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Draft Paper Submitted to : Oregon Division of State Lands

Weighted Moisture and Salinity Tolerance Indexes at the Astoria Airport Mitigation Bank

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by

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April 8, 1993

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Introduction

This report briefly discusses the procedures used to define moisture and salinity tolerance indexes for vegetation samples at the Astoria Airport Mitigation Bank (AAMB) from 1986-1991. All samples were documented by Jackson et al 1991. Moisture tolerance ratings were assigned using the US Fish and Wildlife Service national list of plant species that occur in northwest wetlands (Reed 1988). Numbers (1=obligate wetland and 5=obligate nonwetland) were substituted for the letter codes used by Reed. Salinity tolerances were derived using a report submitted to Washington Department of Ecology (Hutchinson 19??) on the salinity tolerance of plants of estuarine wetlands and associated uplands. As with moisture tolerance, numbers were substituted for word structured ratings (1=very tolerant and 5=very sensitive).

Procedure

A very simple algorithm was used (Federal Interagency Committee for Wetland Delineation 1989) to derive moisture and salinity tolerance indexes per sample. Each species in a given sample was assigned three statistics:

1. A numerical moisture tolerance;
2. A numerical salinity tolerance; and
3. A cover class.

Four steps were used to define the weighted tolerance index:

1. Multiply the cover class of each species by it respective numeric tolerance ratings and tabulate the results in two separate columns;

2. Sum the cover class of all species in the sample;

3. Sum the weighted cover classes in each of the separate " weighted" columns; and

4. Separately divide each of the totals derived in step 3 by the total derived in step 2. Each of the results represents the respective salinity or moisture tolerance index for the sample.

This procedure was done for approximately 13 samples six separate times (one for each successive year of monitoring; 1986-1991). The maximum, minimum and average salinity index was computed for each year and these were then compared with every other year to define trends in salinity and moisture tolerance at the AAMB site. Variance was also calculated.

Calculations were accomplished using microsoft excel spread sheets (version 2.01). While this software was marginally adequate for the application of the weighted tolerance index procedures, it is clear an actual data base program would be needed for larger applications. Fox Pro and Paradox are two good candidate data base systems for consideration.

Results

Moisture tolerance appears to be increasing over time (figure 1) and salinity tolerance appears to be decreasing (figure 2). Variance in both tolerances appears to be decreasing (figures 3 and 4).

Conclusions

The apparent difference between overall site plant moisture and salinity tolerances documented in samples before the dike breach compared with samples documented after the dike breach may or may not be causally linked to the dike breach:

1. For salinity tolerances, the qualitative and subsequent numeric assignments are extremely tenuous and unreliable (Hutchinson 19?? and Frenkel 1993 [personal communication]). Further empirical work needs to be completed to increase their reliability and utility for indicating potential salinity regimes and gradients. Also, salt tolerant species were found in prebreach samples and their presence or absence may not be causally linked to a salinity change;

2. The samples were not established randomly and, therefore, standard quantitative analysis regarding significant differences cannot be applied; and

3. Even if the samples were established using a random site selection technique, the data stream is too short to make inferences from. That is, other causal agents could explain the apparent differences other than the dike breach, including normal climatic variation.

Although there are some significant problems with some of the assumptions and sampling methods employed, the apparent change in the moisture and salinity tolerance regimes in post dike breach samples deserves further review and research. Also, while the sampling techniques are poor, they may be found to be adequate. This would be very useful in planning future work, especially with the recent trends to use volunteers for field work.

The techniques employed for data review should be given more attention with respect to their potential utility for future analytical work. They may also be useful in helping resolving state and federal regulation and policy questions regarding wetland status, estuarine/palustrine system distinctions, ordinary high water mark, mitigation goals, etc.

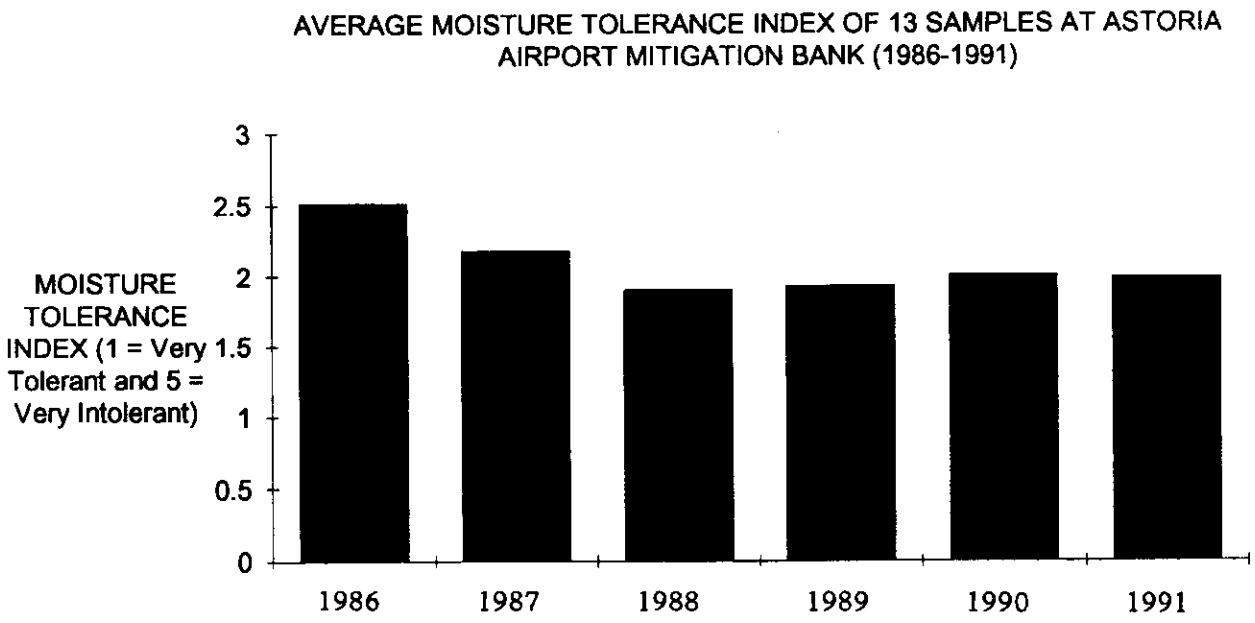

Figure 1. Average moisture tolerance index of 13 sample sites at Astoria Airport Mitigation Bank (1986-1991).

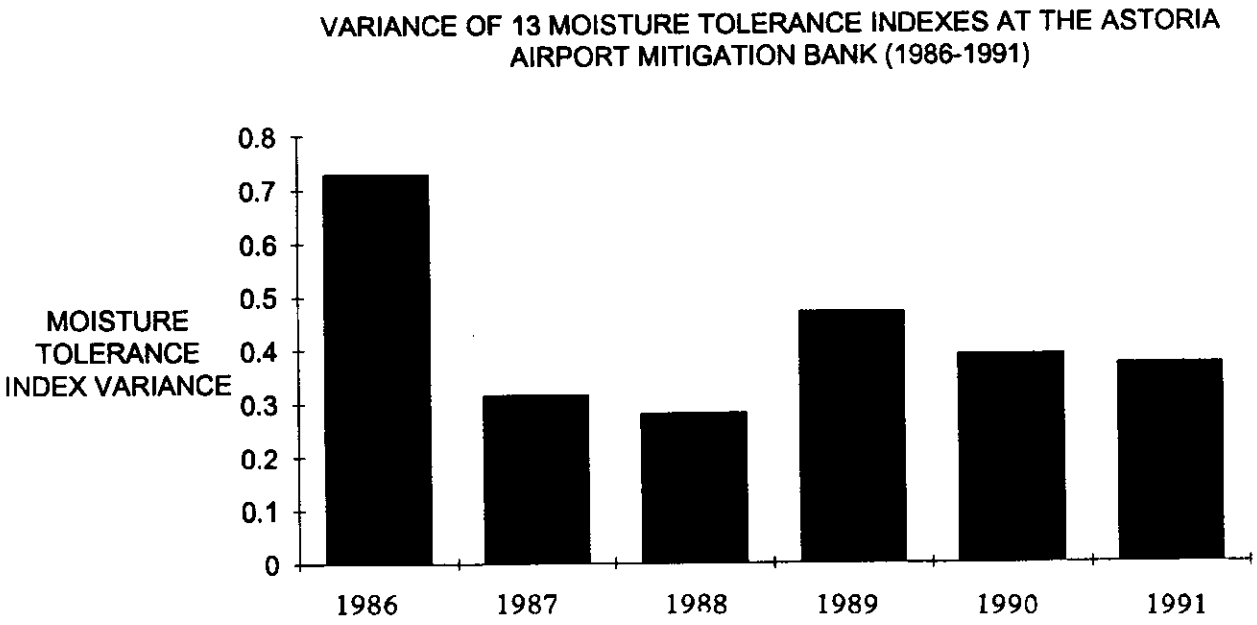

Figure 3. Variance of 13 moisture tolerance indexes at the Astoria Airport Mitigation Bank (1986-1991).

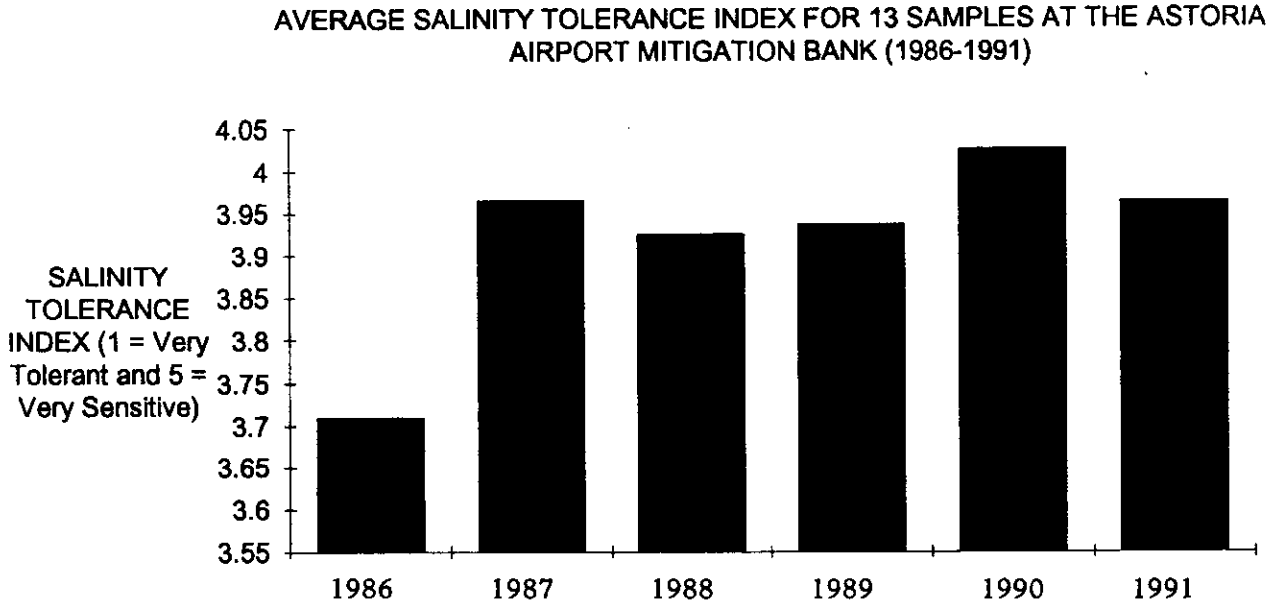

Figure 2. Average salinity tolerance index for 13 sample sites at Astoria Airport Mitigation Bank (1986-1991).

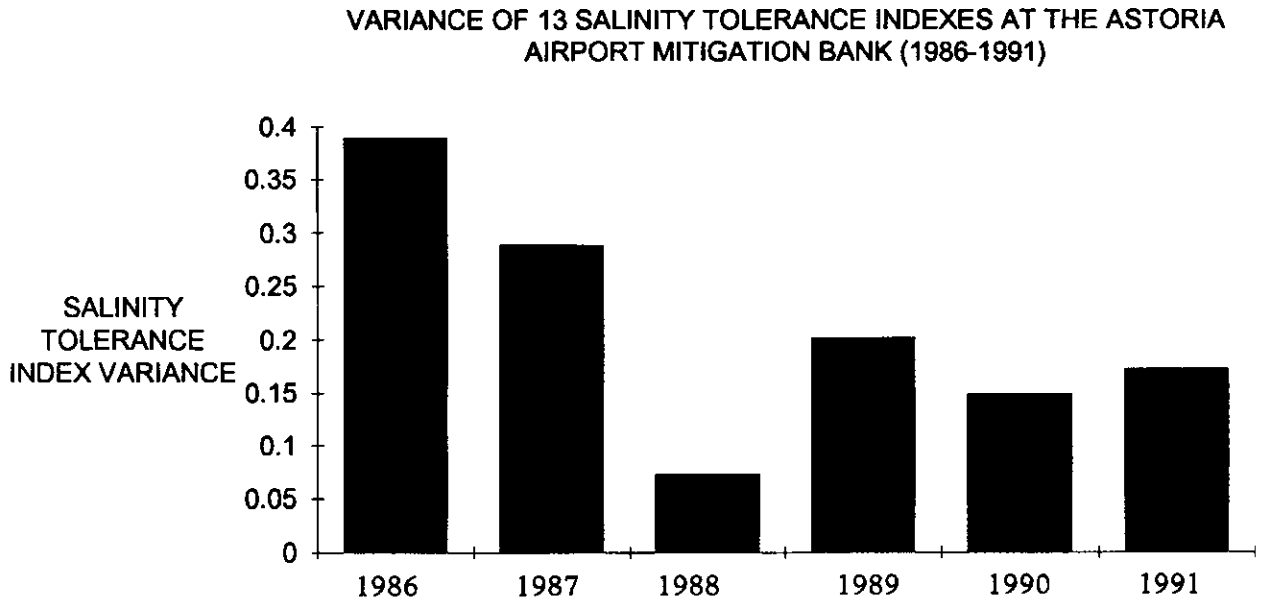

Figure 4. Variance of 13 salinity tolerance sample sites at the Astoria Airport Mitigation Bank (1986-1991).

References

Federal Interagency Committee for Wetland Delineation. 1989. Federal Manual for Identifying and Delineating Jurisdictional Wetlands. U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S. Department of Agriculture Soil Conservation Service, Cooperative Technical Publication. Washington, D.C.

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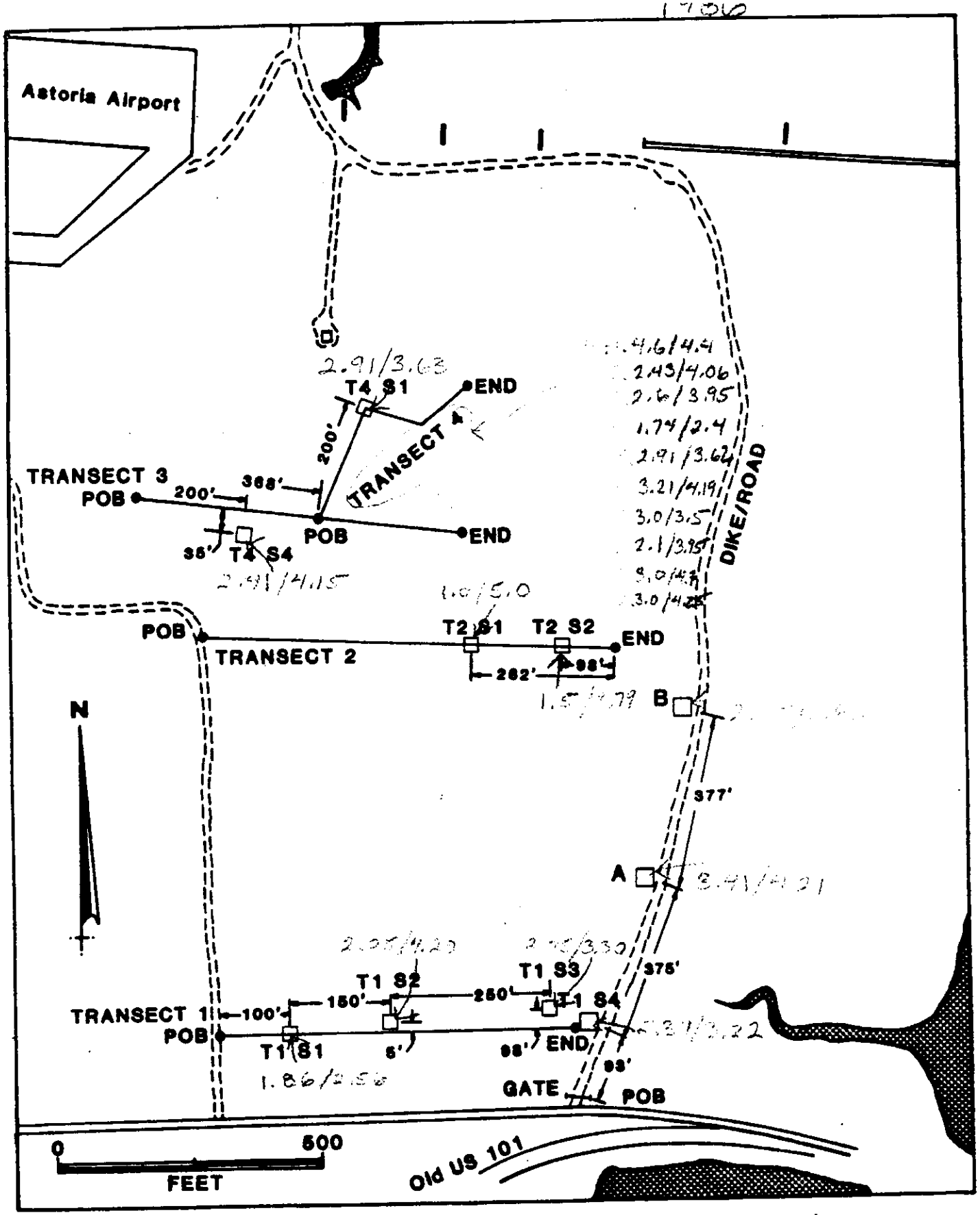
Hutchinson, I. 19??. Salinity tolerance of plants of estuarine wetlands and associated uplands, Washington State Shorelands and Coastal Zone Management Program: Wetlands Section, Washington Department of Ecology, Olympia, Washington, 61 pp.

Reed, P.B. 1988. National list of plant species that occur in wetlands: Northwest (Region 9), U.S. Fish and Wildlife Service, St. Petersburg, Florida, 38 pp.

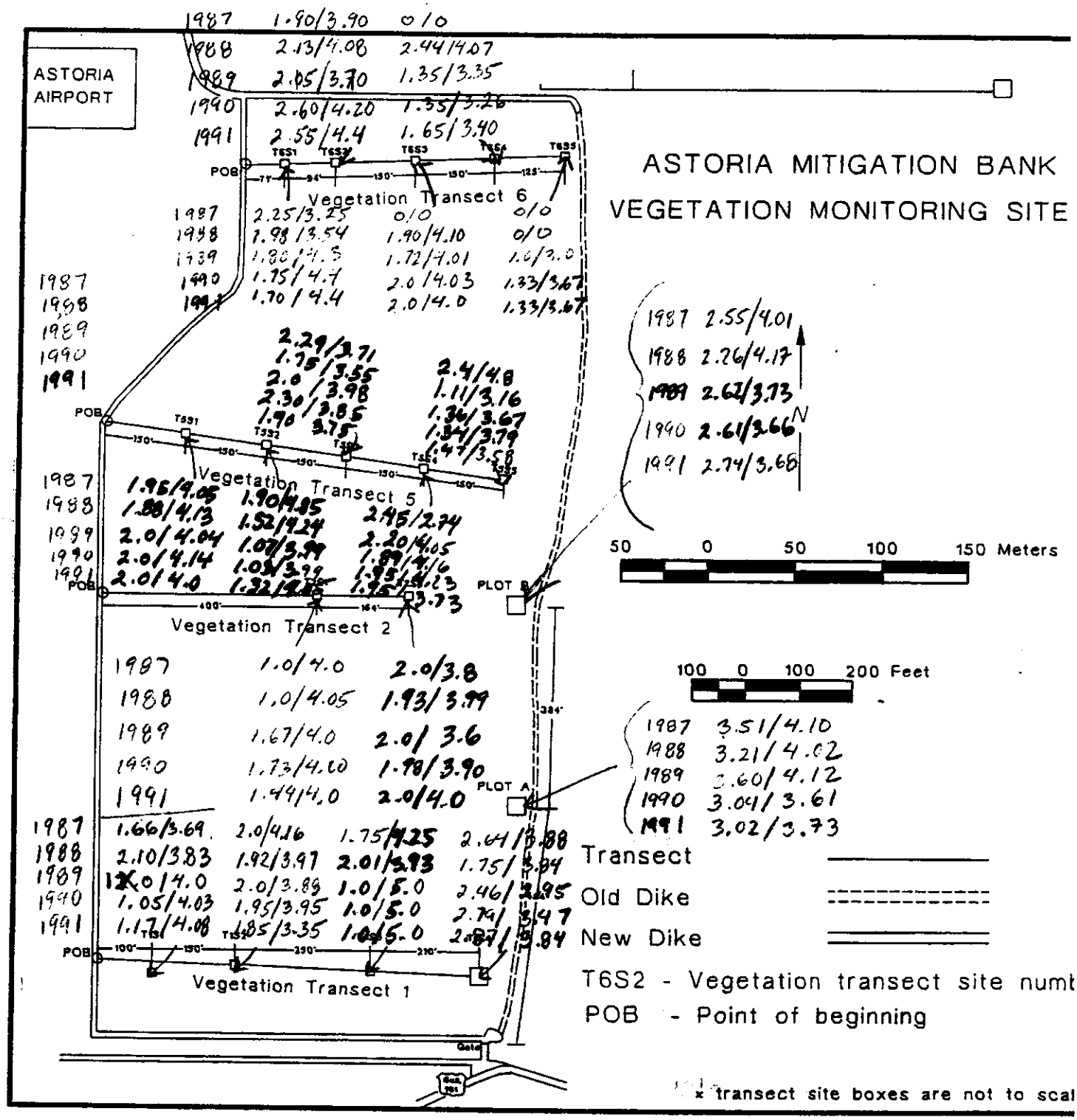
APPENDIX 1. Moisture and Salinity Tolerance Index Data for 18 Sample Sites at the Astoria Airport Mitigation Bank (1986-1991).



Map 4. Vegetation Monitoring Site Locations

M = moisture index (1 = ob... ...tic wetland & 5 = obligate upland)

S = salinity index (1 = Very Tolerant & 5 = Very Sensitive



Observed Changes in Plant Species by Site 1987-1990

	1987 ground/canopy	1988 ground/canopy	1989 ground/canopy	1990 ground/canopy	
T1-S1					
Holcus lanatus	--	40%	--	--	
Glyceria	30%	10%	--	--	
Potentilla pacifica	5%	5%	--	--	
Carex obnupta	--	30%	100%	95%	
Lotus corniculatus	T	15%	--	--	
Ranunculus repens	5%	T	--	--	
Galium trifidum	30%	T	--	--	
Spiraea douglasii	--	T	--	--	
Salix spp.	--	--	--	5%	
Deschampsia cespitosa	30%	--	--	--	
M	1.66	2.10	1.0	1.05	1.17
D	3.07	3.83	4.88	4.85	4.03
T1-S2					
Juncus effusus	75%	90%	98%	90%	
Potentilla pacifica	--	1%	--	--	
Lotus corniculatus	--	1%	--	--	
Carex obnupta	--	8%	--	--	
Deschampsia cespitosa	--	--	2%	5%	
Ranunculus repens	15%	T	--	--	
Galium trifidum	--	T	--	--	
Typha latifolia	--	--	--	5%	
Bare muck	10%	--	--	--	
M	2	1.92	2	1.95	1.85
S	4.16	3.97	3.88	3.95	3.35
T1-S3					
Juncus effusus	75%	98%	--	--	
Holcus lanatus	--	2%	--	--	
Scirpus microcarpus	25%	T	100%	98%	
Typha latifolia	--	--	--	2%	
M	1.75	2.01	1	1	1.0
S	4.25	3.93	5	5	5.0
T1-S4					
Juncus effusus	35%	3%	10%	1%	
Deschampsia cespitosa	15%	--	50%	60%	
Holcus lanatus	10%	20%	--	--	
Lolium perenne	--	20%	--	--	
Agrostis alba	--	20%	--	--	
Rubus spectabilis	--	3%	T	T	
Rosa nutkana	5%	3%	1%	3%	
Ranunculus repens	25%	3%	5%	1%	
Typha latifolia	--	2%	10%	5%	
Oenanthe sarmentosa	--	3%	--	1%	
Rubus ursinus	T	3%	--	--	
Alopecurus geniculatus	--	20%	--	--	
M					
S					

	1987 ground/canopy	1988 ground/canopy	1989 ground/canopy	1990 ground/canopy	
Galium aparine	--	T	--	1%	
Potentilla pacifica	--	--	15%	5%	
Digitalis purpurea	--	--	5%	1%	
Galium trifidum	--	--	T	T	
Heracleum lanatum	--	--	T	T	
Rumex crispus	--	--	T	1%	
Stachys mexicana	--	--	T	T	
Alnus rubra	-- 50%	-- 50%	-- 50%	--	40%
Salix spp.	-- 15%	-- 30%	-- 30%	--	30%
Pyrus fusca	-- 35%	-- 20%	-- 20%	--	30%
Lotus corniculatus	10%	--	--	--	
Vicae gigantea	--	--	--	18%	
Cystus scoparius	--	--	--	3%	
Open	--	--	--	--	--
m	2.64	1.75	2.46	2.79	2.87
s	3.88	3.84	2.95	3.47	3.84
Site A 10m x 10m					
Cirsium spp.	--	1%	--	--	
Lysichtitum americanum	T	2%	2%	1%	
Alopecurus geniculatus	--	10%	--	--	
Rumex conglomeratus	2%	2%	--	--	
Vicae gigantea	--	10%	1%	2%	
Trifolium parryi	--	10%	--	--	
Lotus corniculatius	15%	10%	--	T	
Galium aparine	10%	10%	--	T	
Rosa nutkana	10%	2%	--	--	
Rubus ursinus	30%	2%			
Rubus laciniatus			>35%	>35%	
Rubus discolor					
Holcus lanatus	10%	20%	T	T	
Erichtites spp.	3%	1%	--	--	
Rubus spectabilis	--	T	15%	2%	
Juncus balticus	--	T	--	--	
Oenanthe sarmentosa	--	--	3%	3%	
Carex obnupta	--	--	2%	2%	
Scirpus microcarpus	--	--	1%	5%	
Solanum dulcamara	--	--	T	T	
Bare ground	--	--	11%	15%	
Potentilla pacifica	--	--	--	4%	
Ribes divaricatum	--	--	--	1%	
Water	--	--	30%	30%	
Salix spp.	-- 60%	10% 60%	--	--	85%
Sambucus racemosa	-- 20%	-- 20%	2%	--	--
Alnus rubra	-- 20%	-- 10%	3%	--	--
Pyrus fusca	--	-- 10%	15%	--	--
Open	--	--	--	--	15%
m	3.51	3.21	3.60	3.04	3.02
s	4.10	4.02	4.12	3.61	3.73

	1987 ground/canopy	1988 ground/canopy	1989 ground/canopy	1990 ground/canopy	
T2-S1					
Carex obnupta	100%	95%	50%	50%	
Scirpus microcarpus	--	5%	--	--	
Juncus effusus	--	--	10%	10%	
Potentilla pacifica	--	--	--	--	
Galium aparine	--	--	--	15%	
Water	--	--	40%	25%	
m	1.0	1.0	1.67	1.73	1.44
s	4.0	4.05	4.0	4.20	4.0
T2-S2					
Potentilla pacifica	5%	5%	--	2%	
Juncus effusus	90%	85%	4%	90%	
Scirpus microcarpus	--	5%	--	--	
Ranunculus repens	--	2%	--	--	
Lotus corniculatus	5%	3%	--	--	
Deschampsia cespitosa	--	--	1%	4%	
Unvegetated muck soil	--	--	95%	4%	
m	2.0	1.93	2.0	1.98	2.0
s	3.8	3.99	3.6	3.90	4.0
Site B 10m x 10m					
Ribes divaricatum	--	2%	10%	10%	
Rubus spectabilis	T	5%	15%	15%	
Rumex conglomeratus	--	1%	T	T	
Typha latifolia	--	1%	--	--	
Oenanthe sarmentosa	10%	10%	20%	25%	
Scirpus microcarpus	15%	60%	8%	--	
Lotus corniculatus	5%	2%	13%	10%	
Ranunculus repens	15%	5%	--	--	
Alopecurus geniculatus	--	3%	--	--	
Lonicera involucrata	--	1%	4%	3%	
Agrostis spp.	--	2%	--	--	
Agrostis alba	--	2%	--	--	
Hyoscyamus niger	--	1%	--	--	
Juncus effusus	--	T	6%	12%	
Deschampsia cespitosa	--	--	15%	15%	
Epilobium spp.	--	--	1%	1%	
Potentilla pacifica	--	--	3%	3%	
Vicae gigantea	--	--	1%	1%	
Athyrium filix-femina	--	--	1%	1%	
Galium trifidum	--	--	1%	2%	
Rubus discolor	--	T	\		
Rubus ursinus	--	--	>2%	2%	
Rubus laciniatus	--	--	/		
Salix Sp.	-- 30%	5% 50%	-- 11%	-- 30%	
Alnus rubra	-- 70%	T 50%	-- 3%	-- 5%	
Salix Sp. dead	--	--	-- 2%	-- 5%	
Alnus rubra dead	--	--	-- 8%	-- 15%	
Open	--	--	-- 76%	-- 45%	
m	2.55	2.26	2.62	2.61	2.74
s	4.01	4.17	3.73	3.66	3.68

	1987 ground/canopy	1988 ground/canopy	1989 ground/canopy	1990 ground/canopy	
T5-S5					
Oenanthe sarmentosa	--	75%	40%	50%	
Ranunculus repens	60%	10%	--	--	
Carex obnupta	--	10%	50%	40%	
Ribes divaricatum	--	--	5%	5%	
Rubus spp.	10%	--	4%	4%	
Athyrium filix-femina	--	--	1%	--	
Equisetum spp.	20%	--	T	--	
Lotus corniculatus	--	--	--	1%	
Juncus effusus	10%	--	--	--	
Dead Rubus & Alder	--	5%	--	--	
m	2.4	1.11	1.36	1.34	1.47
s	4.8	3.16	3.67	3.79	3.58
T6-S1					
Lotus corniculatus	40%	2%	20%	15%	
Oenanthe sarmentosa	40%	50%	10%	5%	
Athyrium filix-femina	--	2%	10%	10%	
Ranunculus repens	--	2%	--	--	
Holcus lanatus	5%	42%	--	--	
Heracleum lanatum	--	2%	--	--	
Scirpus microcarpus	--	--	50%	55%	
Agrostis spp.	5%	--	5%	10%	
Galium aparine	10%	--	5%	5%	
m	2.25	1.98	1.80	1.75	1.70
s	3.25	3.54	4.3	4.4	4.4
T6-S2					
Juncus effusus	90%	75%	10%	10%	
Rubus spectabilis	--	10%	10%	10%	
Oenanthe sarmentosa	10%	5%	40%	35%	
Holcus lanatus	--	3%	--		
Athyrium filix-femina	--	5%	5%	5%	
Agrostis spp.	--	2%	20%	--	
Epilobium angustifolium	--	--	15%	40%	
m	1.9	2.13	2.05	2.6	2.55
s	3.9	4.08	3.70	4.2	4.9
T6-S3					
Juncus effusus	--	80%	85%	75%	
Carex obnupta	--	10%	--	--	
Spiraea douglasii	--	10%	1%	2%	
Water	--	--	14%	23%	
m	Ø	1.90	1.72	2.00	2.0
s	Ø	4.10	4.01	4.03	4.0

	1987 ground/canopy	1988 ground/canopy	1989 ground/canopy	1990 ground/canopy	
T6-S4					
Oenanthe sarmentosa	--	40%	80%	85%	
Galium aparine	--	20%	--	--	
Rubus spectabilis	--	20%	9%	5%	
Ribes divaricatum	--	5%	1%	1%	
Scirpus microcarpus	--	2%	--	--	
Holcus lanatus	--	10%	3%	2%	
Bidens cernua	--	--	2%	2%	
Stellaria calycantha	--	--	5%	5%	
Dead fern	--	1%	T	T	
Dead spruce	--	2%	T	T	
m	⊘	2.44	1.35	1.35	1.65
s	⊘	4.07	3.35	3.26	3.40
T6-S5					
Dead Scirpus microcarpus	--	--	65%	65%	
Dead Ribes divaricatum	--	--	20%	--	
Oenanthe sarmentosa	--	--	10%	20%	
Grasses	--	--	1%	5%	
Stellaria spp.	--	--	--	10%	
Water	--	--	4%	--	
	0	0	1.0	1.33	1.3
	0	0	3.0	3.67	3.6