JAN L. CASSIN, PH.D.

POLLUTION CONTROL HEARINGS BOARD
FOR THE STATE OF WASHINGTON

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| AIRPORT COMMUNITIES COALITION and CITIZENS AGAINST SEA-TAC EXPANSION,<br><br>Appellants,<br><br>v.<br><br>DEPARTMENT OF ECOLOGY and THE PORT OF SEATTLE,<br><br>Respondents. | No. PCHB 01-160<br><br>PREFILED TESTIMONY OF JAN L. CASSIN, PH.D. |

AR 015900



FOSTER PEPPER & SHEFELMAN PLLC
1111 THIRD AVENUE, SUITE 3400
SEATTLE, WASHINGTON 98101-3299
206-447-4400

ORIGINAL

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1. I have a Ph.D. in Ecology and Evolutionary Biology from the University of Michigan, Ann Arbor, a Master of Science Degree in Ecology and Evolutionary Biology from the University of Michigan, and a Bachelor of Arts Degree in Biology from the University of Colorado, Boulder. I have over 15 years professional experience in conservation biology, plant ecology, and wetland science. I am currently employed as a Senior Scientist at Parametrix, Inc.

2. My professional experience includes work as an environmental reviewer and conservation planner for The Nature Conservancy in New England and Michigan. As an environmental reviewer for the State of Michigan's Natural Features Inventory, I was one of the people who reviewed CWA 404 permit applications.

3. I have worked as a wetland scientist in the Pacific Northwest for the past five years. My primary professional activities during that time have included: conducting wetland delineations and functional assessments, CWA 404 regulatory assistance, evaluating project impacts to wetlands, preparing wetland and stream restoration designs, writing construction specifications for mitigation designs, providing construction observation on large mitigation/restoration projects, and monitoring mitigation projects. I was responsible for the planting design and construction observation for two large restoration projects in Western Washington: the University of Washington Bothell-Cascadia Community College Campus at North Creek, and the Newskah Creek Aquatic Ecosystem Restoration in Aberdeen, WA (Department of Corrections). I was part of the team that developed several of the regional Hydrogeomorphic (HGM) Functional Assessment models for evaluating wetland functions.[1] A copy of my professional resume is attached as Exhibit A.

4. For the Port of Seattle Master Plan Update project I have reviewed the *Natural Resources Mitigation Plan* (NRMP) to evaluate the adequacy of the plan for replacing the functions impacted by

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[1] Lee, L. C., M. C. Rains, J. L. Cassin, S. R. Stewart, R. Post, M. Brinson, M. Clark, J. Hall, G. Hollands, D. LaPlant, W. Nutter, J. Powell, T. Rockwell, and D. Whigham. 1999. *Operational Draft Guidebook for Reference Based Functional Assessment of the Functions of Precipitation Driven Wetlands on Discontinuous Permafrost in Interior Alaska.* State of Alaska, Department of Environmental Conservation/U. S. Army Corps of Engineers Waterways Experiment Station Technical Report. Anchorage, AK.



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the project, and to assess the feasibility or constructability of the plans based on my experience constructing large restoration projects. Working with Port and Parametrix staff, I made revisions and recommended refinements to the mitigation plan based on my internal review and discussions with the U. S. Army Corps of Engineers (USACE) and the Washington State Department of Ecology. For example, microtopographic complexity was added to some of the mitigation sites, control of invasive weed species was added to performance standards, and protocols for monitoring mitigation sites were added.

5. In this testimony I will address issues raised by ACC regarding identification of wetlands at Vacca Farm, the adequacy of the mitigation plan, mitigation credit ratios, functions being replaced by mitigation, buffer enhancements, and the Vacca Farm mitigation design.

6. Identification of Wetlands on the Vacca Farm Site. The Wetland Delineation Report (September 2000, Section 3.2.3.4, p. 3-20, 3-21; Appendix C, Figure C1; Appendix D, Map 4, Image 4), and the Public Notice (27 December 2000, pp. 2, 5, Sheets 6, 8, and 9) clearly identify and show the locations of wetlands, uplands, farmed wetlands, and prior converted croplands (PCC) on the Vacca Farm site. Figure C1 from the Delineation Report is attached as Exhibit B. These areas were identified and delineated using standard methods for wetland delineation and following the USACE's 1987 Manual and the Washington State Wetland Identification and Delineation Manual (Ecology 1997). By definition, the designation as PCC, and not as upland, indicates that soil saturation in the upper 12 inches is present during the growing season, and such areas would be considered a water of the State by Ecology.

7. Although Ecology and the USACE may differ on how they regulate prior converted croplands, these areas have always clearly been identified by the Port, the basis for the classification of PCC lands has been clear, and the existing condition of the PCC lands as being non-upland areas has been documented. Contrary to the assertions of Ms. Sheldon, the area of the Miller Creek channel to be relocated has been included in the calculation of impacts (Table 1.3-1; impacts of 0.59 acres to Wetland



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A1; includes 0.25 acres of channel and 0.34 acres of wetland impacts). The 0.92 acres of PCC lands are included in the 1999 Public Notice (p. 9), and in the 2000 Public Notice (p. 11).

8. The actions planned to restore wetland functions to prior converted croplands have been clearly explained in the NRMP (Section 5.1.2)[2] and this mitigation action is clearly called out in the Public Notice (December 27, 2000, p. 5). Again, contrary to the assertions of Ms. Sheldon, the Port does not claim that PCC lands do not perform any of the functions that are the targets of restoration. I have reviewed the mitigation documents and observed existing site conditions at Vacca Farm. It is my opinion that this area is significantly degraded and that the mitigation actions proposed will result in significant improvement in wetland functions at this site. The Vacca Farm site has been altered to make it more suitable for farming. The site has been ditched and drained to create more well-drained soils, the stream has been channelized and moved to open up more area for agricultural fields, and wetland areas have been filled with non-wetland soils to provide more suitable substrates for crops. Peat soils have been repeatedly plowed, which along with drying of the soils results in oxidation of the soils. The plowing and application of fertilizers and pesticides likely has significantly altered the microbial soil communities that would have been typical of the unaltered wetlands. Altering soil microbial communities will affect nutrient cycling and nutrient retention functions of the soils. Native vegetation has been removed; most of the site is dominated by non-native plant species. The floodplain performs flood storage functions, however, the channelization of Miller Creek through this site means that flood flows pass downstream more rapidly and overbank flooding is reduced compared to historic conditions.

9. <u>Restoration, Enhancement, Creation and Mitigation Credit.</u> Ms. Sheldon and Ms. Azous both assert that the proposed mitigation is inadequate for project impacts, mitigation credit ratios are too high or have been miscalculated, and that the type of mitigation being proposed by the Port is misrepresented in the documents. These assertions are not supported by the project record, or a careful

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[2] Parametrix, Inc. November 2001. Natural Resource Mitigation Plan, Seattle-Tacoma International Airport Master Plan Update Improvements.



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review of the documents. These statements also reflect a lack of understanding of mitigation, how mitigation credit ratios are used, and of the proposed mitigation plans.

10. Adequacy of the Mitigation Plan. First, as defined by Ecology,[3] mitigation means reducing the total adverse impacts of a project to an acceptable level, and can be accomplished through a variety of methods or actions. Consistent with USACE policy, Ecology's definition of mitigation includes avoiding, minimizing, rectifying, reducing, and compensating for impacts. The Azous and Sheldon statements completely ignore the numerous steps taken by the Port to avoid, minimize, rectify and reduce impacts (see Table 4.1-1 in the NRMP), in addition to the compensatory mitigation that is the subject of the NRMP. For example, a significant avoidance and minimization action includes use of the MSE walls to avoid and minimize stream and wetland impacts along the northern and western edges of the third runway.

11. A major component of the Port's compensatory mitigation that is ignored by Ms. Azous and Ms. Sheldon is the removal of existing land use practices and activities that are currently degrading wetlands and water quality in the project area. An example of this is the removal of existing buildings, which are impervious surfaces, and have contributed to water quality impacts and hydrological alterations in the Miller and Des Moines Creek basins. These buildings and their associated artificial landscapes will be replaced with natural landscapes – i.e., pervious surfaces and native plant species. Also included in these mitigation actions are the removal of septic systems, replacement of lawns and landscaped gardens with native shrub and forested vegetation, and the replacement of active farming, golf course, and nursery operations with native forested and shrub vegetation. All of these actions will reduce the inputs of fertilizers, pesticides, and excess nutrients from septic systems into Miller and Des Moines Creeks. Removal of these existing uses will have a beneficial effect on water quality and the aquatic ecosystems of Miller and Des Moines Creeks. These beneficial effects must be considered by regulatory agencies in evaluating the overall effects of the project on aquatic resources.

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[3] McMillan, Andy. How Ecology Regulates Wetlands. April 1998. Ecology Publication 97-112.



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12. Functions Being Impacted by the Project are the Functions Being Replaced. Ms. Azous states (paragraphs 8-10; Pre-filed Testimony of Amanda Azous, 2/22/02) that the mitigation does not replace the functions being impacted. She states that 'waterfowl habitat and flood storage are the primary wetland functions targeted for replacement in the NRMP'. She cites Table 1.3-1 in support of this statement. She is simply incorrect; it is difficult to see how a careful reading of Table 1.3-1 (Attached as Exhibit C), or a careful review of the mitigation plans could lead to her conclusion.

13. First, reading through Table 1.3-1,[4] there is no mention of waterfowl habitat in the table. Flood storage is being replaced at Vacca Farm because it is being impacted there. Table 1.3-1 mentions the following aspects of the various enhancement and restoration actions being proposed:

- Enhance 10.25 acres of existing wetlands along Miller Creek
- Enhance 40.86 acres of wetland buffer along Miller Creek
- Restore and enhance about 19 acres of stream habitat, floodplain wetlands, and aquatic habitat in Lora Lake and Vacca Farm
- Remove riprap, bridges, trash, weirs, tire bulkheads and concrete walls along Miller Creek
- Enhance instream habitat in Miller Creek with LWD, gravel benches, removing fish passage barriers, replacing residential lawns with native trees and shrubs
- Restore 2.2 acres of wetlands by removing fill and commercial development; enhance 0.8 acres of existing lawn to native shrub wetland
- Restore about 4.5 acres of golf course to native shrub wetland and enhance 3.4 acres of buffers and 1 acre of existing wetland along Des Moines Creek
- Create new and enhance existing wetland functions at a 65 acre parcel near Auburn; create 17.2 acres forested wetland, 6 acres shrub wetland, 6.2 acres of emergent wetland, and 0.6 acres of open water, with 15.9 acres of forested buffers.

14. The **only** item on this list, and the only part of the mitigation plan, that could be considered waterfowl habitat is at the Auburn mitigation site. The 0.6 acres of open water and the fringe of emergent wetland that will surround the open water will be waterfowl habitat.

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[4] NRMP, November 2001; Table 1.3-1, pp. 1-6 through 1-10.



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15. All of the other actions on the list (including 17.2 acres of new forested wetland, 6 acres of new shrub wetlands, 6.2 acres of new emergent wetland, and 0.6 acres of new open water habitat to be created at the Auburn mitigation site) will have the result of the improving wetland and aquatic functions that Ms. Azous claims are ignored by the mitigation design:

- improving water quality functions (removing sources of pollutants, enhancing vegetation density),
- improving sediment and nutrient retention functions (removing pollutant sources, removing impervious surfaces, enhancing vegetation density),
- improving native plant communities (removing/managing non-native invasives, replacing non-native vegetation with native species),
- improving fish habitat (LWD, removing passage barriers, increasing habitat complexity, increasing spawning habitat), and
- improving organic carbon export functions (replacing agricultural/residential lawn/golf course with native emergent, shrub and forested communities; replacing lawn, garden and golf course areas along streams with shrub and forested vegetation).

16. <u>Ecological Functions are Replaced Regardless of Whether Actions are Labeled Enhancement or Restoration</u>. A specific example of how the proposed mitigation actions (which are labeled enhancement by Azous and Sheldon) will restore or replace a suite of impacted functions is given below. Much of the project area, including much of the existing wetland area, consists of residential and commercial buildings, residential lawns, nursery operations (i.e., greenhouses, parking lot fill, turf grass lawn), residential gardens, agricultural fields, and golf course.[5],[6] These areas are characterized by the following attributes:

- Impervious surfaces (buildings, driveways, turf – lawns, golf courses);
- Significant sources of pollutants to surface waters[7],[8] (septic systems, fertilizers, pesticides, herbicides, fungicides, etc. regularly applied to agricultural areas, lawns, gardens and golf courses)

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[5] Parametrix, Inc. 2000. Wetland Delineation Report, Master Plan Update Improvements, Seattle-Tacoma International Airport. September 2000.

[6] NRMP, November 2001.

[7] Voss, F. D., S. S. Embrey, J. C. Ebbert. 1999. Pesticides detected in urban streams during rainstorms and relations to retail sales of pesticides in King County, Washington. U.S. Geological Survey. USGS Fact Sheet 097-99. April 1999.

[8] Bortleson, G. C., D. A. Davis. 1997. Pesticides in selected small streams in the Puget Sound Basin, 1987-1995: U.S. Geological Survey Fact Sheet 067-97, 4 p.



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- Low infiltration capacity; low permeability (i.e., surface water does not infiltrate and recharge groundwater but runs off rapidly)
- Low roughness (i.e., turf grasses, impervious surfaces do not slow the runoff of surface water), and therefore
- Limited capacity to retain sediment and nutrients
- Low **native** plant species diversity
- Not significant sources of large or small woody debris to streams (i.e., lawns/golf course cannot provide wood to streams)
- Not significant sources of litter and/or organic matter to streams (i.e., organic matter is regularly removed and disposed of off-site from lawns, gardens, agricultural operations and golf courses)
- Do not provide shade to streams

17. The NRMP clearly describes how existing buildings (including 380 houses with associated driveways, lawns and septic systems) will be removed from the project area along the Miller Creek riparian zone.[9] This action will remove 4.3 acres of impervious surfaces and replace it with native forest and shrub vegetation. Residential lawns, nursery operations, agricultural areas, and golf course in the Miller and Des Moines Creek basins will be replaced with native forest and/or shrub vegetation. Existing sources of nutrients and pollutants will be removed. Significant sources of nutrients are the existing septic systems, and fertilizers applied in typical household and golf course areas. Significant sources of pollutants are herbicides and pesticides (including fungicides) that are typically applied in residential, agricultural, nursery and golf course operations. Herbicides and pesticides in particular can degrade water quality and be detrimental to aquatic biota.[10] Removing these sources of pollutants from the Miller and Des Moines Creek basins will significantly improve water quality and aquatic habitat. In addition, converting lawns, golf course, nursery and agricultural fields to forested or shrub wetlands will increase roughness, slow runoff, and increase sediment and nutrient trapping capacity;[11],[12] increase permeability of soils and increase infiltration and therefore support

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[9] NRMP, November 2001. Chapter 5.

[10] National Oceanic and Atmospheric Administration. 2000. Endangered and threatened species: final rule governing take of 14 threatened salmon and steelhead evolutionarily significant units (ESU's). Federal Register (Docket 991207324-0148-02, July 2, 2000) 65 (132):42422-42481.

[11] Daniels, R.B., J.W. Gilliam. 1996. Sediment and chemical load reduction by grass and riparian filters. Soil Sci. Soc. Am. J. 60:246-251.

groundwater recharge and base flow in streams;[13] increase sources of large woody debris and small woody debris to streams (which will increase organic debris dams), increase litter and organic matter inputs to streams and enhance aquatic food webs;[14],[15],[16],[17] and increase shade to the streams. These are all functional improvements that will occur in the streams, and in wetlands riparian to Miller and Des Moines Creeks.

18. The water quality benefits due to increases in the amount of pervious surface, increases in soil permeability and infiltration, increased roughness, and increased sediment and nutrient retention will also result from enhancements to the non-wetland portions of the riparian buffers along Miller and Des Moines Creeks. These functional enhancements on non-wetland areas will also improve aquatic habitats in the streams. Furthermore, the replacement of non-native lawn and residential gardens, golf courses, nursery and agricultural operations in the buffer corridor will enhance the capacity of the buffer to support native vegetation and plant communities, increase native plant species diversity, and enhance habitat for small mammals, birds and amphibians.[18],[19]

19. Mitigation Credit Ratios. Ms. Azous and Ms. Sheldon also both assert that mitigation credits have been miscalculated. In particular, they argue that too much credit has been given to one

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[12] Groffman, P.M., E. Axelrod, J. L. Lemunyon, W. M. Sullivan. 1991. Denitrification in grass and forested vegetated filter strips. J. Environmental Qual. 20:671-674.

[13] Dunne, T., R.D. Black. 1970. An experimental investigation of runoff production in permeable soils. Water Resources Research, 6: 478-490.

[14] Bilby, R.E., G.E. Likens. 1980. Importance of organic debris dams in the structure and function of stream ecosystems. Ecology 61:1107-1113.

[15] Bisson, P.A., R.E. Bilby. 1998. Organic matter and trophic dynamic. Pages. 373-398/Chapter 5 *in* R. Naiman, R. Bilby, S. Kanton (eds). River Ecology and Management: Lessons from the Pacific Coastal Ecoregion. Springer-Verlag Publishing, New York, New York.

[16] Environmental Protection Agency. 1977. Impact of nearstream vegetation and stream morphology on water quality and stream biota. Environmental Research Laboratory. Athens, GA.

[17] Meehan, W.R. 1996. Influence of riparian canopy on macroinvertebrate composition and food habits of juvenile salmonids in several Oregon streams. Pacific Northwest Research Station, U.S. Department of Agriculture, Forest Service. PNW-RP-496. 14 p.

[18] Steel, E.A., R. J. Naiman, S. D. West. 1999. Use of woody debris piles by birds and small mammals in a riparian corridor. Northwest Science 73: 19-26.

[19] Azous, A. L., R. R. Horner. (eds). 2001. Wetlands and Urbanization: Implications for the Future. Lewis Publishers, CRC Press, Boca Raton, FL.



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small part of the mitigation plan: the restoration of wetlands at the Vacca Farm site. ACC argues that the mitigation is 'enhancement' and not 'restoration', and the mitigation ratios should be higher.

20. Mitigation credit ratios have been established by both the USACE and Ecology as tools to be used to determine when mitigation adequately compensates for wetland impacts. The mitigation credit ratios are not requirements,[20] and are not intended to be rigidly applied. Rather, credit ratios are 'general guidelines' and recommendations that are intended to be used with flexibility, taking into account the replacement and/or improvement in wetland functions, as well as the likelihood of success of the proposed mitigation plan.

21. The Port and Parametrix did not use mitigation credit ratios in developing the mitigation plan. The mitigation ratios (based on Ecology recommendations) are reported in the NRMP as a means of summarizing the overall mitigation and documenting that the ratios for the Port's project fall within Ecology's recommended guidelines. The mitigation plans were developed by first evaluating the type of wetlands and functions being impacted by the project. Then the potential for on-site mitigation for those impacts was assessed, and mitigation plans were designed (including both on-site and off-site mitigation) that are targeted at replacing and improving the functions impacted by the project. As mentioned above, a careful reading of the NRMP makes clear that a focus on wetland and aquatic system functions is driving the design for each mitigation element. For example, the numerous actions proposed for Miller Creek, Miller Creek riparian wetlands, and the Miller Creek riparian buffer are targeted at replacing and improving a suite of wetland and aquatic system functions.[21],[22]

22. The comments of both Ms. Azous and Ms. Sheldon regarding mitigation ratios and the contention that the mitigation credit ratios reported in the NRMP are too high are not consistent with

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[20] McMillan, Andy. How Ecology Regulates Wetlands. April 1998. Ecology Publication 97-112.

[21] Correll, D. L. 2000. The current status of our knowledge of riparian buffer water quality functions. *In:* P. Wigington and R. Beschta (eds.), Riparian Ecology and Management in Multi-Land Use Watersheds. Conference proceedings. American Water Resources Association. Middleburg, Virginia.

[22] Horner, R. R., J. J. Skupien, E. H. Livingston, H.E. Shaver. 1994. Fundamentals of urban runoff management: technical and institutional issues. Terrene Institute; U.S. Environmental Protection Agency. Washington D.C.



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recent state-of-the-science reviews of compensatory mitigation.[23] Neither Ms. Azous nor Ms. Sheldon provide a justification for why the credit ratios are too high, but base this contention on their opinion that specific mitigation actions should be classified as enhancement instead of restoration. They use narrow definitions of enhancement and restoration, rather than evaluating what is actually being proposed in the mitigation plans.

23. When are Higher Ratios Typically Recommended? The National Research Council (NRC)[24] report on compensatory mitigation recommends that higher ratios should be used to reflect the functional value of the impacted wetland (e.g., pristine wetlands would require higher ratios than highly degraded wetlands) or when there will be a long time period between the impacts and the desired endpoint for the mitigation site. These conditions do not apply to the Port's project area. For example, the wetlands being impacted by the project are not pristine and all of them have been significantly degraded by on-going and/or past land use practices. Ms. Azous and Ms. Sheldon have not provided any analysis of why they think higher ratios are justified for this project, other than a narrow definition of restoration, and their incorrect assumption that the ratios are requirements.

24. The rationale cited by Ecology for using a higher ratio for enhancement than restoration is that enhancement, if used alone, results in a net loss of wetland area and the functional gain is less than that from restoration.[25] This is based on Ecology's published definitions for enhancement and restoration:

25. "Enhancement: actions taken within an existing degraded wetland to augment one or more functions; actions taken to improve the functions provided by a buffer or upland area."[26]

26. "Restoration: actions taken to re-establish wetland area, function, and values where wetlands previously existed, but are currently absent because of the absence of hydrology or hydric

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[23] National Research Council. 2001. Compensating for Wetland Losses Under the Clean Water Act. National Academy of Sciences, National Academy Press.
[24] NRC. 2001. Compensating for Wetland Losses Under the Clean Water Act. National Academy of Science Press.
[25] McMillan, A. 1998. How Ecology Regulates Wetlands. Ecology Publication No. 97-112.
[26] WAC, Chapter 173-700. Compensatory Wetland Mitigation Banks; Part II Definitions.

soils. Restoration can also include the re-establishment of historic wetland HGM classes on sites which have been altered due to human activities to a different class, and which have significantly degraded, or low levels of functions and values." [27]

27. In the past decade the National Research Council has published two reviews on aquatic ecosystems, one on restoration of aquatic ecosystems and one which is a review of compensatory mitigation programs in the United States.[28],[29] These reviews were conducted by a group of prominent wetland scientists and restoration ecologists. The following definitions of enhancement and restoration are included in those reviews. Enhancement: any human activity that increases one or more functions of an existing wetland. Restoration: the return of a wetland from a disturbed or altered condition by human activity to a previously existing condition.[30],[31]

28. The most authoritative and widely read reference book on wetland ecology[32] defines enhancement as "any human activity that increases one or more functions of an existing wetland." The same book defines restoration as "the return of a wetland from a disturbed or altered condition by human activity to a previously existing condition." Wetlands being restored may have been degraded or hydrologically altered, and restoration then may involve re-establishing hydrologic conditions to re-establish previous vegetation communities.

29. Finally, the USACE in a Regulatory Guidance Letter (RGL) No. 01-1,[33] written in response to the review of compensatory mitigation by the NRC, defines enhancement as follows:

> Enhancement: manipulation of physical, chemical, or biological characteristics of a wetland (undisturbed or degraded) site to heighten, intensify, or improve specific function(s) or to change the growth stage or composition of the vegetation present." Enhancement is undertaken for

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[27] WAC, Chapter 173-700. Compensatory Wetland Mitigation Banks; Part II Definitions.
[28] NRC. 2001. Compensating for Wetland Losses Under the Clean Water Act. National Academy of Science Press.
[29] NRC (National Research Council). 1992. Restoration of Aquatic Ecosystems: Science, Technology and Public Policy. Washington D.C., National Academy Press.
[30] NRC. 2001. Compensating for Wetland Losses Under the Clean Water Act. National Academy of Science Press.
[31] NRC (National Research Council). 1992. Restoration of Aquatic Ecosystems: Science, Technology and Public Policy. Washington D.C., National Academy Press.
[32] Mitsch, W.J., Gosselink, J.G. 2000. Wetlands. Third Edition. John Wiley & Sons, Inc. New York.
[33] U.S. Army Corps of Engineers. Regulatory Guidance Letter No. 01-1, October 31, 2001.



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specific functions such as water quality improvement, floodwater retention, or wildlife habitat. Because enhancement is targeted usually at a single function, it can result in a decline in other wetland functions already present. Enhancement results in a net loss of wetland area if it is the only mitigation activity proposed for a project.

a. RGL No. 01-1 defines restoration as:

Restoration: manipulation of physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded wetland. For the purpose of tracking net gains in wetland acres, restoration is divided into:

- Re-establishment: manipulation of physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former wetland. Re-establishment results in re-building a former wetland and results in a gain in wetland acres.
- Re-habilitation: manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions of a degraded wetland. Re-habilitation results in a gain in wetland function but does not result in a gain in wetland acres.

30. It should be clear that there is no single, precise definition of wetland restoration or enhancement that is universally accepted. Also, because enhancement is generally defined as improving or enhancing one or more functions, and restoration is generally defined as returning a degraded system to a former condition, there is no hard line between enhancement and restoration – calling something restoration or enhancement is a matter of the degree to which functions that are degraded are restored or improved.

31. It should be clear from these definitions, that to qualify as restoration, a wetland does not have to have its functions completely absent. Wetlands with degraded functions can be restored.

32. Ms. Azous misrepresents the NRC review and its definitions of restoration and enhancement. She cites the re-establishment definition of restoration from the USACE's regulatory guidance letter[34] in her text and goes on to say: 'the key to understanding the difference between restoration and enhancement activities is that a restoration of a wetland function occurs when the function *is not currently present*' (italics added). However, the full definition (which does appear on the

[34] U.S. Army Corps of Engineers. Regulatory Guidance Letter No. 01-1, October 31, 2001.



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bottom of p. 14, but is not mentioned in her text), clearly states that 're-habilitation is the manipulation of physical, chemical, or biological characteristics of a site with the goal of *repairing* natural/historic functions *of a degraded wetland*' (italics added). Webster's dictionary[35] defines repair as: 'to restore by replacing a part or *putting together what is torn or broken*' (italics added). Clearly, in degraded wetlands where some functions may still exist, repairing these functions in a significant manner fits the USACE definition of restoration.

33. This issue of definitions is important because Ms. Azous and Ms. Sheldon base so much of their criticism of the mitigation actions, and the adequacy of the mitigation on their selective misuse of these definitions. In my opinion, the mitigation proposed at the Vacca Farm site (discussed in more detail below), meets the definition of restoration.

34. <u>Enhancement of Riparian Buffers.</u> Both Ms. Azous and Ms. Sheldon focus their criticism on the mitigation plan's proposed riparian buffer protection and enhancement actions.

35. The focus on buffer enhancement in the Azous and Sheldon testimony ignores both the significant in-basin wetland restoration (11.5 acres) and the significant in-basin wetland enhancement (22.32 acres) proposed in the NRMP. It also ignores the large off-site wetland creation project (29.98 acres of new wetlands) and large areas of off-site wetland enhancement (19.5 acres). In fact, while the in-basin buffer enhancement covers a very large area (54.93 acres), the Port is receiving less mitigation 'credit' for that buffer enhancement than for either the in-basin wetland restoration projects or the in-basin wetland enhancement projects. A copy of the summary of wetland mitigation credit (NRMP Table 4.1-3) is attached as Exhibit D.

36. The ACC criticism also ignores the role that these riparian buffers play in enhancing and restoring wetland and aquatic system functions. Replacing the existing farmland, nursery/greenhouse operations, buildings, golf course, and residential lawns along Miller and Des Moines Creeks with forested and/or native shrub buffers will significantly enhance aquatic habitat for native fish species by

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[35] Merriam-Webster. 1988. Webster's Ninth New Collegiate Dictionary. Merriam-Webster, Inc. Publishers. Springfield, Massachusetts.



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removing pollutants, and contributing shade, litter, particulate organic matter, and large woody debris to the streams.[36],[37],[38]

37. The statement made by Ms. Azous that Ecology is accepting already protected stream and wetland buffers as wetland mitigation is incorrect. She misinterprets the existing condition of the buffers, and the enhancement actions proposed. Under existing conditions (i.e., in the absence of the Port's MPU projects), the stream and wetland 'buffers' associated with the riparian zone of Miller and Des Moines Creeks are:

- Characterized by existing uses that are detrimental to water quality;
- Degraded – i.e., the many of the buffers are not vegetated or not forested, buffers contain buildings, agricultural operations, septic systems, residential lawns, commercial nursery operations, and golf course;
- Portions of the riparian area do not fit the definition of vegetated buffers used by the USACE;[39]
- Portions of the riparian area do not fit the definition of buffers given by Ms. Azous in paragraph 12 of her Pre-filed Testimony. Ms. Azous quotes the NRCS definition of riparian buffers as an 'area of trees and shrubs located adjacent to streams, lakes, ponds, and wetlands'. In the portions of the Miller Creek and Des Moines Creek riparian zones where there are existing nursery operations, agricultural operations, residential lawns, houses, and golf course, *there are no existing buffers by this definition;* and
- These areas do not provide many of the valuable functions to streams and wetlands that vegetated, forested buffers provide.

38. In addition, Ms. Azous mis-states the enhancement activities in stream and wetland buffers that are being proposed as mitigation by the Port. It is wrong to state that upland buffers are being traded for filling wetlands, as Ms. Azous states.

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[36] Meehan, W. R. 1996. Influence of riparian canopy on macroinvertebrate composition and food habits of juvenile salmonds in several Oregon streams. Pacific Northwest Forest Research Station, U.S. Department of Agriculture, Forest Service. P PNW-RP-496.

[37] Robison, E. G., R. L. Beschta. 1990. Identifying trees in riparian areas that can provide coarse woody debris to streams. Forest Science 36(3), 790-801.

[38] Bisson, P. A., R. E. Bilby. 1998. Organic matter and trophic dynamic. *In:* R. Naiman, R. Bilby, S. Kantor (eds). River Ecology and Management: Lessons from the Pacific Coastal Ecoregion. Chapter 15, pp. 373-398. Springer-Verlag Publishing, New York, New York.

[39] U.S. Army Corps of Engineers. 2000. Special Public Notice. Final regional conditions, 401 water quality certification conditions, coastal zone management consistency responses for Nationwide Permits. Seattle District. 16 June 2000.



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39. Protection, or preservation, of such a large riparian corridor in a highly urbanized area would be significant in itself. However, the Port is not proposing simply to protect the area encompassed within the restrictive covenants that will be established along Miller and Des Moines Creeks. Buffer functions, which provide significant benefits to streams and wetlands, will be enhanced under the Port's proposal.

40. As outlined in the NRMP (NRMP, November 2001, Chapter 5), existing detrimental uses will be removed, sources of existing pollutants to the streams (e.g., septic, residential lawns, golf course) will be removed, areas that are currently residential lawn, garden, nursery, and golf course will be replaced with native forested or shrub vegetation that will provide greater sediment and nutrient trapping, greater water quality benefits, and provide shade, organic matter, and large woody debris to the streams.

41. Finally, a significant benefit of the riparian buffers being proposed by the Port lies in the creation of a large (more than 1.4 miles in length, and an average 200 feet wide), unfragmented habitat – a continuous, predominantly forested corridor connecting wetland and riparian habitat from Lora Lake to Des Moines Memorial Drive. Such large, unfragmented habitat patches are extremely rare in urban areas. Large, unfragmented patches provide important benefits to wetland animals that require an upland/wetland habitat matrix (such as amphibians). Large unfragmented habitat also has important benefits for many wetland-dependent animals that require unobstructed dispersal corridors between wetland habitats, or species that require multiple connected habitat patches in a relatively small area, to maintain viable populations.[40] In fact, the National Research Council, in its recent review of compensatory mitigation, stresses the importance of creating protected habitat connections among wetlands – 'both terrestrial connectivity between wetlands in the landscape and terrestrial habitat surrounding the wetland must be considered in designing mitigation wetlands' (p. 53, NRC 2001). The Port's mitigation plan provides significant protection of riparian and wetland buffers, significant

[40] NRC. 2001. Compensating for Wetland Losses Under the Clean Water Act. National Academy Press, pp. 51-53.



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enhancement (removal of existing detrimental uses and enhancement of existing areas) of buffer and wetland/aquatic functions, and a protected habitat corridor that provides a wetland/upland matrix and terrestrial habitat connections among wetlands. All of this provides significant functions that mitigate for the loss of on-site wetlands.

42. Ms. Azous is also wrong when she states that buffers cannot provide functional enhancement of aquatic or wetland systems. She states that 'wetlands and streams are aquatic resources and provide functions that are uniquely different from terrestrial resources such as riparian buffers' (p. 10, paragraph 17, Pre-filed Testimony of Amanda Azous, February 22, 2002). There are unique functions that wetlands and aquatic systems provide. However, terrestrial riparian buffers can provide some of the same functions (albeit in different ways and at different levels), and can also enhance wetland and aquatic ecosystem function. Therefore, protection and enhancement of terrestrial riparian buffers can provide improvements in wetland/stream functions. Several examples functions that are performed by both terrestrial riparian buffers and wetlands are:

43. Terrestrial riparian buffers infiltrate surface water and provide groundwater recharge that in turn, moderates stream flows and temperature, and supports base flows.[41] Forested riparian buffers have more permeable soils and provide greater infiltration and groundwater recharge than residential lawns, buildings or golf course turf.[42],[43]

44. Terrestrial riparian buffers that are comprised of structurally complex tree, shrub, and herbaceous vegetation provide roughness, and sediment and nutrient trapping functions and provide water quality benefits to wetlands and streams.[44]

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[41] Bauer, H.H., M. C. Mastin. 1997. Recharge from precipitation in three small glacial-till-mantled catchments in the Puget Sound Lowland, Washington. Prepared with Washington State Department of Ecology. U.S. Geological Survey: Water Resources Investigations Report 96-4219, Tacoma, Washington.

[42] Dunne, T., R. D. Black. 1970. An experimental investigation of runoff production in permeable soils. Waster Resources Research, 6: 478-490.

[43] Horner, R. R, J. J. Skupien, E. H. Livingston, H.E. Shaver. 1994. Fundamentals of urban runoff management: technical and institutional issues. Terrene Institute; U.S. Environmental Protection Agency. Washington, D. C.

[44] Belt, G. H., J. O'Laughlin, T. Merrill. 1992. Design of forest riparian buffer strips for the protection of water quality: analysis of scientific literature. Idaho Forest, Wildlife and Range Policy Analysis Group, No. 8. University of Idaho, Boise, Idaho. 35 p.



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45. Forested riparian buffers, both forested wetlands and terrestrial riparian forests, also provide significant inputs of organic matter to streams in the form of leaf litter, terrestrial insects which fall into the stream, and large and small woody debris.[45] This organic material supports aquatic food chains, and provides habitat complexity beneficial to aquatic biota, particularly salmonids.[46],[47]

46. Vacca Farm Mitigation Plan. The testimony of Ms. Azous and Ms. Sheldon regarding the specifics of the mitigation design for Vacca Farm and the riparian zone of Miller Creek south of Vacca Farm contain many mis-statements of fact. Their declarations reveal a significant lack of understanding of the basic elements of the mitigation design and how these elements will result in restoring the desired wetland and aquatic functions. A few of the most egregious examples that illustrate the lack of understanding and mis-representation of the mitigation plan are given below.

47. Channel Plantings along Miller Creek Will Shade the Stream. Ms. Sheldon contends that the riparian buffer plantings along Miller Creek in the Vacca Farm site will not provide shade to the creek. She states that a willow shrub planted in the channel planting area, 15 feet away from the channel, would have to be 'nearly 30 feet tall to cast effective cooling shade over the water of the stream in the height of the summer.' This statement reveals a complete unfamiliarity with the design of the mitigation as proposed by the Port, and/or a lack of basic knowledge about common wetland plant species. As clearly shown on the plans in the NRMP,[48] plantings near the stream consist of Pacific willow (*Salix lucida ssp. lasiandra*), Scouler's willow (*Salix scouleriana*) and Sitka willow (*Salix sitchensis*) . The channel planting plans are attached as Exhibit E.

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[45] Meehan, W.R. 1996. Influence of riparian canopy on macroinvertebrate composition and food habits of juvenile salmonids in several Oregon streams. Pacific Northwest Forest Research Station, U.S. Department of Agriculture, Forest Service. PNW-RP-496. 14 p.

[46] Bisson, P.A., R.E. Bilby. 1998. Organic matter and trophic dynamic. *In* R. Naiman, R. Bilby, S. Kantor (eds). River Ecology and Management: Lessons from the Pacific Coastal Ecoregion. Springer-Verlag Publishing, New York, New York.

[47] Harmon, M.E., J.F. Franklin, F. J. Swanson, P. Sollins, S.V. Gregory, J.D. Lattin, N.H. Anderson, S. P. Cline, N. G. Aument, J. R. Sedell, G. W. Lienkaemper, K. Cromack, K.W. Cummins. 1986. Ecology of coarse woody debris in temperate ecosystems. Advances in Ecological Research. 15:133-302.

[48] NRMP, Appendix A, sheets, C5, L4, and L5.



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48. These plantings are located in the high flow channel, at the edge of the low flow channel, and are clearly less than 15 feet from the edge of the low flow channel. Some individual plants would be at the edge of the low flow channel; most plantings would be within 12 feet of the edge of the low flow channel.

49. The basic field guide to Western Washington wetland plants,[49] and the basic flora for the Pacific Northwest[50] describe these species as follows. Scouler's willow is a tall tree to 12 meters tall, with a trunk to 40 centimeters thick; Pacific willow is a common native, usually multi-stemmed tree that grows from 12 meters up to 20 meters tall; and Sitka willow is a multi-stemmed shrub that grows from 6 meters up to 8 meters tall. There are 3.28 ft in one meter, therefore, Scouler's willow grows from about 20 feet up to about 39 feet tall, Pacific willow grows from about 39 feet up to 65 feet, and Sitka willow grows from about 20 feet up to 26 feet. Using Ms. Sheldon's rule, and especially considering that these plantings will be closer to the water than she thinks, these channel plantings will clearly be tall enough to provide shade and temperature amelioration to Miller Creek.

50. In addition, the Port has proposed, as a result of discussions with Ecology, that shade cloth be used along a portion of the newly relocated channel during the first few growing seasons following construction. This shade cloth (standard shade cloth used to reduce heat loads in nursery plants) will provide shade during the summer months for the first few years until the channel plantings become tall enough to provide shade to the stream.

51. <u>Peat Soils, and Hydrology of the Vacca Farm Site and Miller Creek.</u> Ms. Azous and Ms. Sheldon both criticize the Vacca Farm design based on hydrology, but for different reasons. Both of them have incorrectly interpreted the site conditions at Vacca Farm and the mitigation designs.

52. Ms. Azous states that the new channel bed elevation will be higher than the groundwater table and therefore water will drain out of the channel, resulting in a dry channel. Ms. Azous makes

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[49] Cooke, S. S. 1997. A field guide to common wetland plants of western Washington and northwestern Oregon. Seattle Audobon Society, Washington Native Plant Society.

[50] Hitchcock, C.L., A. Cronquist, M. Ownbey, J.W. Thompson. 1964. Vascular Plants of the Pacific Northwest. University of Washington Press, Seattle, Washington.



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some surprising statements about groundwater elevations, peat soils and the functioning of the new channel. She cites the well logs of the wells closest to the new channel location that show groundwater occurs within 8-12 inches of the ground surface at the north end of the new channel, and within 6-16 inches in September and October 2001. She concludes from this that the 'shallow groundwater table is *well below the ground surface* in the locations slated to become the redesigned Miller Creek'. (italics added). This statement is incorrect for several reasons.

53. First, shallow groundwater is generally considered to be groundwater that is close to the ground surface – so if it is well below the ground surface, it is not shallow groundwater. Second, groundwater elevations are at their greatest depths below the ground surface during the dry season in the Puget Sound region (i.e., between May and November). Groundwater that is within 6 to 16 inches of the surface at the end of the dry season in Puget Sound would be considered to be very shallow. For comparison, the Auburn mitigation site has shallow groundwater tables in the wetland areas (NRMP, Chapter 7). In wetland areas on that site, the groundwater table is at or above the ground surface for several months out of the year (late November to late May or June). However, the groundwater is typically about 4 to 6 feet below the ground surface at the end of the dry season (i.e., in September and October) (NRMP, Table 7.2-5). In my opinion, groundwater that is as close to the surface as 16 inches during the dry season, would be considered a shallow groundwater table. The elevation of the new channel bed will be about 2 feet to 2.5 feet below the current ground surface (NRMP, Appendix A, Sheet C6). Groundwater elevations (from the well logs) during the dry season are currently between 6 and 16 inches below the surface, therefore, the new channel bed will not be 'perched' above the groundwater table. Channel hydraulics in the relocated reach of Miller Creek are influenced by high water tables and the downstream water surface elevation, in addition to channel configuration, slope, and roughness. In addition, the existing channel, which is located hydraulically upslope of the proposed channel, has flowing water year round and does 'drain' into the ground.



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54. Finally, Ms. Azous apparently does not understand the nature of the peat soils in the vicinity of the new channel. The peat soils on the Vacca Farm site are saturated to the surface even in late summer;[51] peat soils are typically saturated to the surface throughout the growing season[52]. Peat soils also typically have very low hydraulic conductivity, which means that they do not either take up water or release water easily.[53] In my opinion, given the nature of peat soils and particularly saturated peat soils, water will not 'seep' out of the Miller Creek channel into the peat soils and the channel will not run dry.

55. Further, in contrast to ACCs claim, the Vacca farm mitigation site will, following grading, have adequate hydrology to support wetland vegetation and biological functions. This is demonstrated by the hydrologic monitoring data presented in the *Natural Resource Mitigation Plan* (Table 5.1-10, page 5-32), other on-site observations, and that the development of peat soils at this site is the result of groundwater discharge (which is still present) and not surface flooding. The wetland is graded such overbank and backwater flooding will occur during the mean annual flow, not the 100-year flow as reported by ACC.[54] Following flood events, floodwaters will gradually recede as the water elevation in the stream recedes to prevent long-term ponding.

56. Effects of Removing Peat Soil. Ms. Sheldon expresses concern over the removal of peat soils from the Vacca Farm mitigation area. The NRMP identifies the net changes in surface area of organic (peat or muck) soils at the Vacca Farm site (Appendix O of the NRMP is attached as Exhibit F), showing a net loss of about 0.1 acres of organic soil. Ms Sheldon does not identify any potential functional impacts associated with the removal of 0.1 acre of organic soil, and in my opinion removal of 0.1 acre of peat soils will not impact functions, especially given the mitigation actions planned for Vacca Farm.

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[51] Parametrix, Inc. Wetland Delineation Report. September 2000.
[52] Crum, H., S. Planisek. 1988. A focus on peatlands and peat mosses. The University of Michigan Press, Ann Arbor, MI.
[53] Verry, E. 1997. Hydrologic processes of natural, northern forested wetlands. *In*, C. Trettin et al., *Northern Forested Wetlands: Ecology and Management*. Lewis Publishers, Boca Raton, Florida.
[54] See Response #19 to comment letter by Sheldon & Associates, February 15, 2001 in March 2001 Response to Comments.



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57. Adequacy and Development of Performance Standards. Ms. Sheldon makes the assertion that many mitigation projects fail due to poor performance standards and lack of enforcement. The recent NRC review actually states that while performance standards can be improved, mitigation projects frequently fail because the performance standards are not enforced. I have written performance standards for complex mitigation projects and I have monitored mitigation sites to evaluate compliance with performance standards. In my opinion, the performance standards for the Port's project are enforceable and are related to the goals of the mitigation projects.

58. For example, the National Research Council recommends use of multiple performance-based monitoring standards for mitigation projects. Contrary to the assertions of Ms. Sheldon, the use of multiple standards for the same project, such as percent survival of planted stock in the first year; percent survival of planted stock over the several years, percent canopy cover of native vs. non-native plants, plant installation densities, and final plant densities (Table 5.1-2, 5.1-9, NRMP) is consistent with standard practice wetland mitigation and best available science.[55]

59. Wildlife Hazard Management Plan and Vacca Farm/Miller Creek Mitigation. The Port and Parametrix staff worked closely with the Port's wildlife hazard managers to ensure that the mitigation design could accomplish the goals of the mitigation, meet performance standards, and ensure compliance with State water quality standards, while avoiding the creation of new wildlife hazards near the airport.

60. For example, plant species in areas that would be within 10,000 ft of runways were chosen in consultation with the Port's wildlife hazard managers to avoid species that are particularly attractive to flocking birds or that provide attractive roosts. It is therefore unlikely, in contrast to the contention of Ms. Sheldon, that management actions will remove 'any semblance of forest' from the riparian zone of Miller Creek.

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[55] NRC. 2001. Compensating for wetland losses under the clean water act. National Academy of Sciences.

61. The Port's planting plans also incorporate mixes of species and a diversity of canopy heights in some areas to accommodate the USDA and FAA recommendations regarding hazard wildlife (Cleary and Dolbeer, 1999; FAA/USDA Manual for Wildlife Hazard Management at Airports). Ms. Sheldon is incorrect in stating that the FAA/USDA management guidelines would call for removing 1/3 of the tree canopy on the mitigation sites. The FAA/USDA guidelines call for thinning 'about one-third of the trees.....in dense, overcrowded, young trees...'. The tree plantings in the Vacca Farm floodplain will not be planted in dense stands.

62. Contrary to Ms. Sheldon's statement, the FAA/USDA guidelines do not preclude a mature forested canopy, rather the guidelines preclude a dense, closed canopy, especially one formed from one or only a few tree species. The Port's planting plan at Vacca Farm will result in a shrub and tree canopy that is not closed because it contains a mix of tree and shrub species of different heights.

63. The Wildlife Hazard Management Plan for the airport (WHMP), which has been approved by the FAA, contains two general types of management options (NRMP, November 2001, Chapter 4, pp. 4-46 to 4-47). The first is minor management – these are actions that will not affect permit conditions or performance standards and include thinning of tree branches or planting of additional plants to increase vegetation density. These actions can be undertaken without prior notification of Ecology or the USACE, because they don't affect permit conditions; however, as stated in the NRMP, these agencies will be notified when such actions are taken.

64. The other management options are major management actions that could affect permit conditions or the design goals of the mitigation, and require consultation and/or permits, from the resource agencies (e.g., CWA 404, 401 compliance; ESA review, HPA compliance). These actions would not be undertaken without prior consultation and discussion with the agencies, unless immediate action was determined to be necessary to ensure aircraft safety. Again, because the mitigation design was developed in close conjunction with the Port's wildlife hazard managers, and consistent with FAA and USDA guidelines, it is unlikely that this type of action would be required by the project.



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65. Reliability of Mitigation. The mitigation planning and designs are based on scientifically-recognized methods to create, restore, and enhance wetlands and streams. These methods are focused on creating restored systems that are sustainable over time. Planning for the sites has carefully evaluated site conditions (soil, hydrology, vegetation, and landscape conditions) to determine restoration approaches that will establish desired ecological functions in a sustainable manner, following agency guidelines.[56] The extensive review of these plans by the public and agency staff has resulted in the incorporation of numerous modifications to assure successful mitigation. For example, the applicable recommendations of recent King County assessments of mitigation projects have been included in the Port's plans.[57] The mitigation planning also incorporates many other recommendations,[58] for example, each the plan for each mitigation site (see NRMP Chapters 5 and 7), include: multiple functional goals; development of multiple performance-based monitoring standards for the key ecological elements to be established; and identification of contingency measures, including an adaptive management approach to monitoring and extension of the monitoring period to 15 years. The mitigation sites are assured long-term protection by restrictive covenants that legally protect them from other uses. These approaches are designed to ensure that wetland functions are ultimately replaced and that the duration of temporal impacts are minimized.

I declare under penalty of perjury under the laws of the state of Washington that the foregoing is true and correct.

Executed at Seattle, Washington, this 7th day of March 2002.

Jan L. Cassin, Ph.D.

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[56] The mitigation was planned and evaluated in accordance with the interagency publication *Guidelines for Developing Freshwater Mitigation Plans and Proposals*. Washington State Department of Ecology publication #93-74. 1993.

[57] See response to Comment 1 of State Senator Julia Patterson's letter of November 12, 1999 contained in *Response to Comments on Permit Reference No. 1996-4-02325*, Port of Seattle, March 2000.

[58] See *Compensating for Wetland Losses Under the Clean Water Act, Advanced Copy*, National Research Council, Washington, D.C. 2000, pages 1-8.



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PRE-FILED TESTIMONY OF JAN L. CASSIN, PH.D.

EXHIBITS

| | |
|---|---|
| A | Curriculum Vitae |
| B | Figure C1, Appendix C, Wetland Delineation Report |
| C | Table 1.3-1, NRMP |
| D | Table 4.1-3, NRMP |
| E | NRMP, Appdendix A, Sheets C5, L4 and L5 |
| F | NRMP, Appendix O, Sheet C1 |

A

## RESUME

**Jan L. Cassin**
Wetland Ecology, Plant Community Ecology, Botany, Restoration Ecology

### EDUCATION

Ph.D. (Ecology and Evolutionary Biology) 1997, **University of Michigan, Ann Arbor.** Dissertation Title: 'Balancing Costs and Benefits in a Mutualism: Conditionality in the Interaction between the grass, *Hystrix patula* and its fungal endophyte'.

M.S. (Ecology and Evolutionary Biology) 1989, **University of Michigan, Ann Arbor.** Thesis: 'Ecological Determinants of Host Plant Use in a Willow Flea Beetle (*Altica subplicata*)'.

B.A. (Environmental, Organismic and Population Biology) 1977, **University of Colorado, Boulder.**

### QUALIFICATIONS

Dr. Cassin is a plant community ecologist and wetland scientist with over 17 years experience in applied conservation biology and wetland ecology. Jan has extensive experience conducting botanical and wetland inventories, and wetland/riverine functional assessments in the Pacific Northwest, California, Alaska, New England, the mid-Atlantic states, the Rocky Mountain states and in the upper Great Lakes region. Dr. Cassin specializes in the application of scientific principles to ecosystem assessment and restoration in wetland and riverine systems. She has focused on the development of ecological assessments for impact analysis, and in the design, construction and monitoring of wetland ecosystem restoration, with a particular emphasis on estuarine and riverine restoration. Dr. Cassin helped develop hydrogeomorphic (HGM) functional assessment models for riparian and wetland systems in Alaska, California, the Chesapeake Bay, and the Pacific Northwest.

In addition, Dr. Cassin is experienced in designing vegetation sampling protocols and conducting vegetation sampling to address changes in plant distribution and abundance at a range of spatial scales. Projects include: determining the effects of multiple environmental factors on plant population viability, persistence and distribution; addressing effects of spatial and temporal variation in environmental stressors on plant demographic parameters; linking plant parameters such as growth rates, biomass, productivity and seed production with trends in abundance and distribution; using a combination of historical records, satellite imaging, aerial photos and field surveys to map historic and current distributions of rare plants and communities to assess changes over time; and conducting vegetation sampling along environmental and anthropogenic disturbance gradients to determine conservation priorities as well as to set design and performance targets for ecosystem restoration projects.

As an environmental consultant, Dr. Cassin is experienced in providing the following services to governmental and non-governmental clients: regulatory assistance with wetland permitting efforts at federal, state and local levels; conducting wetland delineations; conducting threatened and endangered species inventories and preparing conservation plans; designing, constructing and monitoring compensatory mitigation projects; monitoring and managing invasive plants; and ecosystem monitoring and management in both wetland and terrestrial systems. In addition, she has extensive experience in the design of protection and management strategies for the conservation and recovery of endangered species. Dr. Cassin has worked in both the public and private sectors, is an experienced teacher and lecturer, and has successfully worked on large multi-agency projects that involved coordination among numerous stakeholders and extensive public participation.

**EXPERIENCE**

Senior Scientist, Wetland Ecology/Plant Ecology, Parametrix, Inc.; Kirkland, WA. 1999 to present. As a Senior Scientist/Plant Ecologist at Parametrix, Dr. Cassin specializes in ecosystem restoration design, construction and monitoring; regulatory assistance; ecosystem functional assessment with a particular focus on riparian and estuarine systems; wetland delineation; and ESA compliance and conservation/recovery planning.

Senior Associate, L. C. Lee & Associates, Inc. (LCLA) and the National Wetland Science Training Cooperative (NWSTC), Seattle, WA. June 1997- December 1999. As a Senior Associate at LCLA, Dr. Cassin provided private, governmental and non-governmental clients with consulting services in wetlands science; regional wetlands inventories and functional assessments; wetlands permitting and regulatory assistance; ecosystem restoration design, construction and monitoring; and ecosystem monitoring and management.

Information Manager/Botanist, The Nature Conservancy. Michigan Natural Features Inventory (MNFI), Lansing, MI. 1990-1992. While at MNFI, Jan provided database/GIS management and botanical support for a state-wide biological inventory. She assisted with environmental reviews using database, conducted botanical and vegetation inventories, helped develop conservation priorities by mapping historic and current distributions of high priority plant community types, and writing natural areas management plans. Additional duties included working as a member of the team developing conservation and management strategies for state-wide natural areas program.

Regional Information Manager/Botanist, The Nature Conservancy (TNC), Eastern Regional Office, Boston, MA. 1982-1987. The regional office of TNC Jan provided database development/management for map and computer files documenting biological inventories for states in the eastern U.S. To support individual state inventories, she assisted with botanical and vegetation surveys, was a member of team developing conservation priorities and plans for rare species and threatened natural communities, assisted with the development of regional vegetation classifications, and prepared stewardship plans for rare species. Additional duties included assisting and training State Natural Heritage data managers in database development and management, and working as a member of the team developing and implementing region-wide conservation and management strategies.

Senior Staff Assistant, Center for Policy Alternatives, Massachusetts Institute of Technology, Cambridge, MA. 1980-1982. Duties included working on multidisciplinary teams preparing technical and scientific review documents on a range of environmental policy issues.

Analyst: Environmental Permitting/Reclamation, Impact Environmental Consultants, Inc., Denver, CO. 1977-1980. Duties included regulatory assistance; air and water quality monitoring technician; Uranium and surface coal mine reclamation planning and assistance.

**SELECTED PUBLICATIONS**

Cassin, J.L. 2001. *Conceptual Mitigation Plan: Oak Woodland, Prairie, and Western Gray Squirrel Habitat Restoration. Cross Base Highway Project.* Prepared for Pierce County, WA. Parametrix, Inc. Kirkland, WA.

Cassin, J.L. 2001. *Native riparian cottonwood communities, groundwater elevations, and impacts of water management regimes.* Report prepared for a confidential client. Parametrix, Inc. Kirkland, WA.

Cassin, J. L. 2000. Filling the Gap in Conservation Strategies: A Mesoscale Tool for Biodiversity Assessment and Conservation. Conservation Biology, Vol. 14, No. 5, October, 2000.

Cassin, J. L., M. L. Louther, and J. C. Kelley. 2000. *Implementation Addendum to the Natural Resource Mitigation Plan: Master Plan Update Improvements for the Seattle-Tacoma International Airport.* Port of Seattle. Parametrix, Inc. Kirkland, WA.

Lee, L. C., M. C. Rains, J. L. Cassin, S. R. Stewart, R. Post, M. Brinson, M. Clark, J. Hall, G. Hollands, D. LaPlant, W. Nutter, J. Powell, T. Rockwell, and D. Whigham. 1999. *Operational Draft Guidebook for Reference Based Functional Assessment of the Functions of Precipitation Driven Wetlands on Discontinuous Permafrost in Interior Alaska.* State of Alaska, Department of Environmental Conservation/U. S. Army Corps of Engineers Waterways Experiment Station Technical Report. Anchorage, AK.

L. C. Lee and Associates, Inc. 1998. *Newskah Creek Aquatic Ecosystem Restoration: Preliminary Restoration Plan for the Washington State Department of Corrections Stafford Creek Corrections Center, Grays Harbor County, Washington.* Prepared by J. L. Cassin and S. M. Winter for the Washington State Department of Corrections, Olympia, WA.

Lee, L.C., M. L. Butterwick, J. L. Cassin, R. A. Leidy, J. A. Mason, M.C. Rains, L.E. Shaw, E. G. White. 1997. *A Draft Guidebook for Assessment of the Functions of Waters of the U.S., Including Wetlands on the Borden Ranch, Sacramento and San Joaquin Counties, California.* Wetland Regulatory Office (WTR-8), United States Environmental Protection Agency /L.C. Lee & Associates, Inc. Seattle, Washington.

Lee, L. C., M. L. Butterwick, J. L. Cassin, R. A. Leidy, J. A. Mason, M. C. Rains, L. E. Shaw, E. G. White. 1997. *A Report on Assessment of the Functions of Waters of the United States, Including Wetlands, on the Borden Ranch, Sacramento and San Joaquin Counties, California.* Wetland Regulatory Office (WTR-8), United States Environmental Protection Agency /L.C. Lee & Associates, Inc. Seattle, Washington.

**PRESENTATIONS AT PROFESSIONAL MEETINGS**

Ecological Society of America and Society of Conservation Biology, 1996 Annual Meeting. August 1996. Paper title: 'Conditionality in a fungal endophyte-grass mutualism: outcomes depend on light, soil nitrogen and herbivore densities'

Ecological Society of America, 1997 Annual Meeting, August 1997. Paper title: 'Recruitment limitation in a perennial grass: the presence of a fungal mutualist determines whether seeds, sites or compensatory mortality limit recruitment'

Society of Wetland Scientists, 1998 Annual Meeting. June 1998. Paper title: 'Using the Hydrogeomorphic Method (HGM) in Wetland Ecosystem Restoration in the Puget Sound Lowlands: The North Creek Aquatic Ecosystem Restoration'

Society for Ecological Restoration, 1999 Annual Meeting. September 1999 (abstract accepted, March 1999). Paper title: 'Enhancing Biodiversity in Wetland Ecosystem Restorations: Restoring Biodiversity in an Urban Watershed in Puget Sound'

Association of State Wetland Managers, 1999 Annual Symposium. October 1999. Restoration: Applying Restoration Science. Paper title: 'The Control of Invasive Weeds: Critical Design, Construction and Maintenance Issues in Riverine Ecosystem Restoration'

**MEMBERSHIPS IN PROFESSIONAL SOCIETIES**

Ecological Society of America
Botanical Society of America
Society for Conservation Biology
Society of Wetland Scientists
Society for Ecological Restoration

**OTHER MEMBERSHIPS**

The Nature Conservancy
Washington Native Plant Society
California Native Plant Society
Oregon Native Plant Society

**REPRESENTATIVE PROJECTS**

*Parametrix Projects*

**City of Issaquah, Integrated Pest Management Plan Development, Issaquah, Wa.**
As project manager, Dr. Cassin is responsible for directing the development of policy guidelines and specific integrated pest management plans for a variety of city-managed landscapes. Activities include a review of existing policies and guidelines being used by local governments, review of policy and guidelines regarding reductions of pesticide use for compliance with the Endangered Species Act 4(d) rule for Puget Sound Pacific salmon ESU's, compilation and development of best management practices for reducing use of pesticides to control landscape pests and noxious weeds on city properties, and working with landscape maintenance staff to implement these practices.

**King County Metro Transit, Environmental Permit Studies for Park and Ride Expansion and Development, King County, WA**
This project is a feasibility study to determine the environmental impacts and permits required for Park and Ride expansion and related development for the King County Metro Transit system. Dr. Cassin is the environmental project manager and is responsible for coordinating the wetland, critical areas, and stormwater studies required to determine project impacts and mitigation. Studies to be completed include a wetland delineation and survey, critical areas study and report, wetland mitigation design, stormwater hydrological analyses, determination of stormwater detention and treatment requirements, and alternative stormwater designs to minimize project impacts.

**Confidential Client, Southwestern U.S.**
For this project Parametrix is conducting environmental studies to evaluate potential impacts of reservoir management on wetlands, native riparian plant communities and riparian wildlife habitat and species along an intermittent river in the southwestern U.S. As the technical lead for wetlands and plant communities studies, Dr. Cassin is responsible for designing and conducting studies to characterize the existing riparian ecosystems, inventory plant species and map vegetation communities, evaluate potential impacts of changes in reservoir operations on existing plant communities, and monitor changes in the plant communities over time related to changes in water management and groundwater elevations. Responsibilities also include recommending mitigation actions to protect and restore native riparian plant communities.

**City of Kent, Covington Water District, King County Water District 111 – Pesticide Survey and Preparation of Integrated Pest Management Plan** Dr. Cassin is the project manager on this study which will evaluate pesticide use within the wellhead protection area for several municipal water districts in King County. Based on the results of the pesticide survey, Parametrix is preparing integrated pest management plans for the management of parks, roadside and utility right of ways, and golf courses to reduce pesticide use within the wellhead protection areas.

**Seattle-Tacoma International Airport Master Plan Update – Port of Seattle**
Dr. Cassin is a member of the consultant team conducting natural resource studies and environmental permitting for the Port's Master Plan Improvements including

construction of a new third runway. To facilitate CWA Section 404 permitting, Dr. Cassin has reviewed and responded to comments on the EIS and Public Notice. She is also providing technical review and final design revisions for the preparation of the detailed wetland mitigation plans. This includes preparation of a final monitoring plan, as well as construction specifications. Key to these mitigation projects are the restoration of natural channel morphology, large woody debris and forested riparian buffers to a currently degraded urban stream, as well as restoring hydrology and native plant communities to forested, shrub and emergent wetlands. In addition, Dr. Cassin is assisting with coordination with Federal and State agencies to evaluate permit conditions and mitigation requirements. **Contact/Reference**: Elizabeth Leavitt, Port of Seattle,

**Cross Base Highway EIS and Mitigation Planning – Pierce County, WA**
As a member of the consultant team preparing the EIS and CWA permitting and mitigation plans for this highway extension, Dr. Cassin is conducting studies to evaluate potential mitigation sites and preparing mitigation plans. The proposed highway route crosses an area containing oak woodlands - one of the highest priority habitats in the State of Washington, as well as habitat for the State-listed western gray squirrel. The restoration design includes restoring a stream which has been heavily degraded by grazing to a native Oregon white oak/Oregon ash gallery forest, one of the rarest habitat types in the Puget Sound lowlands. Development of the mitigation plans involves coordination with Federal and State agencies, as well as review and synthesis of the scientific literature on the technical requirements for restoring these rare habitats. Additional tasks include reviewing and responding to comments on the draft EIS for incorporation into the final EIS. **Contact/Reference**: Pat Baughman, Pierce County, (253) 798-3157.

**Rare/Endangered/Threatened Plant Survey and Biological Assessment – Merlin Co-composting Facility, Grants Pass, Oregon**
Siting and environmental permitting for this co-composting facility required an evaluation of potential impacts on the Federally listed plant, Gentner's mission bells. Because a known location for the plant occurred within several miles of the project location and apparently suitable habitat occurred on the project site, completing permits for the project required determining whether or not the plant occurred within the project site and would be impacted by the project. Dr. Cassin reviewed historic and current information on the plant's distribution and habitat requirements, developed an inventory protocol consistent with U. S. Fish and Wildlife Service requirements, conducted a plant survey of the project site and wrote a Biological Assessment. Although the plant was not found on the project site, a 'no effect' determination was not possible because Gentner's mission bells can remain dormant underground for several years. By carefully documenting habitat conditions at extant locations for the plant and comparing those to habitat conditions on the project site however, a 'not likely to adversely affect' determination was made and the project will be able to move forward without a formal consultation.

***Additional Projects***

Prior to joining Parametrix, Dr. Cassin worked on the development and implementation of several ecoregion or watershed based assessments and restoration projects conducted to support impact analysis or state and regional conservation priorities. Projects include:

**Ecosystem Functional Assessment**
As senior botanist on multi-agency teams, Dr. Cassin has participated in developing functional assessment models and conducting wetland functional assessments for a variety of Federal and State natural resource agencies in Alaska, the Pacific Northwest, California, and the eastern U.S. These models provide reference data and a rapid assessment method for conducting wetland functional assessments and impact assessments pursuant to NEPA, SEPA, CWA 404, and ESA requirements. These models use the Hydrogeomorphic approach to assessing wetland function, and include collection of reference data on systems representing a range of disturbance conditions, relating functional measurements to disturbance condition, and developing model parameters that can be used to rapidly evaluate wetland function in similar systems. Dr. Cassin has been responsible for model development, design of data collection protocols, collection of reference data, managing field teams, overseeing data analysis, development of model parameters, writing model guidebooks and review of guidebooks. Development and testing of models required close coordination with members of the multi-agency teams to ensure that the models can be effectively used to evaluate project impacts and conduct NEPA, SEPA, CWA and ESA reviews. Dr. Cassin participated in the development of two wetland functional assessment models in Alaska: depressional, slope and riverine wetlands associated with the Kenai River watershed, and precipitation driven wetlands on discontinuous permafrost in Interior Alaska. In addition, Dr. Cassin conducted reference sampling and data analysis to develop or refine models for riverine/estuarine wetlands in southwest Washington, Chesapeake Bay coastal plain depressional wetlands, and 3rd and 4th order riverine wetlands in the Puget Sound. **Contacts/References**: CA - Rob Leidy (415-744-1970), USEPA; MD - Leander Brown, NRCS; AK - Jim Powell, Alaska Department of Environmental Conservation (AK).

**Borden Ranch – U.S. EPA, Department of Justice**
As a senior botanist on the L. C. Lee & Associates, Inc. team, Dr. Cassin participated in developing, testing and applying Hydrogeomorphic (HGM) functional assessment models for depressional (vernal pools), slope and riverine wetlands in the California's Central Valley. These functional assessment models were used to evaluate the impacts on vernal pools, and other wetlands, of deep ripping the soils for the purpose of converting grazed pasture land to cultivation for vineyards and orchards. Model development involved collection of reference data from approximately 90 sites, data analysis and synthesis, and the development of wetland functional indices related to a range of land use conditions. Dr. Cassin was responsible for botanical data collection, directing data quality assurance/quality control, overseeing data analysis, and development of model indices. In addition, Dr. Cassin participated in the field testing of the model and application of the model to wetlands on Borden Ranch. She was a co-

author on both the Draft Guidebook and the Report on the Assessment of Wetland Functions that resulted from the development and implementation of functional assessment models to wetlands on the Borden Ranch. These reports were used by the U. S. EPA and the U. S. Justice Department to determine wetland impacts resulting from the deep ripping operation and to determine appropriate mitigation. **Contacts/References**: Rob Leidy, U.S. EPA; Mary Butterwick, U.S. EPA

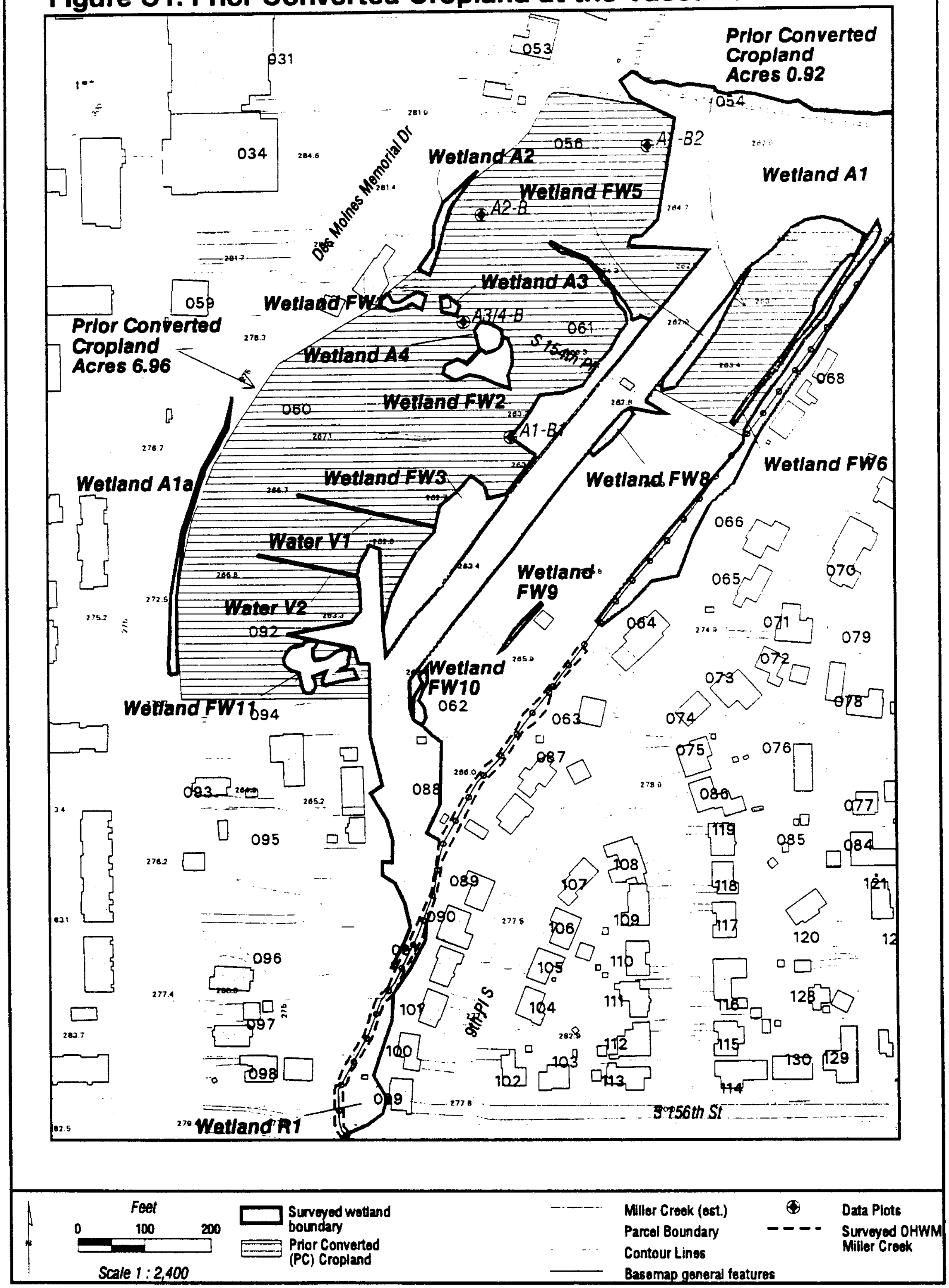
**Stafford Creek Corrections Center EIS, Wetland Permits and Mitigation Design – State of Washington Department of Corrections**
As wetland ecologist/botanist on this project, Dr. Cassin investigated the potential impacts on freshwater tidal wetlands and streams of a utility line extension required for the construction of a new correctional facility. The approximately 20 mile-long utility extension crossed sensitive freshwater tidal wetlands as well as seven salmon-bearing streams adjacent to Grays Harbor estuary. Tasks included review and revision of the draft EIS, preparation of the FEIS sections on wetland and aquatic systems, delineating wetlands along the utility corridor, and preparing Federal, State and local permit applications required for the project. Additional tasks included participating in coordination with Federal and State natural resource agencies, as well as Grays Harbor County, to further evaluate project impacts, potential permitting conditions and mitigation requirements. As senior botanist, Dr. Cassin was responsible for designing the restoration of native freshwater and estuarine wetland, riparian and upland plant communities on the 10-acre mitigation site. Dr. Cassin conducted studies of estuarine and freshwater wetlands in Grays Harbor and Willapa Bay to identify plant communities and habitat features to be incorporated into the design. Additional duties included coordinating native plant procurement and performing construction observation for the Department of Corrections during the planting phase of mitigation construction. **Contact/Reference**: Linda Glasier, WA State Department of Corrections (360-753-6547)

**North Creek Aquatic Ecosystem Restoration, Restoration Design and Construction – Washington State Department of General Administration**
As senior botanist, Dr. Cassin was responsible for the design of native wetland and riparian plant communities on this approximately 60-acre aquatic ecosystem restoration site. As mitigation for impacts to wetlands from the construction of a co-located University of Washington-Bothell and Cascadia Community College campus, the restoration involved restoring natural channel morphology to approximately 4000 feet of the diked and channelized North Creek channel and reconnecting the stream to its floodplain. The restoration design included 20 native plant community types and over 100 native plant species. Additional tasks included completing construction specifications for plant procurement, weed management, and plant installation and maintenance. In addition, Dr. Cassin was responsible for the operation of an on-site nursery facility that propagated native plants for the restoration. Coordination with Federal and State natural resource agencies, as well as the City of Bothell was completed to evaluate project impacts, permitting conditions, and mitigation requirements. Participation in public meetings and presentations to community groups resulted in wide-spread public support for the restoration project and campus construction. Construction

observation, including monitoring permit compliance, was completed for the first planting phase of the project. This phase consisted of planting the channel riparian zone and approximately 40 acres of floodplain wetlands and upland buffer.

B

## Figure C1: Prior Converted Cropland at the Vacca Farm Site

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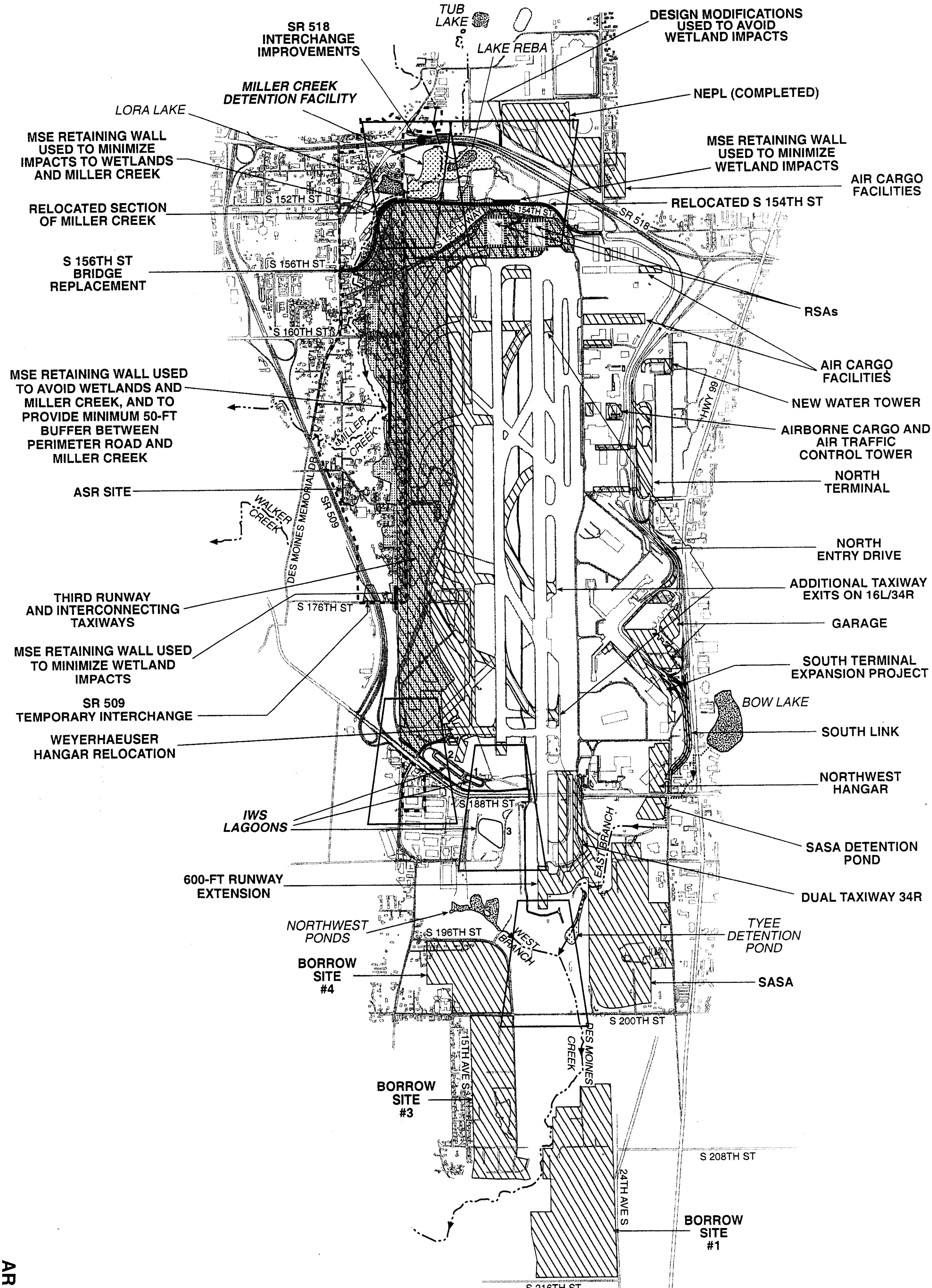
C




AR 015939

ort of Seattle/Natural Resource Mitigation Plan/556-2912-001/01(03) 11/01 (K)

Construction Area (Fill and Grading for Third Runway, Runway Safety Areas, and S. 154th St. Relocation)

Runway Safety Area Boundary (RSA)

Master Plan Projects

Relocated Segment of Miller Creek

Existing Detention Facilities

Water Features

Acquisition Boundary

Piped Stream

Stream

Runway Protection Zone

SCALE IN FEET

0 900 1,800

N

**Figure 1.3-1**
**Master Plan Update Improvement Projects at STIA**

D

**Table 4.1-3. Summary of wetland mitigation credit for Seattle-Tacoma International Airport Master Plan Update improvements. (All impacts and mitigation occur in WRIA 9.)**

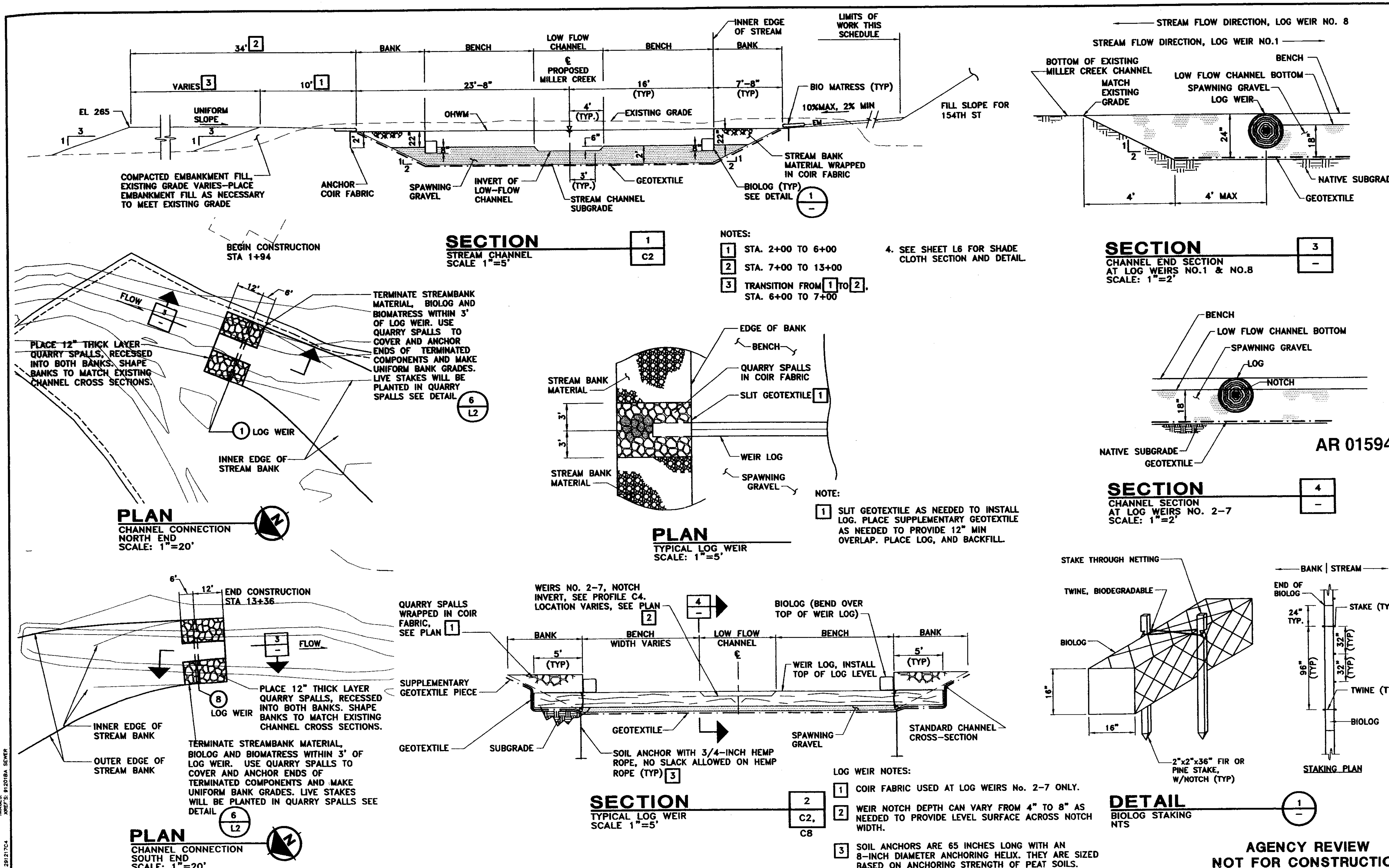
| Mitigation | Mitigation Area (ac) | Mitigation Credit |
|---|---|---|
| **ON-SITE** | | |
| **Wetland Restoration** – Credit ratio 1:1 | | |
| Remove Fill Adjacent to Lora Lake | 1.00 | 1.00 |
| Remove Fill at Des Moines Way Nursery Site | 2.00 | 2.00 |
| Remove Fill at Wetland A17 | 0.30 | 0.30 |
| Vacca Farm (prior converted cropland and other upland) | 6.60 | 6.60 |
| Temporary Impacts | 2.05 | 2.05 |
| | **Subtotal 11.95** | **11.95** |
| **Wetland Enhancement** – Credit ratio 1:2 | | |
| Des Moines Way Nursery | 0.86 | 0.43 |
| Vacca Farm (Farmed Wetland, Other Wetlands, Lora Lake) | 5.70 | 2.85 |
| Wetlands in Miller Creek Wetland and Riparian Buffer | 10.25 | 5.12 |
| Tyee Valley Golf Course | 4.50 | 2.25 |
| Wetland in Des Moines Creek Buffer | 1.01 | 0.51 |
| | **Subtotal 22.32** | **11.16** |
| **Buffer Enhancement**- Credit ratio 1:5 | | |
| Miller Creek Buffer, South of Vacca Farm | 40.86 | 8.17 |
| Vacca Farm | 4.58 | 0.92 |
| Lora Lake | 1.81 | 0.36 |
| Tyee Valley Golf Course Mitigation Area Buffer | 1.57 | 0.31 |
| West Branch Des Moines Creek Buffer | 3.38 | 0.68 |
| Des Moines Way Nursery | 2.73 | 0.55 |
| | **Subtotal 54.93** | **10.99** |
| **Preservation** – Credit Ratio 1:10 | | |
| Borrow Area 3 Wetland | 2.35 | 0.24 |
| Borrow Area 3 Buffer | 21.20 | 2.10 |
| | **Subtotal 23.55** | **2.34** |
| | **Total On-Site** [a, b] **112.75** | **36.44** |
| **OFF-SITE** | | |
| **Wetland Creation**[c] - Credit ratio 1:1 | | |
| Forest (17.20 acres), shrub (6.0 acres), emergent (6.20 acres), and open water (0.60 acres) | 29.98 | 29.98 |
| **Wetland Enhancement** - Credit ratio 1:2 | 19.50 | 9.75 |
| **Buffer Enhancement** - Credit ratio 1:5 | 15.90 | 3.18 |
| | **Total Off-Site 65.38** | **42.91** |
| **TOTAL** | **178.13** | **79.35** |

[a] Mitigation credit has not been assigned for relocating a portion of Miller Creek channel, instream enhancement projects, drainage channel replacement, or a $300,000 trust fund for watershed restoration.

[b] In- basin mitigation area divided by wetland impacts (18.37 acres permanent plus 2.05 acres temporary) provides a 5.5:1 aerial replacement ratio.

[c] Based on maps of hydric soils, mitigation can be also characterized as restoration.

E




NOTES:

1. STA. 2+00 TO 6+00
2. STA. 7+00 TO 13+00
3. TRANSITION FROM 1 TO 2. STA. 6+00 TO 7+00
4. SEE SHEET L6 FOR SHADE CLOTH SECTION AND DETAIL.

NOTE:

1. SLIT GEOTEXTILE AS NEEDED TO INSTALL LOG. PLACE SUPPLEMENTARY GEOTEXTILE AS NEEDED TO PROVIDE 12" MIN OVERLAP. PLACE LOG, AND BACKFILL.

LOG WEIR NOTES:

1. COIR FABRIC USED AT LOG WEIRS No. 2-7 ONLY.
2. WEIR NOTCH DEPTH CAN VARY FROM 4" TO 8" AS NEEDED TO PROVIDE LEVEL SURFACE ACROSS NOTCH WIDTH.
3. SOIL ANCHORS ARE 65 INCHES LONG WITH AN 8-INCH DIAMETER ANCHORING HELIX. THEY ARE SIZED BASED ON ANCHORING STRENGTH OF PEAT SOILS.

AR 015943

AGENCY REVIEW
NOT FOR CONSTRUCTION

CALL 48 HOURS BEFORE YOU DIG 1-800-424-5555

Parametrix, Inc.
5808 Lk. Washington Blvd. NE
Kirkland, WA 98033
Ph:(425) 822-8880
"Quality Service Through Employee Ownership"

PROJECT ENGR./ARCH: P. FENDT
DESIGNED: J. ULMAN
DRAWN BY: PJT/SRN
SCALE: AS SHOWN
DATE: NOVEMBER 2001

ONE INCH AT FULL SCALE IF NOT SCALE ACCORDINGLY

REVISIONS

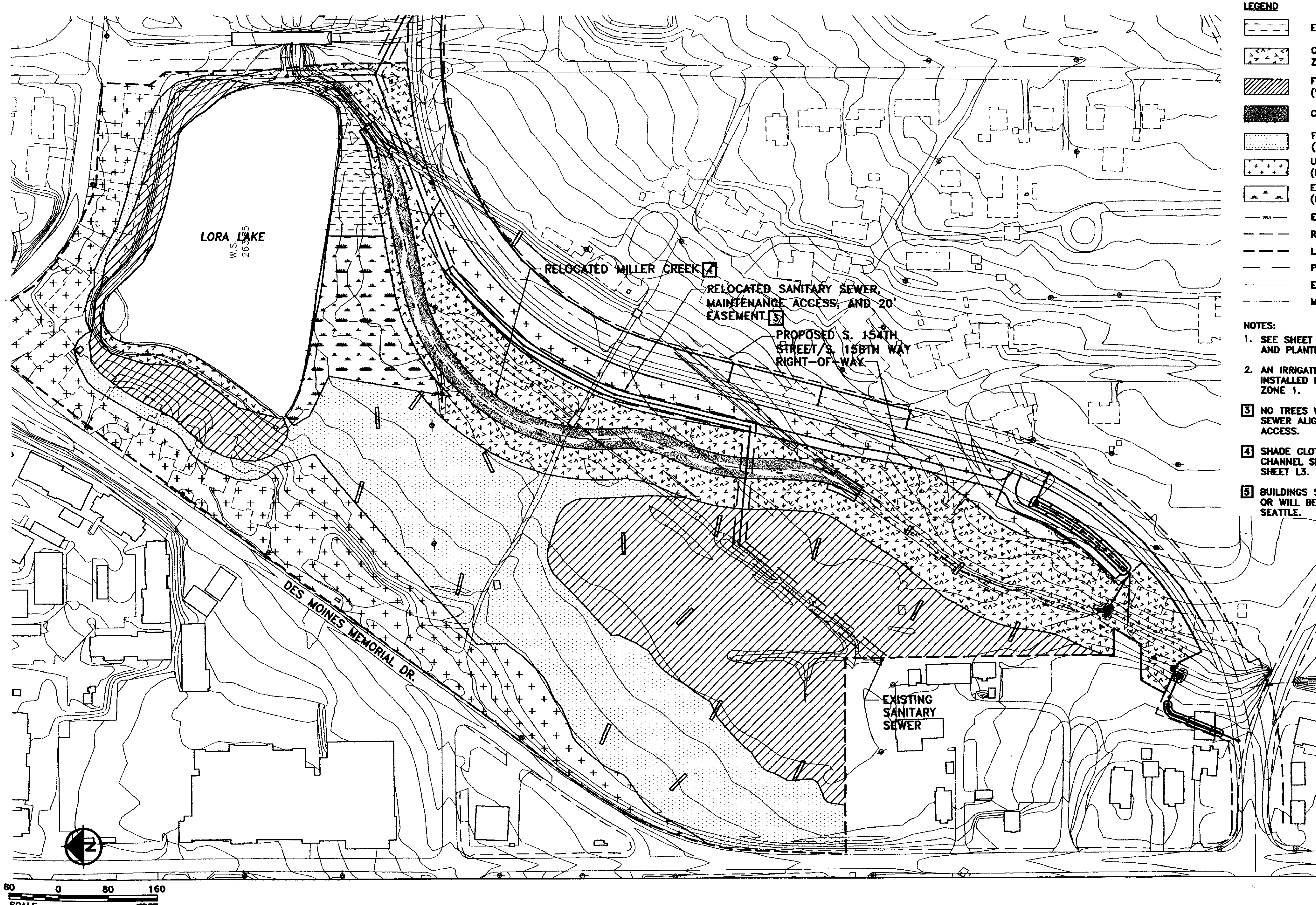
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT: MILLER CREEK RELOCATION
SHEET TITLE: CHANNEL SECTIONS AND DETAILS

WORK ORDER NO. 100051
CONSULTANT'S NO. 291217C4
PORT OF SEATTLE NO. STIA-9805-C5

APPENDIX A

DATE: 11/15/01 FILENAME: 291217C4 XREFS: 912018A SEWER IMAGES:

156.DWG 291217BA.DWG 91201DE.DWG




**LEGEND**

- EXISTING WETLAND TO REMAIN
- CREEK AND LORA LAKE BUFFER ZONE (WETLAND TREES & SHRUBS)
- FLOODPLAIN ZONE #1 (WETLAND SHRUBS)
- CREEK CHANNEL PLANTING
- FLOODPLAIN ZONE #2 (WETLAND TREES & SHRUBS)
- UPLAND BUFFER ZONE (NATIVE TREES & SHRUBS)
- ENHANCED EXISTING WETLAND (NATIVE TREES AND SHRUBS)
- 263 EXISTING CONTOUR
- ROAD RIGHT-OF-WAY
- LIMIT OF CONSTRUCTION
- PROPOSED SEWER LINE
- EXISTING SEWER LINE
- MILLER CREEK

NOTES:

1. SEE SHEET L2 FOR PLANT SCHEDULE AND PLANTING DETAILS.
2. AN IRRIGATION SYSTEM WILL BE INSTALLED IN ALL AREAS EXCEPT ZONE 1.
3. NO TREES WILL BE PLANTED OVER THE SEWER ALIGNMENT OR MAINTENANCE ACCESS.
4. SHADE CLOTH TO BE PLACED OVER CHANNEL SECTION PER DETAILS ON SHEET L3.
5. BUILDINGS SHOWN WITH --- HAVE BEEN OR WILL BE REMOVED BY THE PORT OF SEATTLE.

AR 015944

**AGENCY REVIEW**
**NOT FOR CONSTRUCTION**

CALL 48 HOURS BEFORE YOU DIG 1-800-424-5555

**Parametrix, Inc.**
5808 Lk. Washington Blvd. NE
Kirkland, WA 98033
Ph: (425) 822-8880
"Quality Service Through Employee Ownership"

P. FENDT
M. LOUTHER
PJT/SRH
1"=80'
NOVEMBER 2001

REVISIONS

| NO. | DATE | BY | DESCRIPTION | APP'D | NO. | DATE | BY | DESCRIPTION | APP'D |
|---|---|---|---|---|---|---|---|---|---|

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT: MILLER CREEK RELOCATION
SHEET TITLE: **PLANTING PLAN**

100051
291217L4
STIA-9805-L4

DATE: 11/13/01 FILENAME: 291217L4 XREF'S: 156 SEWER BIO 291201BA 291217LA IMAGES:

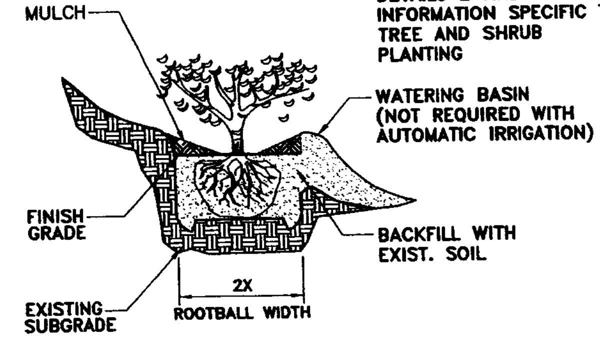
156.DWG 291217BA.DWG

APPENDIX A

## VACCA FARM & MIILER CREEK RELOCATION PLANT SCHEDULE

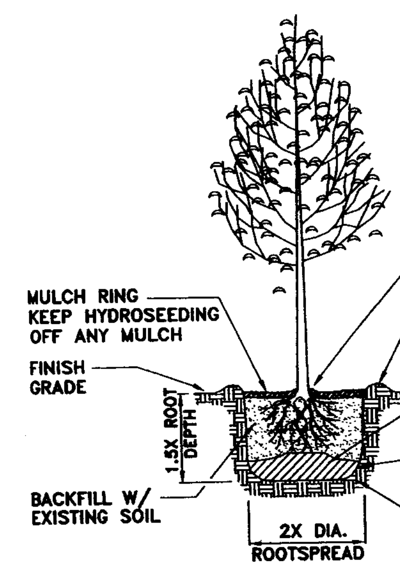
| Symbol | Botanical Name / Common Name | Size | Density (Plants Per Acre) | Condition / Remarks |
|---|---|---|---|---|
| | **MIILER CREEK RELOCATION ZONE** | | | |
| | **Trees** | | 280 | |
| (symbol) | *Acer macrophyllum* / big leaf maple<br>*Alnus rubra*/red alder<br>*Fraxinus latifolia*/Oregon ash<br>*Populus trichocarpa*/black cottonwood | 4'-6' ht.<br>2 gal.<br>4'-6' ht.<br>4'-6' ht. | | – Container or B&B. Rooting to sides and bottom of can or burlap. |
| | **Shrubs - Single Species Groups of 3 to 7** | | 2,100 | |
| | *Acer circinatum*/vine maple<br>*Physocarpus capitatus*/pacific ninebark<br>*Rosa pisocarpa*/clustered rose<br>*Salix lucida spp. lasiandra*/Pacific willow<br>*Salix scouleriana*/Scoulers willow<br>*Salix sitchensis*/Sitka willow | 2 gal.<br>1 gal.<br>1 gal.<br>1gal/Live stake<br>1gal/Live stake<br>1gal/Live stake | | – Container. Rooting to sides and bottom of can. Live stakes shall be 36"-48" ht., 1/2"-1" dia., with a minimum of 10 viable, undamaged buds on each stake. 3-4 buds shall be below grade.<br>– Space 4.5' O.C. typical. |
| | **FLOODPLAIN ZONE #1** | | | |
| | **Shrubs - Single Species Groups of 7 to 12** | | 2,100 | |
| (symbol) | *Salix hookeriana*/Hookers willow<br>*Salix lucida spp. lasiandra*/Pacific willow<br>*Salix scouleriana*/Scoulers willow<br>*Salix sitchensis*/Sitka willow<br>*Spiraea douglasii*/hardhack spiraea | 1gal/Live stake<br>1gal/Live stake<br>1gal/Live stake<br>1gal/Live stake<br>1 gal. | | – Container. Rooting to sides and bottom of can. Live stakes shall be 36"-48" ht., 1/2"-1" dia., with a minimum of 10 viable, undamaged buds on each stake. 3-4 buds shall be below grade.<br>– Space 4.5' O.C. typical. |
| | **FLOODPLAIN ZONE #2** | | | |
| | **Trees** | | 80 | |
| (symbol) | *Picea sitchensis*/Sitka spruce *<br>*Thuja plicata*/western redcedar * | 3'-4' ht<br>3'-4' ht. | | – Container or B&B. Rooting to sides and bottom of can or burlap. |
| | **Shrubs - Single Species Groups of 3 to 7** | | 2,100 | |
| | *Physocarpus capitatus*/Pacific ninebark<br>*Salix lucida spp. lasiandra*/Pacific willow<br>*Salix scouleriana*/Scoulers willow<br>*Salix sitchensis*/Sitka willow<br>*Spiraea douglasii*/hardhack spiraea | 1 gal.<br>1gal/Live stake<br>1gal/Live stake<br>1gal/Live stake<br>1 gal. | | – Container. Rooting to sides and bottom of can. Live stakes shall be 36"-48" ht., 1/2"-1" dia., with a minimum of 10 viable, undamaged buds on each stake. 3-4 buds shall be below grade.<br>– Space 4.5' O.C. typical. |
| | **UPLAND BUFFER ZONE** | | | |
| | **Trees** | | 280 | |
| (symbol) | *Abies grandis* / grand fir<br>*Acer macrophyllum* / big leaf maple<br>*Alnus rubra*/red alder<br>*Picea sitchensis*/Sitka spruce *<br>*Populus trichocarpa*/black cottonwood<br>*Pseudotsuga menziesii*/douglas fir<br>*Thuja plicata*/western redcedar *<br>*Tsuga heterophylla*/western hemlock * | 4'-6' ht.<br>4'-6' ht.<br>2 gal.<br>3'-4' ht<br>4'-6' ht.<br>3'-4' ht.<br>3'-4' ht.<br>3'-4' ht. | | – Container or B&B. Rooting to sides and bottom of can or burlap. |
| | **Shrubs - Single Species Groups of 3 to 7** | | 2,100 | |
| | *Acer circinatum*/vine maple<br>*Philadelphus lewisii*/mock orange<br>*Rosa nutkana*/Nootka rose | 2 gal.<br>1 gal.<br>1 gal. | | – Container. Rooting to sides and bottom of can.<br>– Space 4.5' O.C. typical. |
| | **ENHANCED EXISTING WETLAND** | | 2,100 | |
| (symbol) | **Shrubs**<br>*Acer circinatum*/vine maple<br>*Philadelphus lewisii*/mock orange<br>*Rosa nutkana*/Nootka rose<br>*Rosa pisocarpa*/Clustered rose<br>*Salix lucida spp. lasiandra*/Pacific willow<br>*Salix scouleriana*/Scoulers willow<br>*Salix sitchensis*/Sitka willow | 2 gal.<br>1 gal.<br>1 gal.<br>1 gal.<br>1gal/Live stake<br>1gal/Live stake<br>1gal/Live stake | | – Container. Rooting to sides and bottom of can. Live stakes shall be 36"-48" ht., 1/2"-1" dia., with a minimum of 10 viable, undamaged buds on each stake. 3-4 buds shall be below grade.<br>– Space 4.5' O.C. typical. |
| | **CREEK CHANNEL PLANTING** | | | |
| (symbol) | **Shrubs**<br>*Salix lucida spp. lasiandra*/Pacific willow<br>*Salix scouleriana*/Scoulers willow<br>*Salix sitchensis*/Sitka willow | Live stakes<br>Live stakes<br>Live stakes | | – Live stakes 36"-48" ht., 1/2"-1" dia., with a minimum of 10 viable, undamaged buds on each stake. 3-4 buds shall be below grade.<br>– Space 30" on center (O.C). |

* Western redcedar, Western hemlock and Sitka spruce shall be planted in a second planting phase, to follow year-3 monitoring. These plants shall be located by the wetland biologist in locations where partial shade and favorable soil moisture are present.




NOTE: REFER TO PLANTING DETAILS 2 AND 3 FOR INFORMATION SPECIFIC TO TREE AND SHRUB PLANTING

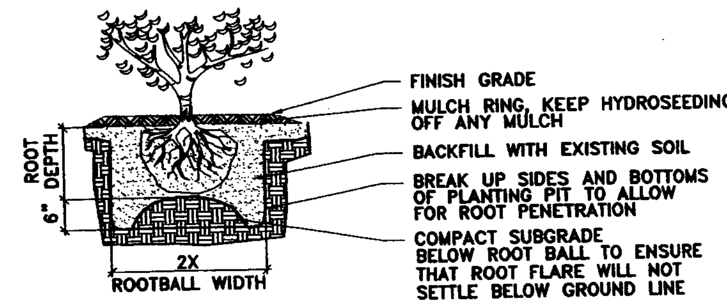
**DETAIL** 1 TYP
PLANTING ON SLOPES
N.T.S.




NOTES:

1. TREE PIT SHALL NOT BE LESS THAN (2) TIMES ROOT BALL DIA.
2. FOR BALLED AND BURLAP PLANTS, CUT ALL TIES AND REMOVE BURLAP FROM UPPER 1/3 OF ROOT BALL
3. REMOVE ALL PLASTIC, WIRE, AND TWINE
4. SPREAD ROOTS IN PLANTING HOLE FOR BARE ROOT PLANTS.
5. WATER THOROUGHLY AFTER PLANTING.
6. SEE SPECIFICATIONS FOR FERTILIZER.

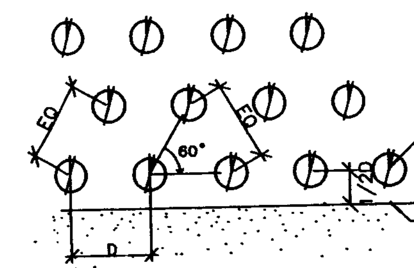
**DETAIL** 2 TYP
TREE PLANTING (TYPICAL)



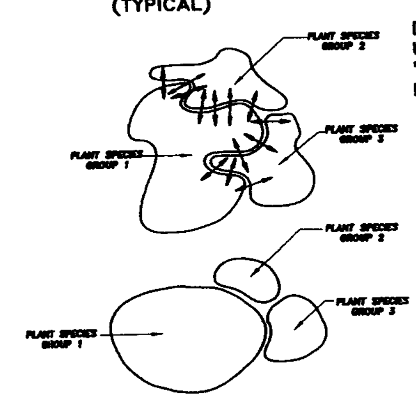

**DETAIL** 3 TYP
SHRUB PLANTING (TYPICAL)

NOTE: ALL SHRUB SPACING SHALL BE EQUIDISTANT UNLESS OTHERWISE SPECIFIED

DISTANCE (D) ON CENTER AS REQUIRED TO MEET PLANTS PER ACRE STANDARD.

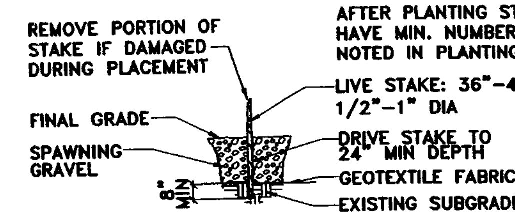



**DETAIL** 4 TYP
TRIANGULAR SHRUB SPACING (TYPICAL)




**DETAIL** 5 TYP
SHAPES OF PLANTING MASSES
N.T.S.

NOTE: AFTER PLANTING STAKE MUST HAVE MIN. NUMBER OF BUDS NOTED IN PLANTING LEGEND




**DETAIL** 6 TYP
LIVE STAKE PLANTING
N.T.S.

NOTES:

1. For installation of plant material through coir fabric wrap, excavate to reveal wrap cut "x" pattern through wrap, fold & secure under adjacent wrap, install planting as per typical detail.
2. Preserve and protect all trees and shrubs not designated for removal. Provide, erect, and maintain barricades necessary to prevent access to areas within drip lines of existing trees. Allow no vehicular or pedestrian traffic, or stacking and/or storage of construction materials within barricades.
3. For each planting zone Contractor shall lay out a 10,000 s.f. test plot, in which the positions of all plants shall be staked with flags that are color coded to represent specific species. Layout for each zone shall be inspected and approved prior to commencement of planting. Approved staking shall serve as the plant layout standard for the remainder of each zone.
4. Shrub masses shall consist of multiple single-species groups (see detail 5). Contractor shall ensure that these single-species groups have a variety of sizes and shapes, and that shrub masses have a variety of species. See planting schedule for numbers of plants in single-species groups.
5. Hydroseed all planting areas. Re-seed areas that are disturbed by subsequent work. Keep hydroseeding off any mulch circles except where needed to protect roots of conifers.

AR 015945

AGENCY REVIEW
NOT FOR CONSTRUCTION

CALL 48 HOURS BEFORE YOU DIG 1-800-424-5555

Parametrix, Inc.
5808 Lk. Washington Blvd. NE
Kirkland, WA 98033
Ph:(425) 822-8880
"Quality Service Through Employee Ownership"

P. FENDT
M. HAFS
PJT/SRN
AS SHOWN
NOVEMBER 2001

REVISIONS

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT: MILLER CREEK RELOCATION
SHEET TITLE: PLANTING SCHEDULE AND DETAILS

100051
291217L5
STIA-9805-L5
APPENDIX A

DATE: 11/19/01 FILENAME: 291217L5 XREFS: IMAGES:

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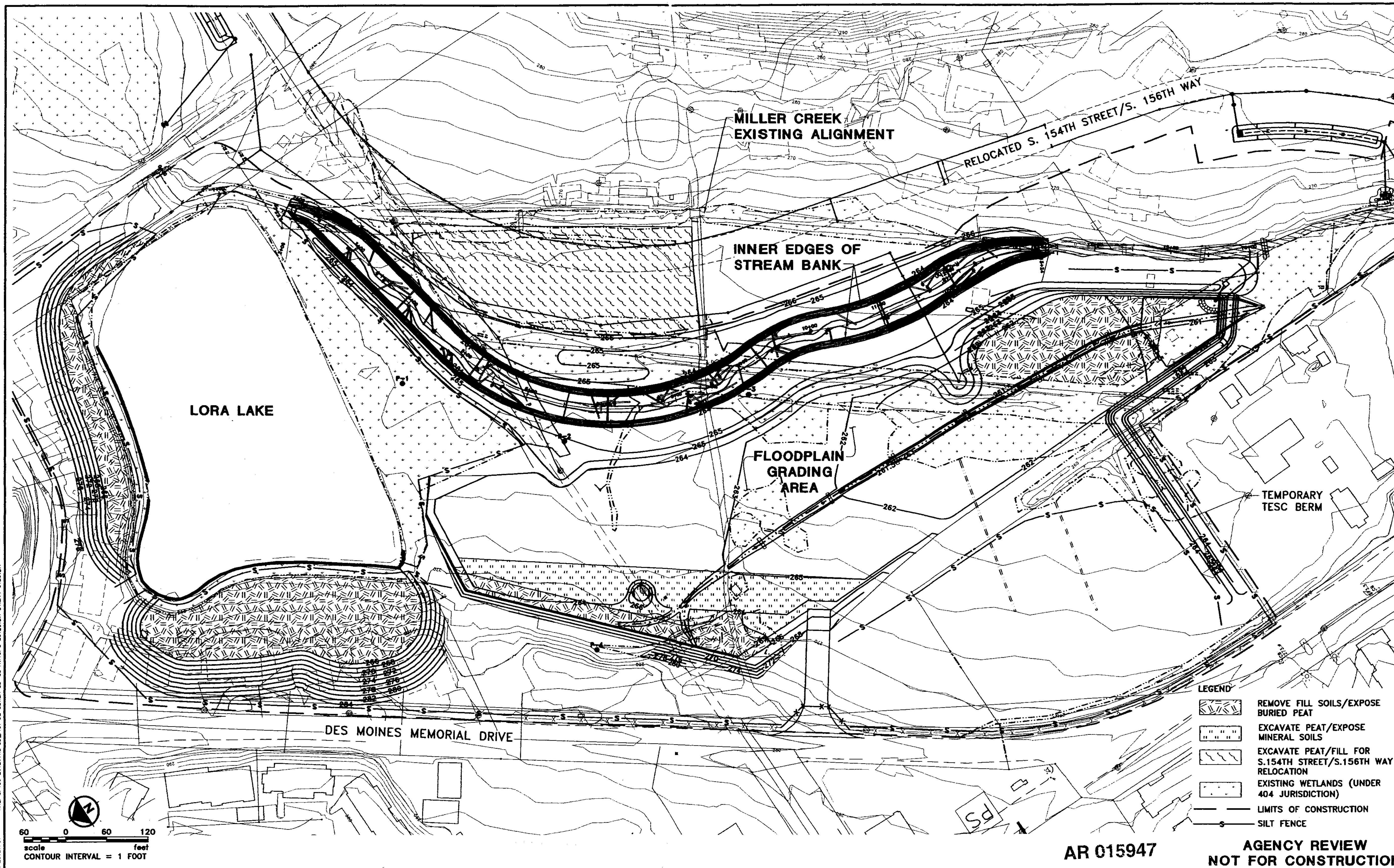


IMAGES:
XREF'S: 156 291201WL SD_FIG1 DE SEWER SD-SS KWTOPO 291201BA UTILITY 91201BA

DATE: 11/14/01 FILENAME: 291217C1

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PROJECT ENGR./ARCH.: P. FENDT
DESIGNED: J. ULMAN
DRAWN BY: PJT/SRH
SCALE: 1"=60'
DATE: NOVEMBER 2001
CHECKED BY:
APPROVED BY:

| REVISIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NO. | DATE | BY | DESCRIPTION | APP'D | NO. | DATE | BY | DESCRIPTION | APP'D |

PROJECT ENGINEER:
DESIGNED:
DRAWN BY:
SCALE:
DATE:
CHECKED BY:
APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT: MILLER CREEK RELOCATION
SHEET TITLE: **CHANGES IN PEAT AND MUCK SOIL AT VACCA FARM**

WORK ORDER NO. 100051
CONSULTANT'S NO. 291217C1
PORT OF SEATTLE NO. STIA-9805-C1

156.DWG 291217BA.DWG 91201DE.DWG

APPENDIX O