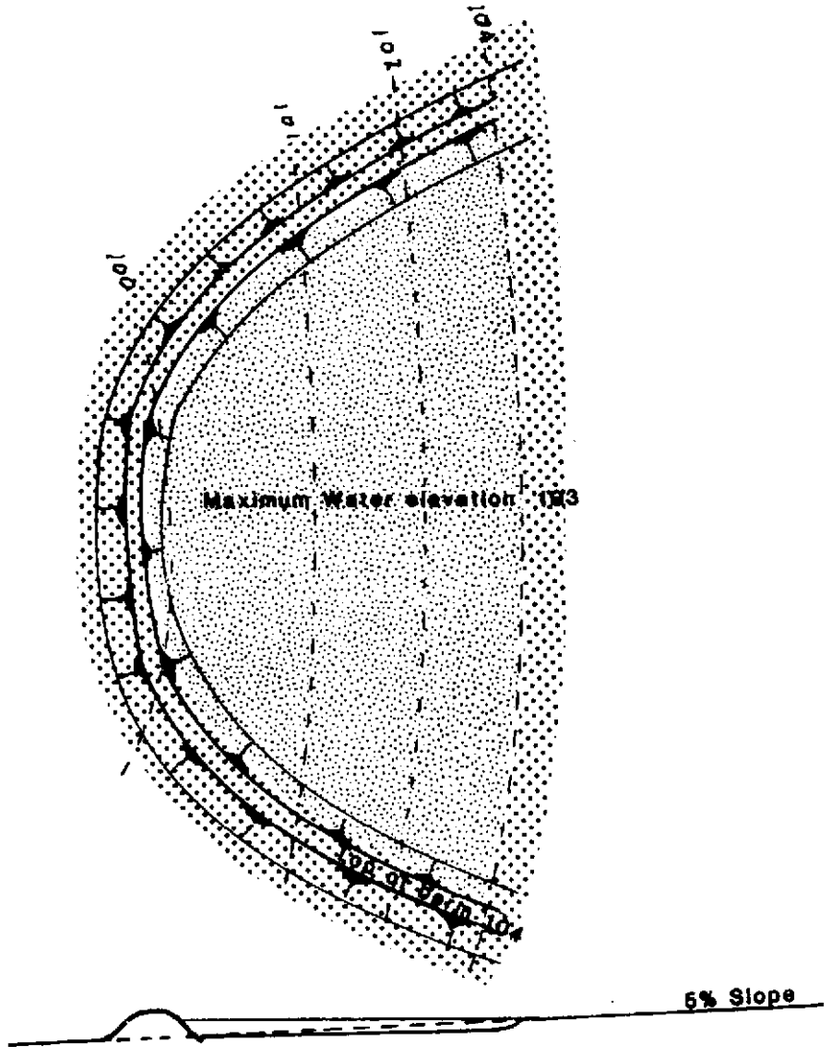
Area of Wetland created	5100 sq.ft. = .12 acre	
Estimated cost per acre		$11700
Area of disturbed soil outside of wetland	3040 sq.ft.	
Area of disturbed soil per acre of wetland created	0.6 acre	



TERRA ASSOCIATES
Geotechnical Consultants

SCHEMATIC MODEL OF CREATED WETLAND ON 2% SLOPE

Proj. No. 258	Date Nov. 86	Figure 1



TERRA ASSOCIATES
Geotechnical Consultants

SCHEMATIC MODEL OF CREATED WETLAND ON 5% SLOPE

Proj. No. 258	Date Nov. 86	Figure 2

APPENDIX E

RECOMMENDATIONS FOR MANAGING WETLANDS ON SEATTLE CITY LIGHT RIGHTS-OF-WAY

Appendix E. Recommendations for Managing Existing Wetlands on Seattle City Light Rights-of-Way

Introduction

Wetland communities are an effective means for controlling problem tree growth on the rights-of-way. Wetlands are also a valued environmental resource protected by local, state and federal laws. The following recommendations are presented to assist City Light maintenance crews with controlling problem tree growth in the wetland areas while maintaining the integrity of the wetland communities.

Wetland Plant Community Descriptions

In general, there are two types of wetland plant communities or classes that are typically found on the rights-of-way, scrub-shrub wetlands and emergent wetlands.

Scrub-shrub wetlands

This wetland plant community is dominated by deciduous woody shrubs less than 20 feet tall. These wetlands exhibit a range of water conditions, from standing water in the wetter months of the year, to saturated soils in drier times of the year. A common name for this type of wetland is swamp.

The scrub-shrub wetlands present on the rights-of-way are dominated by hardhack spirea (Spiraea douglasii). Hardhack spirea usually grows in nearly solid stands, with very little vegetation growing under this dense canopy. Spirea can also be found at the transition zone between wet and dry areas in less dense stands or as scattered individual plants. Spirea is a multi-stemmed shrub with 1 to 2 inch long oval leaves. In the summer, this plant has upright pink plumes of tiny flowers. In the winter, thin reddish stems with dry pyramidal husks are most noticeable (Lyons 1956). It typically grows 3 to 4 feet but can grow up to 8 feet tall.

Other species that are also present in scrub-shrub wetlands are red alder (Alnus rubra), thimbleberry (Rubus parviflorus), willow (Salix spp.), blackberry (Rubus spp.) as well as other herbaceous species. In the drier scrub-shrub wetlands, species more commonly associated with uplands can be found invading, such as salal (Gaultheria shallon), red alder, western hemlock (Tsuga heterophylla) and western red cedar (Thuja plicata).

Emergent wetlands

Emergent wetland communities are dominated by non-woody vegetation with soil and water conditions that vary from seasonally saturated to permanent inundation. The absence of trees or shrubs is due to frequent flooding. Common names for emergent wetlands are marsh, wet meadow, and slough.

The emergent wetlands found on the rights-of-way are typically dominated by cat-tails (Typha latifolia) and other assorted grasslike plants such as bulrushes (Scripus spp.) and sedges (Carex spp.).

In general, other species such as red alder, willow, and salmonberry (Rubus spectabilis) are located on the edge of the emergent wetland, or on hummocks within the plant community. Cat-tail communities are often located along the fringes of open water, between the open water and the scrub-shrub communities. Cat-tails can grow in water up to 24 inches deep.

Tree control/removal in the wetland areas

Thick stands of trees are not commonly found in established wetlands on the right-of-way. Eighty-five percent of the wetland areas have only scattered individual trees or small clumps of trees. Only 15 percent of the wetland areas have problem tree densities greater than >200 stems per acre. The most common problem species (83 percent) is red alder. Red alder is very successful at invading and establishing seedlings in open disturbed areas and

resprouting from cut stumps. It is best controlled if other vegetation can be established in the disturbed areas before the alder is able to establish itself, or if a canopy of taller vegetation creates too much shade for alder to seed itself and grow.

When removing problem trees from wetland areas it is best to do the removal with as little soil disturbance as possible. This minimizes the area of bare soil for alder to seed itself in. The non-chemical control method of least disturbance is manual cutting and removal of the trees. Once a coniferous tree is cut down it is eliminated as a problem if its seedlings are prevented from invading the area. Deciduous trees present a greater problem since many species, especially red alder, maples and cottonwoods, will sucker and resprout at the cut, creating thicker stands of problem trees. Cutting deciduous trees during the late spring, when their food reserves are low may help reduce or prevent this suckering problem (Harrington 1984, Hoyer and Belz 1984). The most successful method to prevent or reduce suckering is to treat the cut stump with a concentrated herbicide immediately after cutting.

Prior to 1980, herbicides such as 2,4-D, and 2,4,5-T were used to control vegetation on City Light rights-of-way. Many plants now commonly found on the rights-of-way are present in part because they are resistant to 2,4-D and/or 2,4,5-T or are susceptible to these chemicals only at very high dosages. These include spirea, salal, bracken fern (Pteridium aquiliuum), rose (Rosa spp.), Rubus spp. (thimbleberry, salmonberry, blackberries), horsetail, (Equisetum spp.), cat-tails and bulrushes. These are also species commonly found in open, cleared land in the Northwest.

In 1980 a moratorium was placed on all herbicide use on City Light rights-of-way. Since 1984 the use of Banvel (active ingredient Dicamba) has been allowed for both spot-spray and cut-stump treatment. Its use is restricted to spring and summer seasons only (March 31-September 30). No chemical use is permitted within 50 feet of open water or wetland areas. If spot chemical treatment of cut stumps was carefully executed during the dry season in scrub-shrub wetlands with no open water, the elimination of alder suckering and growth in these communities could be significantly reduced. Spirea is such a successful plant in these areas that it can create a canopy

too dense to allow sunlight to reach the understory and prevent the regrowth of the alder stumps. Reducing sucker growth with the aid of chemical stump treatment would enhance this process of eliminating alder growth.

Other methods of tree control which would cut or remove low growing vegetation or disturb the soil in the process of removing trees (i.e., heavy machinery, scarification or mechanical cutting machines) should be avoided unless the tree problem is severe. In addition to a seed bed for alder being created, the low growing vegetation which could compete with the alder would be destroyed.

Revegetation

Disturbed areas should be revegetated as soon as possible after the disturbance. Hand seeding with an annual grass mix would be sufficient in areas where the existing wetland vegetation can naturally reseed itself during the following year. Hand seeding with a flower/shrub/grass mix (annual/perennial mix) would be a preferred method in larger disturbed areas or areas where a greater plant diversity is desired. Soil preparation is usually not necessary when hand seeding. In fact, it has been shown that with increased soil preparation, plant diversity decreases (Gaynor, per. comm., November 1986).

Recommended seed mixes for some common conditions found in Western Washington are listed in Table 1. When revegetating an area, the conditions can be site specific (i.e., soil type and depth, drainage, slope or exposure) and it may be difficult to choose a seed mix. Information and assistance for seed mix recommendations is available through Native Plants, Inc. and Jacklin Seed Company (listed in Table 1). The following general information is useful when selecting a seed mix. (See Appendix F for sources of native plants and seeds).

1. The addition of nitrogen fixing legumes to the mixes helps to control alder (BEAK 1986).

2. Grass mixes are the most economical, but the addition of native flowers to the mixes, especially at rates less than 15 percent by weight, does not cause significant increases in cost. The added plant diversity offered by the addition of flowers to the mix should justify the extra cost.

3. Shrub seeds are expensive and difficult to find; rose and Vaccinium spp. are some of the more readily available species. The success of establishing shrubs from seed is very low. If the goal is to establish a ground cover quickly and aesthetics or habitat diversity are of little concern, the cost of adding shrub seeds to the mix may not be justified. Planting cuttings of one-year liner stock in addition to handseeding and/or natural seeding may be a more reliable method to establish a scrub-shrub community.

Hydroseeding would only be practical for large disturbed areas or a steeper slope. The most common need for hydroseeding on the rights-of-way would be to revegetate after road construction. Hydroseeders simultaneously apply mulch, tackifier and fertilizer at the following rates:

Mulch (Silva-mulch or equal)	2,000 lbs/acre
Tackifier	45 lbs/acre
Fertilizer (20-10-10)	220 lbs/acre
For grass seed mixes	65 lbs/acre
For native wetland wildflower/shrub/grass mix	50 lbs/acre

For hydroseeding of slopes 2.5:1 and steeper, double the amount of tackifier applied from 45 lbs/acre to 90 lbs/acre.

Appendix E Table 1.

SUGGESTED SEED MIXES FOR RESTORATION OF DISTURBED AREAS

For all applications install a 20-10-10 fast release nitrogen fertilizer at 220 lbs/acre or 5 lbs/MSF.

A. Seed mixes for wet-to-moist conditions in Western Washington: the following mixes are approved by the Washington State Department of Game, although the rates of application have been reduced to reflect recent research in England on the creation of diverse grassland swards. In general, that research suggests that lower seed application rates provide for superior establishment of diverse species.

Seed Mix No. 1 - seeding rate of 60 pounds per acre.

percent by weight		
10%		Agrostis tenuis (Colonial bentgrass)
40%		Festuca rubra (Red fescue)
40%		Lolium perenne (Perennial ryegrass)
10%		Trifolium repens (White dutch clover)
	and/or	Lotus corniculatus (Birdsfoot trefoil)

Seed Mix No. 2 - seeding rate of 25 pounds per acre plus Seed Mix No. 1 at 30 pounds per acre.

percent by weight	
60%	Rosa nutkana (Nootka rose)
40%	Vaccinium parvifolium (Red huckleberry)

Seed Mix No. 3 - seeding rate of 60 pounds per acre.

percent by weight	
80%	Festuca pratensis (Meadow fescue)
10%	Agrostis tenuis (Colonial bentgrass)
10%	Polygonum hydropiperoides (Smartweed)

B. Flower/Shrub/Grass Mix for Wet Meadow in Western Washington:

pounds per acre	
6 lbs/acre	Wildflowers - Applewood Seed Company #8044, Moist Mixture or equal
9.5 lbs/acre	*Vaccinium ovatum or parvifolium
14.5 lbs/acre	*Rosa nutkana
2.5 lbs/acre	Lolium multiflorum - provides quick cover

*Shrubs may be replaced with other wildflowers; suggestions: Lupinus polyphyllus (Big-leaf lupine), Monarda sp. (beebalm), and Mimulus guttata (Yellow monkeyflower) at appropriate seed application rates per acre.

Appendix E Table 1. Continued

C. Legume Seed for Wet-to-Moist Conditions in Western Washington:

percent by weight	
100%	Trifolium repens, inoculated

D. Wildflower/Grass Seed Mix for Erosion Control in Dry-to-Moist Conditions in Western Washington:

pounds per acre	
6 lbs/acre	Agropyron trachycaulum (Slender wheatgrass)
.125 lbs (2 oz)/acre	Epilobium angustifolium (Fireweed)
6.5 lbs/acre	Festuca ovina (Sheep fescue)
2.5 lbs/acre	Lolium multiflorum (Annual ryegrass)

E. Shrub/Grass Seed Mix for Dry/Unirrigated Slopes in Western Washington:

Apply the following shrub seeds at 4 pounds per acre.

percent by weight	
12%	Ceanothus velutinus
11.4%	Ceanothus prostratus
22.8%	Cercis occidentalis
1.8%	Cistus villosus
9.7%	Mahonia aquifolium
1.3%	Ribes sanguineum
34%	Rosa nutkana
1.3%	Sambucus cerulea
5.7%	Symphoricarpus albus

Apply the following grass seeds at 30 pounds per acre.

percent by weight	
50%	Festuca arundinacea 'Rebel 2'
28%	Festuca ovina var. duriuscula 'Durar'
12%	Poa compressa 'Reubens'
10%	Trifolium repens, inoculated

Appendix E Table 1. Continued

F. Grass Seed Mix for Dry Conditions in Western Washington:

Apply the following grass seed mix at 60-90 pounds per acre.

percent by weight	
13%	Fylking Kentucky Bluegrass
13%	Reubens Canada Bluegrass
37%	Sheep Fescue
37%	Durar Hard Fescue

In addition to the seed mixes listed above, excellent information and catalog materials are available through the following companies:

Native Plants, Inc.
1697 West 2100 North
P.O. Box 177
Lehi, Utah 84043
(801) 768-422 or 531-1456

Jacklin Seed Company
Route 2, Box 402
Post Falls, Idaho 83854
(208) 773-7581

Road and Tower Maintenance in Wetland Areas

In general, roads through the wetland areas should be avoided. When access roads are needed through these areas for right-of-way or tower maintenance, they should be constructed so as not to alter the drainage pattern in the area. It is not possible to make recommendations for the road design through wet areas as it is a very site-specific process. The number of culverts needed and their size and design is dependent on the amount of water draining through the area and the size of the drainage area. The most important factor to keep in mind is the drainage pattern, as any alteration of the drainage in the area will also alter the vegetation. Many of the wetland presently on the rights-of-way owe their existence to drainage interruptions caused by the access road.

Soil stabilization and revegetation will be required for road construction. The area should be hydroseeded as recommended in the preceding revegetation section (refer to Table 1 for suggested seed mixes). Mixes for moderate to steep slopes and erosion control would be most applicable in this situation.

REFERENCES

BEAK. 1986. Establishment and monitoring of experimental grassland plots on the Skagit transmission line right-of-way: 1986 Progress Report. Beak Consultants Incorporated, Bellevue, WA.

Gaynor, P. 1986. Landscape Architect. Personal Communication. November 1986.

Harrington, C.A. 1984. Factors influencing initial sprouting of red alder. Can. J. For. Res. 14:357-361.

Hoyer, G.E., and D. Belz. 1984. Stump sprouting related to time of cutting red alder. Washington State Department of Natural Resources, DNR Report 45. 17 p.

Lyons, C.P. 1956. Trees, shrubs and flowers to know in Washington.

APPENDIX F

SOURCES OF NATIVE PLANTS

Appendix F. Sources of Native Plants

The following species were chosen because they are typically found in Pacific Northwest wetlands or in the adjacent upland areas. In addition, these species are commercially available. If a species is not on this list, it can be assumed it is not commercially available. However, there are a number of nurseries that will collect or grow these species for a specific contract. It should also be noted that the list of sources is not exhaustive and the plant stock available will change with seasons and demand.

A * indicates that this species is common and available at most nurseries listed in the attached nursery directory.

Scientific Name	Common Name	Source
SHRUBS:		
Amelanchier canadensis	Shadblow serviceberry	Native Plants, Inc. Trees
Berberis nervosa	Oregon grape	*
Cornus stolonifera	Red-osier dogwood	*
Crataegus spp.	Hawthorn	EF Nursery Tree Native Plants, Inc.
Gaultheria shallon	Salal	*
Oemleria cerasiformis	Indian plum	Forest farm MSK Rare Plant Nursery
Oplopanax horridum	Devil's club	Newell Wholesale Nursery
Ribes sanguineum	Red current	Briggs Nursery De Wilders Rosso Wholesale Nursery Co. Storm Lake Growers
Rosa nutkana	Nutkana rose	Native Plants, Inc.

Scientific Name	Common Name	Source
Rosa rugosa	Rugosa rose	Cascadian Nurseries C.R. Harnden Growth Nursery Native Plants, Inc. Rosso Wholesale Nursery Co. Walter Van Vloten
Rosa woodsii	Wood's rose	Native Plants, Inc.
Rubus parviflorus	Thimbleberry	Native Plants, Inc.
SHRUBS:		
Rubus spectabilis	Salmonberry	Newell Wholesale Nursery Rosso Wholesale Nursery Co. Teufel Nursery, Inc.
Salix spp.	Willow	Newell Wholesale Nursery
Sambucus racemosa	Red elderberry	Newell Wholesale Nursery Native Plants, Inc. Rosso Wholesale Nursery Co.
Spiraea douglasii	Hardhack spirea	Newell Wholesale Nursery
Symphoricarpos alba	Common snowberry	Native Plants, Inc. Newell Wholesale Nursery Rosso Wholesale Nursery Co.
Vaccinium parvifolium	Red huckleberry	Cascadia Nurseries Newell Wholesale Nursery Rosso Wholesale Nursery Co.

Scientific Name	Common Name	Source
HERBACEOUS AND OTHER PLANT SPECIES:		
Aquatics:		
Iris pseudacorus	Yellow flag	Sweetbriar
Nuphar polysepalum	Indian pond-lily	Kester's Wild Game Food Nurseries, Inc.
Nymphaea odorata	Fragrant water-lily	"
Scirpus acutus	Hardstem bulrush	"
Scirpus fluviatilis	River bulrush	"
Scirpus validus	Softstem bulrush	"
Sparganium eurycarpun	Broad-fruited bur-reed	"
Typha latifolia	Common cat-tail	"
Ferns:		
Athyrium felix-femina	Lady-fern	Barfod's Nursery
Polystichum munitum	Sword-fern	Briggs Nursery Newell Wholesale Nursery
Wildflower seeds:		
Applewood Seed Company Clyde Robin Seed Company Native Plants, Inc.		
Shrub seeds:		
Clyde Robin Seed Company Native Plants, Inc. Newell Wholesale Nursery		
Grass seeds:		
Jacklin Seed Company Native Plants, Inc.		

NURSERY DIRECTORY

Abundant Life Seed Foundation
P.O. Box 772
Port Townsend, WA 98368
(206) 385-5560

Barfod's Nursery
23622 Bothell Way
Bothell, WA 98148
(206) 483-0205

Briggs Nursery, Inc.
4407 Henderson Blvd.
Olympia, WA 98501
(206) 352-5405

Brooks Tree Farm
9785 Portland Rd. NE
Salem, Oregon 97305
(503) 393-6300

Cascadian Nurseries, Inc.
13495 NW Thompson Road
Portland, OR 97229
(503) 645-3350

C.R. Harnden Company, Inc.
16426 67th West
Lynnwood, WA 98037
(206) 743-1173, 668-2901

Clyde Robin Co., Inc.
P.O. Box 2855
Castro Valley, CA 94546
(415) 581-3467

De Wildes Nursery
6930 Old Guide Road
Lynden, WA 98264
(206) 398-1960

EF Nursery
Rt. 1, Box 185
Forest Grove, OR 97116
(503) 357-7157

Far Pastures
26929 115th Avenue NE
Arlington, WA 98223
(206) 435-4300

Forest Farm
990 Tetherow Road
Williams, OR 97544

Furney's Nursery, Inc.
21215 Pacific Hwy. S.
Seattle, WA 98188
(206) 624-0634

Growth Nursery Farms
3006 W. Valley Hwy. N.
Auburn, WA 98002
(206) 833-1555

Hardy Ferns
1911 4th Avenue W.
Seattle, WA 98119

Hillview Garden Products
120 S. Fillmore Street
Kennewick, WA 99336
(509) 783-2695

Hollandia Nursery Co.
10725 39th Ave. NE
Seattle, WA 98125
(206) ~~363-8080~~ 363-6080

Jacklin Seed Co.
W. 5300 Jacklin Avenue
Post Falls, ID 83854
(208) 773-7581

Kester's Wild Game Food Nurseries, Inc.
P.O. Box V
Omro, Wisconsin 54963
(414) 685-2929, Toll free for orders only 1-800-558-8815

MSK Rare Plant Nursery
20066 15th NW
Seattle, WA 98177
(206) 546-1281

Native Plants, Inc.
9180 S. Wasatch Blvd.
Sandy, UT 84092
(801) 583-6067

Newell Wholesale Nursery
P.O. Box 372
Ethel, WA 98542
(206) 985-2460

Northwest Shade Trees
12973 SE 352nd Ave.
Boring, OR 97009
(503) 663-3520

Pacific Coast Nursery
18616 NW Reeder Road
Portland, OR 97231
(503) 224-2277

Rosso Wholesale Nursery Co.
P.O. Box 80345
Seattle, WA 98108
(206) 763-1888

Storm Lake Growers
21809 89th Street SE
Snohomish, WA 98290
(206) 794-4842

Sweetbriar
13825 132nd Ave. NE
Kirkland, WA 98034
(206) 821-2222

T. H. Blecher Nursery, Inc.
33755 SE Bluff Road
Boring, OR 97009
(503) 663-3593

Teufel Nursery, Inc.
666 134th St. SW
Everett, WA 98204
(206) 743-4444

Trees
23132 Sixth Ave. NE
Arlington, WA
Days - (206) 322-3291
Evenings - 659-5473

Valley View Nursery
1675 N. Vallie View Road
Ashland, OR 97520
(503) 488-2450

Vibert Nursery, Inc.
P.O. Box 627
15025 124th NE
Woodenville, WA 98072
(206) 488-1155

Walter Van Vlofen Nurseries
17616 Ford Road
Pitt Meadows, B.C. V0M1P0
(604) 465-9922

APPENDIX G

PRINTOUTS OF COMPUTER SCREENING

SCL ROW VEGETATION

CO	SPAN	S	H	LEN	WID	SL	SOIL	LANDUSE ROW	LSD	RSD	ACEMG		CONF SP	CONF WI	CONF H	CONF D	DECID SP	DECID WI	DECID H	DECID D	SHRUB SP	SHRUB WI	SHRUB CV	HERB SP	HERB WI	HERB CV	FISH USE	WATER SOURCE	SPAN VEG	COMMENTS
N	D00/07N	C	0	0537	300	1	1	BV	ID	FDM	GG3WX	1	LC	-0-	3	0	AR	3	3	0	RS	3	3	GR	6	2	-0-	YES	FACWET	BOG
												2	PM	5*	2	1	-0	-0-	-	-	SD	2	3	BX	4	2				
												3	PL	3-	2	0	-0	-0-	-	-	GS	4*	2	-0	-0-	-				
N	D00/18N	A	0	0275	300	1	1	BV	ID	FDM	GG3NO	1	TS	4-	2	0	-0	-0-	-	-	CB	5*	2	GR	6	4	-0-	WW*	FACWET	-0-
												2	TP	3	2	0	-0	-0-	-	-	RS	3	1	BX	4	1				
												3	PM	5*	1	0	-0	-0-	-	-	SD	2	1	JE	2	1				
N	D00/18N	B	0	0470	300	1	1	WW	ID	FDM	GG3NO	1	TP	3	2	0	-0	-0-	-	-	SD	2	3	JE	2	2	-0-	WW	OBWET	-0-
												2	PM	5*	2	0	-0	-0-	-	-	RS	3	2	CX	1	2				
												3	0	-0-	-	-	-0	-0-	-	-	TL	1	1	-0	-0-	-				
N	D00/32N	A	0	0300	300	1	1	WW	ID	FDM	GG3NO	1	PM	5*	2	0	AR	3	2	0	SD	2	5	JE	2	1	-0-	WW	OBWET	-0-
												2	TS	4-	2	0	-0	-0-	-	-	SX	3*	1	GR	6	1				
												3	PL	3-	2	0	-0	-0-	-	-	AC	4+	1	CX	1	1				
N	D01/24N	B	0	0950	300	1	1	BV	ID	FDM	GF1WX	1	PL	3-	3	0	AR	3	3	2	CB	5*	3	GR	6	2	-0-	MAYBE	FACWET	SUBSTATION
												2	TS	4-	3	0	-0	-0-	-	-	GS	4*	2	BX	4	1				ON RIGHT.
												3	PM	5*	3	0	-0	-0-	-	-	SD	2	2	-0	-0-	-				
N	D08/37N	B	0	0500	300	1	34	WW	ID	FDM	DG3WX	1	-0	-0-	-	-	AR	3	3	1	RS	3	4	GR	6	4	-0-	WW	OBWET	WETLAND
												2	-0	-0-	-	-	PT	3*	2	0	SD	2	3	TL	1	3				
												3	-0	-0-	-	-	-0	-0-	-	-	AC	4+	1	JE	2	2				
N	D10/38N	B	0	0600	300	1	72	BV	ID	ID	DG1NO	1	-0	-0-	-	-	-0	-0-	-	-	CB	5*	1	GR	6	5	-0-	WW*	FACWET	-0-
												2	-0	-0-	-	-	-0	-0-	-	-	SD	2	1	JE	2	2				
												3	-0	-0-	-	-	-0	-0-	-	-	-0	-0-	-	-0	-0-	-				
N	D10/38N	C	0	1700	300	0	72	BV	ID	ID	DG1NO	1	-0	-0-	-	-	AR	3	2	0	SD	2	3	GR	6	2	-0-	WW*	FACWET	-0-
												2	-0	-0-	-	-	-0	-0-	-	-	CB	5*	2	-0	-0-	-				
												3	-0	-0-	-	-	-0	-0-	-	-	RD	4-	1	-0	-0-	-				
N	D12/05N	B	0	0600	150	1	72	WW	ID	IH	PE1 0	1	-0	-0-	-	-	-0	-0-	-	-	RS	3	3	RR	2	2	-0-	WW	FACWET	-0-
												2	-0	-0-	-	-	-0	-0-	-	-	RD	4-	2	-0	-0-	-				
												3	-0	-0-	-	-	-0	-0-	-	-	-0	-0-	-	-0	-0-	-				
N	D12/16N	C	0	0415	300	1	72	BV	IH	FDM	PE1 0	1	-0	-0-	-	-	AR	3	2	1	RS	3	3	GR	6	3	-0-	WW*	FACWET	-0-
												2	-0	-0-	-	-	-0	-0-	-	-	SD	2	2	-0	-0-	-				
												3	-0	-0-	-	-	-0	-0-	-	-	GS	4*	2	-0	-0-	-				
N	D12/34N	B	0	0600	300	1	73	BV	ID	FDM	DP3NX	1	PM	5*	4	1	AR	3	3	1	SD	2	4	GR	6	2	-0-	WW*	FACWET	HOUSE ON
												2	TP	3	4	1	-0	-0-	-	-	RS	3	2	BX	4	2				RIGHT
												3	-0	-0-	-	-	-0	-0-	-	-	GS	4*	2	-0	-0-	-				SIDE.
N	D12/53N	B	L	0600	150	1	72	BV	ID	-0-	PE1NO	1	-0	-0-	-	-	AR	3	2	0	RS	3	5	GR	6	1	-0-	WW*	FACWET	-0-
												2	-0	-0-	-	-	-0	-0-	-	-	SD	2	1	-0	-0-	-				
												3	-0	-0-	-	-	-0	-0-	-	-	-0	-0-	-	-0	-0-	-				
N	D14/34N	X	0	0865	300	1	34	WW	ID	FDM	GF3NO	1	TP	3	2	0	AR	3	2	0	RS	3	3	TL	1	2	-0-	WW	OBWET	adj. to
												2	TS	4-	3	0	-0	-0-	-	-	SD	2	2	JE	2	2				Lake
												3	PS	3	3	0	-0	-0-	-	-	GS	4*	2	BX	4	2				Martha
N	D14/43N	X	0	0900	300	1	34	WW	ID	FDM	GF3NO	1	TP	3	2	0	AR	3	2	0	SD	2	5	TL	1	2	-0-	WW	OBWET	adj. to
												2	TS	4-	3	0	-0	-0-	-	-	RS	3	2	JE	2	1				Lake
												3	PS	3	3	0	-0	-0-	-	-	GS	4*	1	AF	3	1				Martha
N	D14/52N	X	0	1080	300	1	34	WW	ID	FDM	GF3NO	1	TP	3	3	1	AR	3	2	0	SD	2	5	TL	1	2	-0-	WW	OBWET	-0-
												2	TS	4-	3	0	BP	4	3	0	RS	3	1	JE	2	1				
												3	PW	4	2	0	-0	-0-	-	-	LL	1	1	GR	6	1				
N	D15/10N	A	0	0300	300	1	34	WW	ID	FDM	GP3NO	1	PM	5*	3	0	AR	3	2	0	LL	1	2	TL	1	3	-0-	WW	OBWET	BAD SPOT
												2	TS	4-	3	0	BP	4	3	0	SD	2	2	GR	6	2				IN
												3	TP	3	2	0	-0	-0-	-	-	RS	3	1	BX	4	1				ROAD/WATER
N	D15/10N	B	0	0880	300	1	72	BV	ID	FC	GG3NX	1	PM	5*	2	0	AR	3	3	1	GS	4*	2	GR	6	2	-0-	WW*	OBWET	
												2	TS	4-	2	0	BP	4	2	1	SD	2	2	BX	4	2				DISTURBED-
												3	-0	-0-	-	-	-0	-0-	-	-	LL	1	1	JE	2	1				LOGGING
N	D15/22N	X	0	1320	300	1	72	BV	ID	FC	GG1NO	1	PM	5*	2	0	AR	3	3	1	RS	3	2	BX	4	3	-0-	WW*	OBWET	-0-
												2	TS	4-	2	0	-0	-0-	-	-	GS	4*	2	GR	6	2				
												3	-0	-0-	-	-	-0	-0-	-	-	RD	4*	1	TL	1	1				
N	D15/35N	B	0	0590	300	1	34	WW	ID	FD	GG3NO	1	PS	3	3	0	AR	3	2	0	SD	2	3	GR	6	2	-0-	WW	OBWET	-0-
												2	TP	3	3	0	PL	3-	2	0	RS	3	2	TL	1	2				
												3	PM	5*	3	0	-0	-0-	-	-	SX	3*	2	JE	2	2				
N	D16/26N	A	0	0640	300	1	34	WW5	ID	FDM	DG3WO	1	PM	5*	3	0	-0	-0-	-	-	SD	2	2	JE	2	4	-0-	WW5	FACWET	-0-
												2	-0	-0-	-	-	-0	-0-	-	-	-0	-0-	-	GR	6	2				
												3	-0	-0-	-	-	-0	-0-	-	-	-0	-0	-	0	-0					

N	D16/40N	A	0	0890	300	1	72	BV	ID	FCM	DG3WX	1	TS 4-	3 1	AR 3	3 2	GS 4*	3	BX 4	2	-0-	WW	OBWET	SMALL
												2	PM 5*	3 1	-0 -0-	- -	RS 3	3	GR 6	2				SWAMP
												3	TP 3	3 0	-0 -0-	- -	-0 -0-	-	TL 1	1				
N	D17/00N	B	0	0470	300	1	72	BV	ID	IH	DG1NX	1	PM 5*	3 0	AR 3	3 0	SD 2	3	BX 4	2	-0-	WW	FACWET	WETLAND
												2	TP 3	3 0	SX 3*	3 0	RS 3	2	GR 6	2				
												3	-0 -0-	- -	-0 -0-	- -	-0 -0-	-	-0 -0-	-				
N	D17/00N	C	0	0475	300	1	72	BV	ID	IH	DG1NO	1	PM 5*	2 1	AR 3	3 0	GS 4*	2	GR 6	2	-0-	WW*	FACWET	-0-
												2	TP 3	3 0	LE -0-	3 0	RS 3	2	BX 4	2				
												3	-0 -0-	- -	-0 -0-	- -	SD 2	2	-0 -0-	-				
N	D17/12N	X	0	0800	300	1	72	BV	ID	FCM	DG1WO	1	PM 5*	3 0	AR 3	2 1	GS 4*	2	GR 6	2	-0-	MAYBE	FACWET	-0-
												2	TP 3	3 0	PT 3*	2 0	SD 2	2	JE 2	2				
												3	TS 4-	3 0	-0 -0-	- -	RS 3	2	BX 4	2				
N	D17/20N	A	0	0360	300	1	72	WW	ID	FCM	GG3WO	1	TP 3	3 0	AR 3	3 0	SD 2	2	CO 1	2	-0-	WW	OBWET	-0-
												2	TS 4-	3 0	-0 -0-	- -	RS 3	2	JE 2	2				
												3	-0 -0-	- -	-0 -0-	- -	GS 4*	1	AF 3	1				
N	D17/31N	C	0	0795	300	1	72	WW	ID	FCM	GG3WO	1	PM 5*	2 0	AR 3	3 1	SD 2	2	JE 2	2	-0-	WW	OBWET	-0-
												2	TP 3	3 0	-0 -0-	- -	RS 3	2	CO 1	1				
												3	-0 -0-	- -	-0 -0-	- -	GS 4*	2	GR 6	1				
N	D17/42N	X	0	0980	300	1	72	BV	ID	FCM	GG3NO	1	PM 5*	3 0	AR 3	4 1	RS 3	3	GR 6	2	-0-	WW*	FACWET	-0-
												2	TP 3	3 0	-0 -0-	- -	GS 4*	2	BX 4	2				
												3	TS 4-	3 0	-0 -0-	- -	SD 2	2	-0 -0-	-				
N	D17/52N	A	0	0430	300	1	72	BV	ID	FCM	GG3NO	1	PM 5*	3 0	AR 3	3 1	SD 2	2	GR 6	2	-0-	WW*	FACWET	-0-
												2	TP 3	3 0	RP 5*	3 0	GS 4*	2	BX 4	2				
												3	TS 4-	3 0	-0 -0-	- -	RS 3	2	-0 -0-	-				
N	D17/52N	B	0	0340	300	1	32	WW	ID	FCM	GG3WX	1	PM 5*	2 0	AR 3	2 0	SD 2	2	CO 1	2	-0-	WW	OBWET	LOCKED
												2	TP 3	3 0	-0 -0-	- -	LG 1	2	TL 1	1				GATE
												3	-0 -0-	- -	-0 -0-	- -	RS 3	2	JE 2	1				
N	D20/09N	A	0	1185	300	1	72	WW	ID	FCM	DG2WO	1	PM 5*	3 0	AR 3	2 0	SD 2	4	GR 6	2	-0-	WW	FACWET	-0-
												2	TS 4-	3 0	-0 -0-	- -	RS 3	2	JE 2	2				
												3	-0 -0-	- -	-0 -0-	- -	SX 3*	1	-0 -0-	-				
N	D20/30N	B	0	0745	300	1	34	WW	ID	FCM	DG1WO	1	TS 4-	2 0	AR 3	3 1	SD 2	5	JE 2	1	-0-	WW	FACWET	-0-
												2	PL 3-	2 0	-0 -0-	- -	RS 3	2	GR 6	1				
												3	-0 -0-	- -	-0 -0-	- -	-0 -0-	-	-0 -0-	-				
N	D20/44N	B	0	0200	300	0	34	WW	ID	FCM	DG1WO	1	TS 4-	3 0	-0 -0-	- -	SD 2	3	TL 1	2	-0-	WW	OBWET	-0-
												2	TP 3	3 0	-0 -0-	- -	RS 3	3	BX 4	2				
												3	-0 -0-	- -	-0 -0-	- -	-0 -0-	-	-0 -0-	-				
N	D21/03N	X	0	1125	300	1	72	BV	ID	FCM	DG1NO	1	TS 4-	4 0	AR 3	3 1	RS 3	3	GR 6	2	-0-	WW*	FACWET	-0-
												2	PM 5*	3 0	-0 -0-	- -	GS 4*	2	BX 4	2				
												3	TP 4-	4 0	-0 -0-	- -	SD 2	2	-0 -0-	-				
N	D21/23N	A	0	0520	300	1	72	BV	FCM	FCM	DG3NX	1	TP 3	1 0	AR 3	4 1	RS 3	2	JE 2	3	-0-	MAYBE	FACWET	DRAINAGE
												2	TS 4-	1 0	-0 -0-	- -	GS 4*	1	GR 6	3				DITCH
												3	-0 -0-	- -	-0 -0-	- -	-0 -0-	-	BX 4	2				
N	D21/23N	B	L	0340	150	1	73	WW	FCM	FCM	DG3WO	1	-0 -0-	- -	AR 3	3 0	SD 2	4	JE 2	3	-0-	WW*	FACWET	-0-
												2	-0 -0-	- -	SX 3*	3 0	RS 3	3	GR 6	1				
												3	-0 -0-	- -	-0 -0-	- -	-0 -0-	-	-0 -0-	-				
N	D21/23N	C	R	0340	150	1	73	WL5	FCM	FCM	DG3WX	1	TP 3	2 0	AR 3	3 0	SD 2	2	JE 2	3	-0-	YES	FACWET	POND
												2	TS 4-	1 0	SX 3*	3 0	RL 4*	2	GR 6	2				
												3	PM 5*	1 0	-0 -0-	- -	RS 3	2	-0 -0-	-				
N	D21/23N	D	0	0455	300	1	73	BV	FCM	FCM	DG3NO	1	-0 -0-	- -	AR 3	3 2	RS 3	3	GR 6	3	-0-	WW*	FACWET	-0-
												2	-0 -0-	- -	-0 -0-	- -	RL 4*	1	BX 4	2				
												3	-0 -0-	- -	-0 -0-	- -	GS 4*	1	JE 2	2				
N	D23/26N	A	0	0840	300	1	47	BV	BV	FCY	GG3NO	1	-0 -0-	- -	AR 3	3 0	RS 3	4	GR 6	3	-0-	WW*	FACWET	-0-
												2	-0 -0-	- -	-0 -0-	- -	SD 2	2	JE 2	1				
												3	-0 -0-	- -	-0 -0-	- -	-0 -0-	-	-0 -0-	-				
N	D27/46N	A	0	0275	300	0	70	BV	ID	FCM	GG1NO	1	TS 4-	2 0	AR 3	2 0	RS 3	3	GR 6	3	-0-	WW*	FACWET	-0-
												2	TP 3	2 0	-0 -0-	- -	SD 2	2	BX 4	2				
												3	-0 -0-	- -	-0 -0-	- -	CB 5*	1	-0 -0-	-				
N	D29/38N	B	0	0765	300	1	7	BV	ID	FCM	GG3NO	1	TS 4-	3 0	AR 3	2 0	RS 3	2	GR 6	4	-0-	WW*	FACWET	-0-
												2	TP 3	3 0	-0 -0-	- -	SD 2	2	BX 4	2				
												3	PM 5*	3 0	-0 -0-	- -	-0 -0-	-	-0 -0-	-				

N	D30/07N	B	0	1040	300	0	34	WW	ID	FCM	GG3NO	1	TP 3	2 0	AR 3	2 0	SD 2	5	GR 6	2	-0-	WW	FACWET	adj. to
												2	-0 -0-	- -	-0 -0-	- -	RL 4*	2	BX 4	2				Riley Lake
												3	-0 -0-	- -	-0 -0-	- -	RS 3	1	-0 -0-	-				
N	D30/21N	A	0	0440	300	0	39	WW	ID	FCM	GG3NO	1	TP 3	2 0	AR 3	2 0	SD 2	4	GR 6	2	-0-	WW	FACWET	-0-
												2	TS 4-	3 0	-0 -0-	- -	GS 4*	2	BX 4	2				
												3	FM 5*	3 0	-0 -0-	- -	RL 4*	2	-0 -0-	-				
N	D30/21N	B	0	0460	300	1	35	BV	ID	FCM	GG3NO	1	TP 3	2 0	AR 3	2 0	SD 2	2	GR 6	3	-0-	WW*	OBWET	-0-
												2	FM 5*	2 0	-0 -0-	- -	GS 4*	2	BX 4	3				
												3	TS 4-	2 0	-0 -0-	- -	LG 1	2	-0 -0-	-				
N	D30/21N	C	0	0170	300	1	35	WW	ID	FCM	GG3NO	1	TP 3	2 0	AR 3	2 0	SD 2	3	GR 6	2	-0-	WW	OBWET	-0-
												2	FM 5*	2 0	-0 -0-	- -	RS 3	2	JE 2	2				
												3	TS 4-	2 0	-0 -0-	- -	LG 1	2	-0 -0-	-				
N	D35/22N	B	0	0240	300	1	18	WW	TD	FDM	GG3WO	1	TS 4-	2 0	AR 3	2 0	RS 3	4	GR 6	2	-0-	WW	OBWET	near old
												2	TP 3	2 0	-0 -0-	- -	SD 2	2	SE 1	2				Stillaguam
												3	-0 -0-	- -	-0 -0-	- -	RL 4*	1	CX 1	1				ish River
N	D35/33N	A	0	0555	300	1	18	WW	ID	FDM	GG3WO	1	-0 -0-	- -	AR 3	2 0	SD 2	4	GR 6	2	-0-	WW	FACWET	-0-
												2	-0 -0-	- -	-0 -0-	- -	RS 3	3	EH 3*	1				
												3	-0 -0-	- -	-0 -0-	- -	RL 4*	1	-0 -0-	-				
N	D38/00N	A	0	0510	300	0	35	BV	FCM	FCM	GG3NO	1	FM 5*	2 0	AR 3	2 0	SD 2	3	GR 6	2	-0-	WW*	FACWET	-0-
												2	TP 3	2 0	-0 -0-	- -	RS 3	2	-0 -0-	-				
												3	TS 4-	2 0	-0 -0-	- -	BX 4	2	-0 -0-	-				
N	D41/21N	X	0	1110	300	1	33	BV	ID	FCM	DG3WX	1	FM 5*	1 0	SX 6	2 0	RL 4*	2	GR 6	5	-0-	YES	FACUP	SMALL
												2	TS 4-	1 0	-0 -0-	- -	CB 5*	1	BX 4	2				DRAINAGE,
												3	TP 3	1 0	-0 -0-	- -	GS 4*	1	PM 4*	1				NEAR WHITE
N	D42/03N	A	0	0250	300	1	33	BV	ID	FCM	GG3WX	1	-0 -0-	- -	-0 -0-	- -	RS 3	4	GR 6	2	YES	YES	FACWET	MOOSE
												2	-0 -0-	- -	-0 -0-	- -	RT 4*	4	-0 -0-	-				GREEK -
												3	-0 -0-	- -	-0 -0-	- -	SD 2	2	-0 -0-	-				DRY
N	D42/03N	C	R	0480	150	0	33	BV	AC	FDM	GG3NO	1	TP 3	2 0	AR 3	2 0	RS 3	5	GR 6	3	-0-	WW*	FACWET	-0-
												2	-0 -0-	- -	SX 3*	2 0	SD 2	2	-0 -0-	-				
												3	-0 -0-	- -	-0 -0-	- -	-0 -0-	-	-0 -0-	-				
N	D42/03N	D	0	0500	300	0	33	BV	ID	FCM	GG3WX	1	TP 3	2 0	AR 3	2 0	SD 2	4	GR 6	2	-0-	YES	FACWET	DRAINAGE
												2	FM 5*	2 0	-0 -0-	- -	RS 3	3	-0 -0-	0				+ WET
												3	-0 -0-	- -	-0 -0-	- -	-0 -0-	-	0 -0-	-				THROUGHOUT
N	D42/15N	C	R	0885	150	0	33	BV	BV	FCM	GG3NO	1	FM 5*	2 0	AR 3	2 0	RS 3	3	BX 4	2	-0-	WW*	FACWET	-0-
												2	TS 4-	2 0	SX 3*	2 0	SD 2	2	GR 6	2				
												3	-0 -0-	- -	-0 -0-	- -	GS 4*	2	-0 -0-	-				
N	D42/27N	A	0	0550	300	0	33	BV	ID	FCM	GG1NO	1	FM 5*	2 0	AR 3	2 0	RS 3	4	GR 6	2	-0-	WW*	FACWET	-0-
												2	TS 4-	2 0	AM 4	2 0	SD 2	2	-0 -0-	-				
												3	TP 3 -	2 0	SX 3*	1 0	-0 -0-	-	-0 -0-	-				
N	D42/27N	B	0	0700	300	0	33	BV	ID	FCM	GG1WO	1	FM 5*	2 0	AR 3	2 0	RS 3	2	GR 6	6	-0-	MAYBE	FACUP	-0-
												2	TS 4-	1 0	PP 4*	2 0	RL 4*	1	BX -0-	2				
												3	-0 -0-	- -	-0 -0-	- -	-0 -0-	-	-0 -0-	-				
N	D42/39N	C	0	0620	300	0	33	BV	ID	FCM	DG3WX	1	FM 5*	2 0	AR 3	3 0	SA 4*	3	BX 6	2	-0-	MAYBE	FACUP	DRAINAGE
												2	TS 4-	1 0	SX 3*	2 0	RS 3	3	GR 4	2				
												3	-0 -0-	- -	PP 4*	3 0	SD 2	1	-0 -0-	-				
N	D45/22N	B	0	0600	300	1	81	WW	FDY	FCM	GE1WO	1	TP 3	3 0	AR 3	3 0	SD 2	5	JE 2	2	-0-	WW	FACWET	-0-
												2	PW 4	3 0	-0 -0-	- -	RS 3	1	GR 6	2				
												3	TS 4-	2 0	-0 -0-	- -	RT 4*	1	-0 -0-	-				
N	D45/34N	X	0	1210	300	0	39	WW	FDY	FDM	GE1WO	1	TP 3	4 0	AR 3	3 1	SD 2	5	JE 2	2	-0-	WW	FACWET	-0-
												2	FM 5*	4 0	SX 3*	3 0	-0 -0-	-	-0 -0-	-				
												3	TS 4-	4 0	-0 -0-	- -	-0 -0-	-	-0 -0-	-				
N	D45/46N	X	0	1210	300	0	13	WW	FDM	FCM	GE1WO	1	FM 5*	4 0	AR 3	4 0	SD 2	5	BX 4	1	-0-	WW	FACWET	-0-
												2	TP 3	3 0	SX 3*	2 0	GS 4*	1	JE 2	1				
												3	TS 4-	4 0	AC 4+	2 0	-0 -0-	-	-0 -0-	-				
N	D46/06N	A	0	0270	300	0	13	WW	WW	FCM	GE1WO	1	FM 5*	2 0	AR 3	3 0	SD 2	5	JE 2	1	-0-	WW	FACWET	-0-
												2	TS 4-	3 0	SX 3*	2 0	RS 3	1	-0 -0-	-				
												3	TP 3	1 0	AC 4+	2 0	-0 -0-	-	-0 -0-	-				
N	D46/06N	B	0	0950	300	0	13	BV	FDM	FCM	GE1WO	1	PL 3-	3 0	AR 3	3 0	GS 4*	3	BX 4	3	-0-	MAYBE	FACWET	-0-
												2	FM 5*	3 0	AC 4+	2 0	SD 2	2	GR 6	1				
												3	TS 4-	3 0	SX 3*	2 0	RS 3	2	-0 -0-	-				

N	D46/18N	A	0	0320	300	0	13	BV	FDM	FCM	GE1WO	1	PM	5*	3	0	AR	3	3	1	GS	4*	3	BX	4	2	-0-	MAYBE	FACWET	-0-
												2	TS	4-	2	0	PT	3*	3	0	SD	2	1	JE	2	2				
												3	PW	4	3	0	SX	3*	2	0	-0	-0-	-	GR	6	1				
N	D46/18N	B	0	0880	300	0	24	FCY	FDM	FCM	GE1WO	1	PM	5*	3	2	AR	3	3	1	GS	4*	3	BX	4	3	-0-	MAYBE	FACUP	-0-
												2	TP	3	3	0	PT	3*	3	1	CB	5*	1	GR	6	2				
												3	TS	4-	3	0	SX	3*	3	0	RU	4*	1	-0	-0-	-				
N	D46/42N	B	0	0100	300	0	24	WW	FCM	FCM	GE1NO	1	PM	5*	4	1	PT	3*	3	0	RS	3	4	BX	4	3	-0-	WW	FACWET	-0-
												2	PW	4	3	0	AM	4	4	0	SD	2	1	-0	-0-	-				
												3	-0	-0-	-	-	SX	3*	3	0	-0	-0-	-	-0	-0-	-				
N	D48/12N	X	0	1170	300	1	24	BV	FCM	FCM	GE1WX	1	TP	3	2	0	-0	-0-	-	-	RD	4-	1	GR	6	5	-0-	MAYBE	FACUP	SMALL
												2	TS	4-	1	0	-0	-0-	-	-	RL	4*	1	BX	4	1				CREEK DRY,
												3	PM	5*	1	0	-0	-0-	-	-	GS	4*	1	-0	-0-	-				APPEARS TO
S	D58/48N	A	L	0575	300	1	132	WW	FCM	-0-	GG4WO	1	-0	-0-	-	-	0	-0-	-	-	SD	2	4	TL	1	2	-0-	WW	OBWET	-0-
												2	-0	-0-	-	-	-0	-0-	-	-	RS	3	2	-0	-0-	-				
												3	-0	-0-	-	-	-0	-0-	-	-	-0	-0-	-	-0	-0-	-				
S	D63/38N	B	0	0680	300	1	12	WW	FDM	FDY	GG3WX	1	TS	4-	3	1	AR	3	3	1	SW	4	2	EH	3*	4	-0-	WW	OBWET	WETLAND
												2	TP	3	2	1	PT	3*	4	1	SX	3*	1	GR	6	2				
												3	PM	5*	3	0	AM	4	3	0	-0	-0-	-	TL	1	1				
S	D63/50N	B	0	0420	300	0	5	WW	FCM	FDY	GG3WX	1	-0	-0-	-	-	AR	3	4	2	SW	4	3	EH	3*	3	-0-	WW	FACWET	WETLAND
												2	-0	-0-	-	-	PT	3*	3	1	RS	3	1	-0	-0-	-				
												3	-0	-0-	-	-	-0	-0-	-	-	RD	4-	1	-0	-0-	-				
S	D64/09N	X	0	1400	300	0	75	WW	FCM	FDY	GG3WX	1	PM	5*	3	1	AR	3	4	1	SW	4	3	EH	3*	3	-0-	WW	FACWET	WETLAND
												2	TP	3	3	0	AM	4	4	1	RS	3	2	GR	6	3				
												3	TS	4-	3	0	PT	3*	4	0	SX	3*	1	BX	4	3				
S	D64/24N	B	0	0425	300	0	104	WS1	WS1	WS1	GG3WX	1	-0	-0-	-	-	AR	3	4	1	SX	3*	1	BX	4	1	YES	WS1	FACWET	SKAGIT
												2	-0	-0-	-	-	PT	3*	4	1	-0	-0-	-	-0	-0-	-				RIVER
												3	-0	-0-	-	-	-0	-0-	-	-	-0	-0-	-	-0	-0-	-				
S	D67/01N	X	0	1170	320	1	158	BV	AP	FDM	DG3WX	1	-0	-0-	-	-	AR	3	2	0	RL	4*	2	GR	6	5	-0-	YES	FACUP	DRAINAGE
												2	-0	-0-	-	-	-0	-0-	-	-	SW	4	2	-0	-0-	-				PARALLELS
												3	-0	-0-	-	-	-0	-0-	-	-	SX	3*	1	-0	-0-	-				ROW UNDER
S	D67/12N	X	0	1000	315	1	60	BV	AP	FCM	GG1WX	1	-0	-0-	-	-	AM	4	3	0	RS	3	3	GR	6	4	-0-	MAYBE	FACUP	-0-
												2	-0	-0-	-	-	SX	3*	4	0	RD	4-	3	-0	-0-	-				
												3	-0	-0-	-	-	LE	-0-	3	0	SC	4*	2	-0	-0-	-				

```
*              CO = COUNTY
*            SPAN = SPAN NUMBER
*               S = SPAN SUBDIVISION LENGTHWISE
*               H = SPAN DIVISION WIDTHWISE
*             LEN = LENGTH OF SPAN
*             WID = WIDTH OF SPAN
*              SL = SLOPE
         LANDUSE
*             ROW = LANDUSE ON RIGHT-OF-WAY
*             LSD = LANDUSE ON LEFT SIDE OF R-O-W
*             RSD = LANDUSE ON RIGHT SIDE OF R-O-W
*           ACEMG = ACCESS CONDITIONS AND SPECIAL MANAGEMENT CONCERNS
            CONF = CONIFEROUS TREES
            DECD = DECIDUOUS TREES
           SHRUB = SHRUBS
            HERB = HERBACEOUS PLANTS
*              SP = SPECIES
**             WI = WETLAND INDICATOR SPECIES RATING
*               H = HEIGHT
*               D = DENSITY
*              CV = PERCENT COVER
    WATER SOURCE
*              WW = NONFORESTED WETLAND AS INDENTIFIED IN THE R-O-W VEGETATION INVENTORY
**            WW* = NONFORESTED WETLAND AS INDENTIFIED BY THE VEGETATIVE COMMUNITY
        SPAN VEG
           OBWET = OBLIGATE WETLAND SPECIES PRESENT
**         FACWET = FACULTATIVE WETLAND COMMUNITY
**          FACUP = FACULTATIVE UPLAND COMMUNITY
***        FACUPf = FACULTATIVE UPLAND COMMUNITY / WATER SOURCE HAS ANADROMOUS FISH USE
**         UPLAND = UPLAND COMMUNITY
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* This data was provided by Seattle City Light's transmission right-of-way vegetaion inventory. All the codes used are defined in this inventory.

** Wetland indicator species ratings and vegetation community descriptions are discussed in Appendix B.

*** Anadromous fish use as identified in WDF's Stream Utilization Catalog.