

# **Williamson River Delta Preserve vegetation monitoring: Goose Bay first-year post-breaching results**

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## **I. Introduction**

Establishing native wetland vegetation in restored wetlands is an integral component of the Williamson River Delta Preserve's restoration goals. In fall 2007, large sections of levee were breached on the Tulana portion of the property, and in fall 2008, additional sections of levee were breached on the Goose Bay portion of the property, resulting in the re-connection of the entire delta to the surrounding water bodies. Goose Bay, which was not previously managed as a wetland, was flooded and became colonized by wetland vegetation for the first time since being drained and converted from wetland to agricultural fields over 60 years ago.

A new monitoring program was developed in 2008 to track the response of vegetation to hydrologic restoration. The first year of post-breaching vegetation monitoring was completed on Tulana in 2008 (Elseroad et al. 2009), and in 2009, monitoring was initiated on Goose Bay. This report describes the first-year post breaching results from Goose Bay.

## **II. Methods**

### **Monitoring design**

The same monitoring methodology that was developed for Tulana in 2008 (see Elseroad et al. 2009) was used on Goose Bay in 2009, although the number of plots sampled within each hydrologic zone varied. As in 2008, vegetation in 1m<sup>2</sup> plots was sampled within the hydrologic zones (riparian/wet prairie, emergent wetland, and deep water wetland) that encompass the range of ground surface elevations where wetland vegetation is expected to establish (Table 1, Figure 1). A total of 40 plots were sampled in the riparian/wet prairie zone, 60 plots were sampled in the emergent wetland zone, and 20 plots were sampled in deep water wetland-1 zone. Compared to sampling in Tulana, the number of plots in emergent wetlands was increased from 40 to 60 because a greater proportion of Goose Bay is emergent wetland. The number of deep water wetland-1 plots was decreased from 40 to 20, because much less of Goose Bay is composed of deep water wetlands. Also, due to higher ground surface elevations in Goose Bay, all of the deep water wetland-1 plots were at 4137 ft., compared to 4135-4137 ft. in Tulana, and no deep water wetland-2 plots were sampled. The number of plots in riparian/wet prairies was the same in Goose Bay as in Tulana.

Plot locations were randomly selected prior to sampling using Hawth's tools in ArcMap. Plot locations are intended to be re-randomized each year that monitoring occurs, which will allow a larger percentage of the area to be sampled over time.

## Data collection

In plots without standing water (i.e. all riparian/wet prairie plots and some emergent wetland plots), the aerial cover of each species and ground surface type (bare ground or litter) was estimated. Plant cover was estimated separately for each species; therefore plant cover totaled over 100% when species overlapped one another. In plots with standing water (i.e. some emergent wetland plots and all deep water wetland-1 plots), cover was estimated, as described above, if emergent plant species were present. For species submerged underwater, the plot sampling frame was used to scoop the vegetation out of the water, and the presence of each submerged species was recorded. The double-headed garden rake used on Tulana in 2008 was not needed in deep water wetlands in Goose Bay because water depths were much shallower (10-24 inches) than in Tulana (24-56 inches). Nomenclature followed Hitchcock and Cronquist's (1973) Flora of the Pacific Northwest, and species names were updated following USDA (2009).

Water depths were also measured in plots with standing water. Lake elevations during sampling (obtained from the U.S. Bureau of Reclamation website, <http://www.usbr.gov/mp/kbao/operations/water>) and measured water depths were used to estimate plot elevations. If the estimated plot elevation was more than 12 inches off from the intended plot elevation, a new plot location was chosen from a list of additional random plots. All data were collected by Adrien Elseroad from September 2-7, 2009.

## Data analysis

For each hydrologic zone, average species richness, and the average cover of each ground surface type, all species, native species, exotic species, and three plant guilds were calculated. Plant guilds included perennial forbs, perennial graminoids, and annuals (combined with biennials). Species nativity and duration followed USDA (2009). For submerged aquatic species, only frequency values were calculated. One deep water wetland-1 plot (plot 9) was eliminated from analysis because the water depth (9 in.) was later determined to have been too shallow for the plot to be at 4137 ft.

## III. Results

### Riparian/wet prairies

Total plant cover in riparian/wet prairies averaged 68% (Table 2). Plant cover was dominated by native species, and was composed largely of annuals (Table 2). A total of 31 species were found in riparian/wet prairie plots, and species richness averaged 9 species/m<sup>2</sup> (Tables 3 and 4).

The most abundant species in plots included *Tripleurospermum maritimum* (formerly *Matricaria maritime*), an exotic annual forb, and *Symphotrichum frondosum* and *Rorippa curvisiliqua*, both native annual forbs (Table 4). Although cover of native perennials was low, native perennial species including *Potentilla norvegica*, *Typha latifolia*, and *Eleocharis palustris* were frequently encountered (in 45%, 35%, and 30% of plots, respectively).

In addition to *Tripleurospermum maritimum*, other common exotic species included the annuals *Erysimum cheiranthoides*, *Chenopodium album*, and *Polygonum aviculare* (Table 4).

## Emergent wetlands

Total plant cover in emergent wetlands averaged 10%, and was composed of a mix of native and exotic annual species (Table 2). Plot area not occupied by plants consisted of either bare ground or water, depending on the plot elevation. Plots located at 4139-4140 ft. had saturated soils but no standing water, and plots located at 4138 ft. had up to 9 inches of standing water. A total of 33 species were found in emergent wetland plots, and species richness averaged 3 species/m<sup>2</sup> (Tables 3 and 5).

Species that dominated plant cover included *Elymus repens* (formerly *Elytrigia repens*), an exotic perennial, and *Tripleurospermum maritimum*, an exotic annual forb, although cover of these species averaged only 1-2% (Table 5). Cover of native perennials was low, but the native perennial species *Elodea canadensis*, *Typha latifolia*, *Schoenoplectus acutus* (formerly *Scirpus acutus*), and *Eleocharis palustris* occurred in 10-16% of plots.

## Deep water wetlands

Aquatic species were the most abundant plant guild in deep water wetlands, occurring in 84% of plots (data not shown). A total of 9 species were found, and species richness averaged 2 species/m<sup>2</sup> (Tables 3 and 6). Water depths during sampling ranged from 10-24 inches.

Dominant species included *Potamogeton crispus*, an exotic submerged aquatic species, which was found in 68% of plots, and *Elodea canadensis*, a native submerged aquatic species, which was found in 37% of plots (Table 6). The native emergent species *Schoenoplectus acutus*, *Typha latifolia*, and *Polygonum amphibium* were found in plots as well, but were not common. Each of these species occurred in one of the 19 plots sampled.

## IV. Discussion

### Short-term vegetation establishment

Vegetation establishment the first year following levee breaching in Goose Bay varied among hydrologic zones. Plot cover in the riparian/wet prairie zone was dominated by native annual species; the emergent wetland zone was dominated by bare ground or water, depending on plot elevation, with low plant cover; and in the deep water wetlands, submerged aquatic species were common. Although low in cover, native perennials common in adjacent lake-fringe wetlands and in the delta's early action projects, such as *Salix* spp., *Typha latifolia*, *Eleocharis palustris*, *Schoenoplectus acutus*, and *Polygonum amphibium*, were widely established in the riparian/wet prairie and/or emergent wetland zones. If vegetation development follows similar patterns that occurred following flooding and levee breaching previously on the delta (see Elseroad et al. 2006 and Elseroad and Aldous 2008), these and other native perennial species can be expected to increase in cover and eventually dominate the Goose Bay wetlands.

### Comparisons to Tulana

First-year post breaching vegetation establishment in Goose Bay differed from that in Tulana (see Elseroad et al. 2009 for Tulana first-year post breaching results). In riparian/wet prairies and emergent

wetlands, plant cover was substantially lower in Goose Bay than in Tulana. Plant cover averaged 68% in riparian/wet prairies and 10% in emergent wetlands in Goose Bay, compared to 100% and 36%, respectively, in Tulana. While plant cover at both sites was dominated by annuals, perennial forb and graminoid cover was substantially less in Goose Bay.

Post-breaching plant establishment was probably greater in Tulana because it had been seasonally flooded since 1998, and thus wetland vegetation was already established in most areas when levees were breached (Elseroad et al. 2006). While many of the established plants may not have survived the deeper water and longer hydroperiods following breaching, the availability of on-site wetland plant propagules probably accelerated plant establishment.

In contrast to the riparian/wet prairies and emergent wetlands, plant abundance in the deep water wetland-1 plots was much greater in Goose Bay than it was in Tulana. In Goose Bay, plants were found in 84% of plots, whereas in Tulana, no plants were found. Higher plant abundance in deep water wetlands in Goose Bay was probably largely due to shallower water depths. Only the shallowest end of the deep water wetland elevational range was sampled in Goose Bay, and in addition, lake levels during sampling were approximately 8 inches lower in 2009 compared to 2008, when Tulana was sampled. As a result, water depths in deep water wetland-1 plots in Goose Bay ranged from 10-24 inches, compared to 24-56 inches in Tulana. The most common species in Goose Bay deep water wetlands were submerged aquatics, which are strongly influenced by light availability (Cronk and Fennessy 2001). Increased light penetration in shallower water may have increased the establishment of these species in Goose Bay.

### **Exotic species**

The majority of exotic species found in riparian/wet prairies and emergent wetlands were annual species (i.e. *Tripleurospermum maritimum* and *Erysimum cheiranthoides*) that are not considered invasive. Life history characteristics of annuals (i.e. high seed production and rapid growth) allow them to quickly colonize bare ground following drawdown and dominate plant cover in the short-term. These species can be expected to decrease in the next few years as native perennials become more abundant. In deep water wetlands, the dominant species, *Potamogeton crispus* is an exotic, although it is not considered noxious in Oregon. This species also occurs in the delta's early action projects (Elseroad and Aldous 2008) and often co-occurs with native submerged aquatic species. *Phalaris arundinacea*, the exotic species of most concern in the delta's wetlands because of its ability to form large monocultures, was not observed in Goose Bay.

## **V. Management recommendations**

### **1) Continue scheduled monitoring frequency.**

Vegetation monitoring plots on Goose Bay are scheduled to be re-sampled in 2013. Sampling once every three years should provide a long enough time period for detecting additional changes in vegetation that occur following hydrologic restoration.

### **2) Survey for *Phalaris arundinacea* annually.**

Although *Phalaris* was not detected in Goose Bay in 2009, it does occur in isolated patches elsewhere within the restored wetlands and can form large monocultures once established. Due to the aggressive nature of this invasive species, *Phalaris* surveys should be conducted in the riparian/wet prairie hydrologic zone every year and all patches found should be controlled.

## VI. Literature cited

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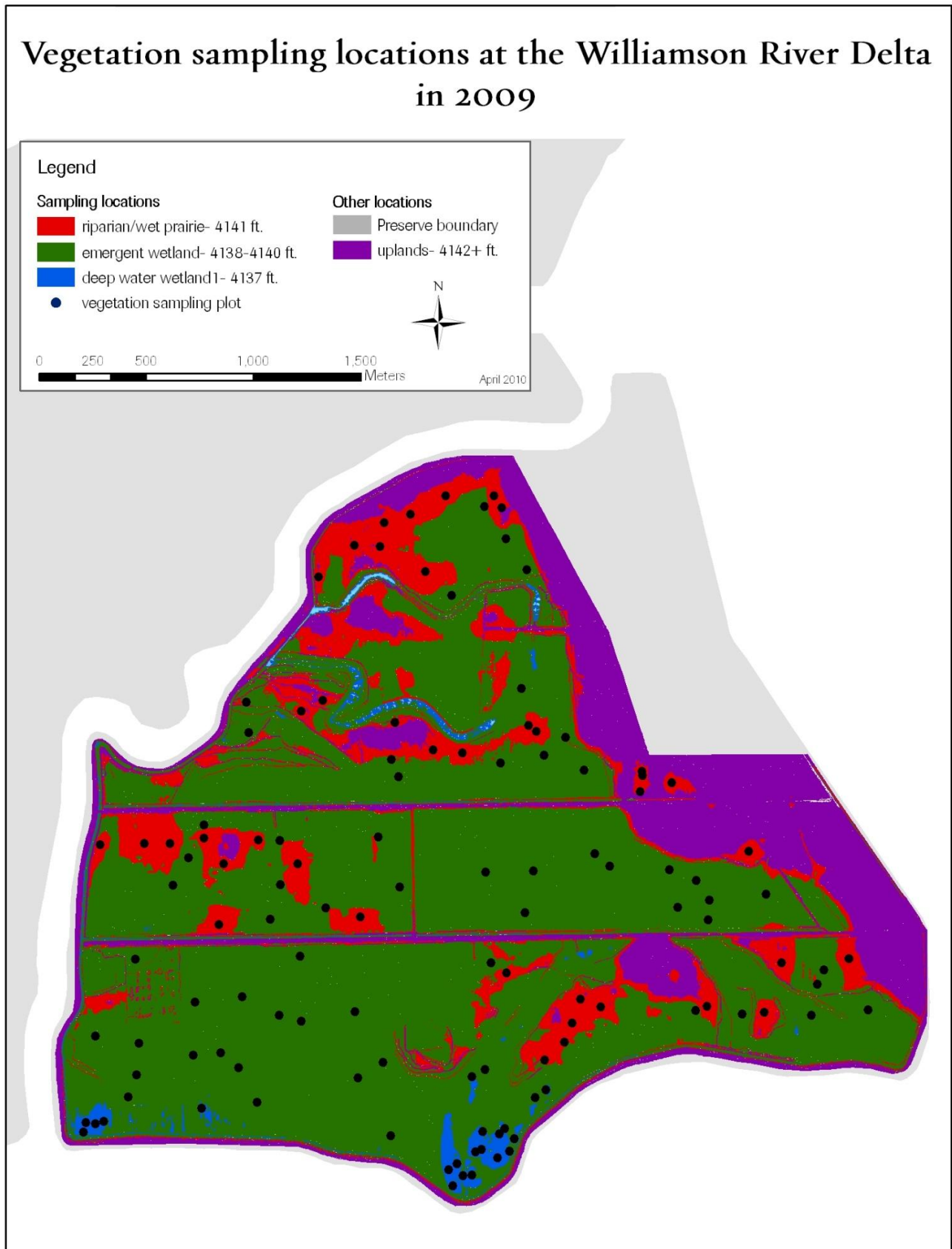
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Figure 1.



**Table 1.** Hydrologic zones where vegetation monitoring plots were sampled at the Williamson River Delta in 2009.

Hydrologic zone	Elevation range (ft)	Minimum water depth (ft)*	Maximum water depth (ft)*
riparian/wet prairie	4141	0	1.8
emergent wetland	4138-4140	0-0.8	2.8-4.8
deep water wetland-1	4137	1.8	5.8

\* water depths based on the Below Average water year type as stated in the U.S. Fish and Wildlife Service's Biological Opinion on the 10-year operation plan for the Klamath Project (U.S. Fish and Wildlife Service 2002).

**Table 2.** Average plant and substrate cover in Goose Bay vegetation monitoring plots at the Williamson River Delta in 2009. Values are means  $\pm$  SE (n=40 for riparian/wet prairie, n=60 for emergent wetland, and n=19 for deep water wetland-1).

	Riparian/wet prairie	Emergent wetland	Deep water wetland- 1
Total plant cover	67.62 $\pm$ 5.48	9.89 $\pm$ 2.4	3.63 $\pm$ 2.53
bare ground	34.73 $\pm$ 4.54	37.8 $\pm$ 5.32	0 $\pm$ 0
litter	3.63 $\pm$ 1.03	3.65 $\pm$ 1.01	0 $\pm$ 0
water	0 $\pm$ 0	50 $\pm$ 6.51	100 $\pm$ 0
Native species	41.11 $\pm$ 5.25	4 $\pm$ 1.06	3.63 $\pm$ 2.53
Exotic species	23.72 $\pm$ 3.83	4.37 $\pm$ 1.57	0 $\pm$ 0
annuals	59.84 $\pm$ 5.55	4.47 $\pm$ 1.5	0 $\pm$ 0
perennial forbs	3.66 $\pm$ 0.82	0.99 $\pm$ 0.52	2.58 $\pm$ 2.37
perennial graminoids	1.12 $\pm$ 0.53	1.82 $\pm$ 1.03	1.05 $\pm$ 1.05
aquatics	0 $\pm$ 0	1.32 $\pm$ 0.74	0 $\pm$ 0
shrub/tree	0.21 $\pm$ 0.15	0 $\pm$ 0	0 $\pm$ 0

**Table 3.** Average plant species richness (# species/m<sup>2</sup>) in Goose Bay vegetation monitoring plots at the Williamson River Delta in 2009. Values are means  $\pm$  SE (n=40 for riparian/wet prairie, n=60 for emergent wetland, and n=19 for deep water wetland-1).

	Riparian/wet prairie	Emergent wetland	Deep water wetland- 1
All species	8.65 $\pm$ 0.39	2.88 $\pm$ 0.37	1.73 $\pm$ 0.25
Native	5.35 $\pm$ 0.32	1.58 $\pm$ 0.22	1.05 $\pm$ 0.22
Exotic	2.75 $\pm$ 0.16	1 $\pm$ 0.15	0.68 $\pm$ 0.11

**Table 4.** Average plant species cover (average  $\pm$  SE; n=40) and frequency for riparian/wet prairie monitoring plots in Goose Bay at the Williamson River Delta Preserve in 2009 (n=40). N= native, I= introduced, U= unknown, P= perennial, A= annual, B= biennial. Wetland status and species nomenclature follow USDA (2007).

Scientific name	Cover (%)	Frequency (%)	Common name	Family	Origin	Duration	Wetland status	Growth habit	Plant guild
<i>Amaranthus powellii</i>	2.46 $\pm$ 1.38	27.50	Powell's amaranth	Amaranthaceae	N	A	UPL	forb	annual
<i>Bidens cernua</i>	0.1 $\pm$ 0.06	15.00	nodding beggarticks	Asteraceae	N	A	FACW+	forb	annual
<i>Capsella bursa</i>	0.03 $\pm$ 0.01	7.50	shepard's purse	Brassicaceae	I	A	FAC-	forb	annual
<i>Chamaesyce serpyllifolia</i>	0.09 $\pm$ 0.06	7.50	thymeleaf sandmat	Euphorbiaceae	N	A	none	forb	annual
<i>Chenopodium album</i>	0.97 $\pm$ 0.49	45.00	lambsquarters	Chenopodiaceae	I	A	FAC	forb	annual
<i>Cirsium arvense</i>	0.75 $\pm$ 0.37	42.50	Canada thistle	Asteraceae	I	P	FACU+	forb	perennial forb
<i>Eleocharis acicularis</i>	0.65 $\pm$ 0.43	10.00	needle spike-rush	Cyperaceae	N	A/P	OBL	graminoid	perennial graminoid
<i>Eleocharis palustris</i>	0.3 $\pm$ 0.13	30.00	creeping spike-rush	Cyperaceae	N	P	OBL	graminoid	perennial graminoid
<i>Elymus repens</i>	0.11 $\pm$ 0.1	5.00	quackgrass	Poaceae	I	P	FACU	graminoid	perennial graminoid
<i>Epilobium ciliatum</i>	0.08 $\pm$ 0.04	17.50	fringed willowherb	Onagraceae	N	P	FACW-	forb	perennial forb
<i>Erysimum cheiranthoides</i>	5.16 $\pm$ 1.77	32.50	wormseed wallflower	Brassicaceae	I	A/B	FACU	forb	annual
<i>Gnaphalium palustre</i>	0.95 $\pm$ 0.41	62.50	western marsh cudweed	Asteraceae	N	A	FAC+	forb	annual
<i>Gratiola neglecta</i>	2.85 $\pm$ 1.01	25.00	clammy hedgehyssop	Scrophulariaceae	N	A	OBL	forb	annual
<i>Lactuca serriola</i>	0.11 $\pm$ 0.1	5.00	prickly lettuce	Asteraceae	I	A/B	FAC-	forb	annual
<i>Limosella aquatica</i>	0.38 $\pm$ 0.38	2.50	water mudwort	Scrophulariaceae	N	A	OBL	forb	annual
<i>Ludwigia palustris</i>	0.38 $\pm$ 0.37	5.00	marsh seedbox	Onagraceae	N	P	OBL	forb	perennial forb
<i>Panicum capillare</i>	8.48 $\pm$ 2.9	42.50	witchgrass	Poaceae	N	A	FAC	graminoid	annual
<i>Plagiobothrys scouleri</i>	0.33 $\pm$ 0.2	7.50	Scouler's popcornflower	Boraginaceae	N	A	FACW	forb	annual
<i>Polygonum aviculare</i>	3.54 $\pm$ 1.32	32.50	prostrate knotweed	Polygonaceae	I	A/P	FACW-	forb	annual
<i>Polygonum persicaria</i>	0.79 $\pm$ 0.5	27.50	spotted ladythumb	Polygonaceae	I	A/P	FACW	forb	annual
<i>Potentilla norvegica</i>	1.19 $\pm$ 0.35	45.00	Norwegian cinquefoil	Rosaceae	N	A/B/P	FAC	forb	perennial forb
<i>Rorippa curvisiliqua</i>	9.08 $\pm$ 2.92	65.00	curvepod yellowcress	Brassicaceae	N	A/B	FACW+	forb	annual
<i>Rumex maritimus</i>	1.82 $\pm$ 0.46	52.50	golden dock	Polygonaceae	N	A/B	FACW+	forb	annual
<i>Salix geyeriana</i>	0.13 $\pm$ 0.12	7.50	Geyer's willow	Salicaceae	N	P	FACW+	tree/shrub	shrub/tree
<i>Salix lucida</i> ssp. <i>lasiandra</i>	0.08 $\pm$ 0.04	15.00	Pacific willow	Salicaceae	N	P	FACW+	tree/shrub	shrub/tree
<i>Schoenoplectus acutus</i>	0.06 $\pm$ 0.05	5.00	hardstem bulrush	Cyperaceae	N	P	OBL	graminoid	perennial graminoid
<i>Sisymbrium altissimum</i>	0.1 $\pm$ 0.1	2.50	tall tumbled mustard	Brassicaceae	I	A/B	FACU-	forb	annual
<i>Symphyotrichum frondosum</i>	10.46 $\pm$ 3.63	57.50	short-rayed alkalai aster	Asteraceae	N	A	FACW+	forb	annual
<i>Tripleurospermum maritimum</i>	12.17 $\pm$ 3.52	75.00	false mayweed	Asteraceae	I	A/B/P	FACU	forb	annual
<i>Typha latifolia</i>	1.26 $\pm$ 0.44	35.00	broadleaf cattail	Typhaceae	N	P	OBL	forb	perennial forb
Unknown grass	2.79 $\pm$ 1.69	55.00		Poaceae	U	U		graminoid	U



**Table 5.** Average plant species cover (average  $\pm$  SE; n=60) and frequency for emergent wetland monitoring plots in Goose Bay at the Williamson River Delta Preserve in 2009 (n=60). N=native, I=introduced, U=unknown, P=perennial, A=annual, B=biennial. Wetland status and species nomenclature follow USDA (2007). \*cover not estimated for submerged species

Scientific name	Cover* (%)	Frequency (%)	Common name	Family	Origin	Duration	Wetland status	Growth habit	Plant guild
<i>Alisma triviale</i>	0.08 $\pm$ 0.06	1.67	American water-plantain	Alistmataceae	N	P	OBL	forb	perennial forb
<i>Alopecurus aequalis</i>	0.01 $\pm$ 0.01	3.33	shortawn foxtail	Poaceae	N	P	OBL	graminoid	perennial graminoid
<i>Bidens frondosa</i>	0 $\pm$ 0	1.67	devil beggarticks	Asteraceae	N	A	FACW+	forb	annual
<i>Ceratophyllum demersum</i>	-	1.67	coontail	Ceratophyllaceae	N	P	OBL	forb	aquatic
<i>Chenopodium album</i>	0.09 $\pm$ 0.08	10.00	lambquarters	Chenopodiaceae	I	A	FAC	forb	annual
<i>Cirsium arvense</i>	0.01 $\pm$ 0	5.00	Canada thistle	Asteraceae	I	P	FACU+	forb	perennial forb
<i>Eleocharis palustris</i>	0.13 $\pm$ 0.08	10.00	creeping spike-rush	Cyperaceae	N	P	OBL	graminoid	perennial graminoid
<i>Elodea canadensis</i>	0.65 $\pm$ 0.59	16.67	Canadian waterweed	Hydrocharitaceae	N	P	OBL	forb	aquatic
<i>Elymus repens</i>	1.61 $\pm$ 1.03	16.67	quackgrass	Poaceae	I	P	FACU	graminoid	perennial graminoid
<i>Epilobium ciliatum</i>	0.03 $\pm$ 0.02	5.00	fringed willowherb	Onagraceae	N	P	FACW-	forb	perennial forb
<i>Erysimum cheiranthoides</i>	0.5 $\pm$ 0.35	11.67	wormseed wallflower	Brassicaceae	I	A/B	FACU	forb	annual
<i>Gnaphalium palustre</i>	0.04 $\pm$ 0.02	16.67	western marsh cudweed	Asteraceae	N	A	FAC+	forb	annual
<i>Gratiola neglecta</i>	0.13 $\pm$ 0.13	1.67	clammy hedgehyssop	Scrophulariaceae	N	A	OBL	forb	annual
<i>Limosella aquatica</i>	0 $\pm$ 0	1.67	water mudwort	Scrophulariaceae	N	A	OBL	forb	annual
<i>Ludwigia palustris</i>	0.37 $\pm$ 0.37	8.33	marsh seedbox	Onagraceae	N	P	OBL	forb	perennial forb
<i>Myriophyllum sp.</i>	0.24 $\pm$ 0.18	8.33		Haloragaceae	U	U	OBL	forb	aquatic
<i>Najas guadalupensis</i>	-	6.67	southern waternymph	Najadaceae	N	A	OBL	forb	aquatic
<i>Panicum capillare</i>	0.94 $\pm$ 0.64	6.67	witchgrass	Poaceae	N	A	FAC	graminoid	annual
<i>Polygonum amphibium</i>	0.37 $\pm$ 0.37	1.67	water smartweed	Polygonaceae	N	P	OBL	forb	perennial forb
<i>Polygonum aviculare</i>	0.12 $\pm$ 0.12	5.00	prostrate knotweed	Polygonaceae	I	A/P	FACW-	forb	annual
<i>Polygonum persicaria</i>	0.2 $\pm$ 0.17	18.33	spotted ladythumb	Polygonaceae	I	A/P	FACW	forb	annual
<i>Potamogeton crispus</i>	0.42 $\pm$ 0.42	6.67	curly pondweed	Potamogetonaceae	I	P	OBL	forb	aquatic
<i>Potentilla norvegica</i>	0.01 $\pm$ 0	6.67	Norwegian cinquefoil	Rosaceae	N	A/B/P	FAC	forb	perennial forb
<i>Ranunculus aquatilis</i>	0.02 $\pm$ 0.02	1.67	whitewater crowfoot	Ranunculaceae	N	P	OBL	forb	aquatic
<i>Rorippa curvisiliqua</i>	0.2 $\pm$ 0.08	13.33	curvepod yellowcress	Brassicaceae	N	A/B	FACW+	forb	annual
<i>Rumex maritimus</i>	0.06 $\pm$ 0.04	8.33	golden dock	Polygonaceae	N	A/B	FACW+	forb	annual
<i>Sagittaria cuneata</i>	0.01 $\pm$ 0.01	1.67	arumleaf arrowhead	Alistmataceae	N	P	OBL	forb	perennial forb
<i>Schoenoplectus acutus</i>	0.08 $\pm$ 0.04	11.67	hardstem bulrush	Cyperaceae	N	P	OBL	graminoid	perennial graminoid
<i>Stuckenia pectinatus</i>	-	1.67	leafy pondweed	Potamogetonaceae	N	P	OBL	forb	aquatic
<i>Symphotrichum frondosum</i>	0.78 $\pm$ 0.33	15.00	short-rayed alkalai aster	Asteraceae	N	A	FACW+	forb	annual
<i>Tripleurospermum maritimum</i>	1.42 $\pm$ 1.01	26.67	false mayweed	Asteraceae	I	A/B/P	FACU	forb	annual
<i>Typha latifolia</i>	0.12 $\pm$ 0.07	15.00	broadleaf cattail	Typhaceae	N	P	OBL	forb	perennial forb
Unknown grass	1.29 $\pm$ 0.73	21.67		Poaceae	U	U	U	graminoid	U

**Table 6.** Average plant species cover (average  $\pm$  SE; n=19) and frequency for deep water wetland-1 monitoring plots in Goose Bay at the Williamson River Delta Preserve in 2009 (n=19). N= native, I= introduced, U= unknown, P= perennial, A= annual, B= biennial. Wetland status and species nomenclature follow USDA (2007). \*cover not estimated for submerged species

Scientific name	Cover* (%)	Frequency (%)	Common name	Family	Origin	Duration	Wetland status	Growth habit	Plant guild
<i>Ceratophyllum demersum</i>	-	10.53	coontail	Ceratophyllaceae	N	P	OBL	forb	aquatic
<i>Elodea canadensis</i>	-	36.84	Canadian waterweed	Hydrocharitaceae	N	P	OBL	forb	aquatic
<i>Ludwigia palustris</i>	-	5.26	marsh seedbox	Onagraceae	N	P	OBL	forb	perennial forb
<i>Najas guadalupensis</i>	-	21.05	southern waternymph	Najadaceae	N	A	OBL	forb	aquatic
<i>Polygonum amphibium</i>	0.21 $\pm$ 0.21	5.26	water smartweed	Polygonaceae	N	P	OBL	forb	perennial forb
<i>Potamogeton crispus</i>	-	68.42	curly pondweed	Potamogetonaceae	I	P	OBL	forb	aquatic
<i>Schoenoplectus acutus</i>	1.05 $\pm$ 1.05	5.26	hardstem bulrush	Cyperaceae	N	P	OBL	graminoid	perennial graminoid
<i>Stuckenia pectinatus</i>	-	15.79	leafy pondweed	Potamogetonaceae	N	P	OBL	forb	aquatic
<i>Typha latifolia</i>	2.37 $\pm$ 2.37	5.26	broadleaf cattail	Typhaceae	N	P	OBL	forb	perennial forb