Habitat Monitoring Report: Year 0
City of Tacoma Middle Waterway Restoration Project

AND PICKLEWEED RANCH

salicornia virginica

October 2001

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Habitat Monitoring Report: Year 0
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1.0 Introduction

The City of Tacoma (City) performed a habitat restoration on 1.9 acres of vacant industrial property at the head of Middle Waterway in Tacoma, Washington. The property is located near the intersection of East F Street and East 11th Street. The primary objectives of the restoration action were to lower the grade of the properties to salt marsh elevations, cover the surface with clean habitat material, and vegetate the salt marsh and its bordering riparian buffer zones.

This restoration action was conducted as part of the City's settlement of alleged natural resource damages with the Commencement Bay Natural Resource Trustees[1] (Trustees). This monitoring report is being provided to the Trustees as a part of that settlement.

Restoration activities included construction (excavation, backfilling, grading, slope stabilization, fencing, and installation of an irrigation system) performed by RCI Environmental, Inc. between July 21 and September 29, 2000; planting of all the riparian areas by the City and citizen volunteers on November 4, 2000; and planting of salt marsh areas on May 26, 2001.

The City has conducted four monitoring events since completion of construction: December 21, 2000; March 29, 2001; June 26, 2001; and August 15, 2001. The methods and frequency of these monitoring events were detailed in the "Monitoring and Adaptive Management Plan" (Hart Crowser, February 25, 2000) prepared for this site. The first three events were qualitative and the fourth was a quantitative monitoring effort per the plan.

[1] Commencement Bay Natural Resource Trustees consist of the following entities: National Oceanic and Atmospheric Administration; U.S. Fish and Wildlife Service; Washington State Department of Ecology; Washington State Department of Fish and Wildlife; Washington State Department of Natural Resources; Puyallup Tribe of Indians and Muckleshoot Indian Tribe.

2.0 Qualitative Monitoring & Results

Qualitative monitoring results are based upon observations of trained personnel during site visits. Qualitative observations were taken of vegetation, sedimentation, wildlife, and other local environmental conditions. For the City of Tacoma, these personnel are John O'Loughlin, Project Manager and Desiree Pooley, Water Quality Technician. The City has retained David Adams as a site steward, and his observations are also included.

2.1 Physical Site Description

The site is composed of three general areas: the City parcel, the DNR parcel and the 11th Street Right of Way (ROW).

The City parcel is approximately 1 acre and is situated adjacent to the substation on along East "F" Street. The riparian area (elevation > 14 ft MLLW) lines three edges in this portion of the site and is sloped at 4:1 (horizontal: vertical). The riparian soil is all imported sandy loam. There is a broad flat upper salt marsh area (elevations between 12 and 14 ft MLLW) and the substrate is native sands and silts/clays that were uncovered when the excavation got to the project grade. The lower salt marsh area (elevations between 12 ft MLLW down to the project boundary, which is approximately 9 ft MLLW) consists predominantly of imported silty sand.

The 0.7-acre DNR parcel follows the irregularly shaped project boundary on the waterside and is bordered by the substation and the Port Yacht Basin on the upland side. All the substrate on this parcel is imported material. The riparian has some broad flat areas in addition to the transitional sloping portion that leads to the salt marsh. Owing to the limiting project boundaries in this area, the upper and lower salt marsh areas are narrow bands following project boundary. All three elevation ranges converge at a relatively steep slope along side the Port Yacht basin.

The 11th Street ROW is approximately 0.2-acre strip of riparian area that starts at the end of the Port Yacht Basin Property and stretches along East 11th Street. All the soil was imported riparian topsoil.

2.2 Photo Points

Photo points were established as described in the Monitoring Plan and depicted in Figure 1. The location of each point was marked by a stake and surveyed. A photo with a digital camera was taken from each photo point during each monitoring event. The photos are presented in Appendix A.

The photos of the riparian areas show the general good health and vigor of the riparian plantings, as well as the development of volunteers, which are quite extensive in areas. Generally the slopes tend to have fewer volunteers than the flat riparian areas. This is likely due to the preferential fall out of source seeds on the flats rather as opposed to the slopes.

Photos of the salt marsh areas show less development of the plantings, owing to the fact that these areas weren't planted until May of 2001. However, the upper salt marsh does show some areas of substantial volunteer coverage by clover and horsetails.

These photos document the need for a weeding effort to prevent the volunteers from crowding out the target species.

2.3 Vegetation

Several general trends have been observed over the course of several monitoring events.

- Nootka rose, alder, and hooker's willow have all thrived.
- Pickleweed is growing very well in the lower salt marsh.
- Grasses were subject to extensive herbivory by rabbits until chicken wire was installed around the planted areas.
- Virtually all of the hazelnut shrubs were subject to herbivory (rabbits and / or geese) in the months following planting. However, by August of 2001 many of these plants had leaves and new growth.
- Only a few of the madrone have survived. This is reportedly the case on many restoration sites.
- Weeds have encroached in the riparian areas to a greater extent where the ground is relatively flat as opposed to where the ground is sloped.
- Blackberries, scot's broom and knapweed have not re-established to any significant extent. St. John's-wort, butterfly bush, clover and horsetails are established to a larger extent.

2.4 Sediment

Certain areas of the restoration site have experienced limited sediment loss since construction was completed. The salt marsh area developed small rills after construction (see Appendix A, photo points UM1, UM5, LM1A and B.) This erosion has not caused a problem and it appears to have been mitigated with the establishment of root mass from the plantings and the volunteer vegetation. In the area near the pedestrian walkway (Photo point LM1A) some stone was added to prevent the possibility of exposing any of the capped materials.

2.5 Wildlife

Many animals have been visiting the site. Direct observations and / or evidence of the following animals have been documented:

- Salmon fry
- mole
- rabbit
- skunk
- raccoon
- goose
- caspian tern
- killdeer
- gull
- peregrine falcon
- crow
- swallow

2.6 Local Environment

Reports have been made to the City on the local environmental conditions in the project area. These reports typically come through Citizens for a Healthy Bay (CHB) as well as others.

A couple of reports were made of a sheen on the water coming out of Outfall 200. Storm Water Quality Representatives from the City searched the drainage basin but could find no apparent source. Most recently a sample was taken and the lab identified the oily substance as having a biological source (i.e. accumulation of secretions and excretions of various denizens of the Middle Waterway.) Likely, the wind pushes the floating material, concentrating it at the head of the waterway. The rising tide carries it up into the storm drain, then it comes out of the drain when the tide falls.

Another report was received about a white, salt-like material being deposited by the tide on the shore of the restoration site. There is no evidence of what this material may have been or that it caused any harm.

3.0 Quantitative Monitoring Methods

Quantitative monitoring involves collection and analysis of numerical data concerning habitat features such as vegetation and sedimentation.

3.1 Vegetation

Quantitative vegetation monitoring was conducted on August 15, 2001. Transects were established in the riparian, upper salt marsh and lower salt marsh, as shown in Figure 1.

Twenty-eight sample plots (quadrats) were established at random along the transects. The riparian area contained 8 quadrats and ten each were established in the upper and lower salt marsh areas. Quadrats L-4 and L-5 along the lower salt marsh transect and quadrats U 5 and U 7 along the upper salt marsh transect were outside the area that had been planted. In the riparian area the quadrats were 28.3 m^2, and in the salt marsh they were 0.25 m^2. The locations of each quadrat were surveyed in and the location information is supplied in Table 1.

For each quadrat, the Daubenmire cover class (i.e. 0-5%, 5-15%, 15-25%, 25-50%, 50-75%, 75-95% or 95-100%) was estimated for plants found within that quadrat as well as the amount of bare substrate. This data is presented in Table 2. Also in this table are the corresponding Daubenmire cover class midpoint values (i.e. 2.5%, 12.5%, 20.5%, 35%, 65%, 85%, or 97.5%).

Plants were categorized as Native according to Pojar & Mackinnon, 1994. The total Native vegetative cover is calculated for each transect. Alders trees in Quadrats R2-1 and R2-3 were volunteers, as well as the oak in R2-2.

3.2 Sediment

Quantitative sediment monitoring consisted of recording the sediment elevation at each of 8 sediment stakes. The stakes were installed on October 30, 2000 in the areas shown on Figure 1. Each stake was marked in centimeters starting at the top of the stake. The stakes were driven into the soil in surveyed locations and the initial reading was taken. At each subsequent quarterly monitoring event another reading was taken. The data is presented in Table 3. In this table, a positive net change corresponds to the sediment getting further from the top of the stake (i.e. erosion) and a negative net change corresponds to the sediment getting closer to the top of the stake (i.e. sedimentation.) There has been little change over the course of the first year of monitoring.

3.3 Seep Sampling

The site was monitored for the presence of seeps throughout each quarterly event, but no seeps have been observed. Therefore, no seep sampling or analysis is possible at this time. We will continue to look for seeps during future monitoring events.

4.0 Quantitative Results

The Monitoring and Adaptive Management Plan established goals for the quantitative measures presented in the previous section. These goals were established for one year post planting. As of August of 2001, when the quantitative data was collected, the riparian plants had been in place for 9 months and the slat marsh plants had been in place for only 3 months. Therefore it is inappropriate to evaluate the success of the project in meeting those goals at this time. However this section compares the quantitative results to the year 1 goals as a basis for discussion.

4.1 Vegetation

Goals for vegetation are split into three categories: Plant Cover, Diversity and Invasive Species.

4.1.1 Plant Cover

Total area cover within a quadrat and mean percent cover are the two measures used to evaluate the successful establishment of the planted areas. Because much of the energy of the first few years of growth is spent on development of below ground biomass the first year's goals should be modest.

The Year 1 performance goals for the riparian area are 1) between 20 and 40% areal coverage of native or naturalized non-native plants within each quadrat and 2) average areal coverage for all quadrats greater than 30%.

Table 2 shows that riparian quadrats R1-1, R1-2, R1-3, R1-4 and R2-3 meet the first goal, while R2-1, R2-2, and R2-4 do not yet. Quadrat R2-2 is close to 90% of the goal (17.5% vs 20%), however R2-1 and R2-4 are only at approximately 60% of the goal. The average for all quadrats is 26 % areal coverage for native species, which is less than the goal of 30%. Therefore good progress has been made toward reaching the Year 1 goal, even though the plants have yet to have a complete years growth.

Potential factors affecting the progress toward the goal include:

- The vegetation, overall, was in a slightly less developed state when it was planted than had been anticipated when the goal was set.
- The hazel nut shrubs were subject to some herbivory at the onset.
- Much of the energy of the first few years of growth is spent on development of below ground biomass.

Generally riparian plant survival has been very good, and there is a good chance the Year 1 goals can be met with the next monitoring event. The hazel nut appears to have recovered from its initial set back. No adaptive management action is warranted due to these results.

The Year 1 performance goals for the salt marsh areas are the same as for riparian: 1) between 20 and 40% areal coverage of native or naturalized non-native plants and 2) average areal coverage greater than 30%.

Table 2 shows that two (L-3 and U-3) of the twenty quadrats in the salt marsh areas meet the first goal. The overall coverage of native plants in the salt marsh is approximately 9%, which is about 1/3 of the goal. These results seem reasonable, given the salt marsh plants have only had 3 months to establish themselves. Factors similar to the riparian situation are in play:

- The vegetation, overall, was in a less developed state when it was planted than had been anticipated when the goal was set.
- The grasses were subject to some herbivory at the onset.
- The salt marsh areas were planted in defined areas to facilitate goose excluder construction, therefore some quadrats are in areas where nothing was planted.
- Much of the energy of the first few years of growth is spent on development of below ground biomass.

There is good reason for optimism that these goals can be met, given the thriving condition of the pickleweed and the fact that chicken wire installed around the upper salt marsh will prevent predation of the grasses.

No additional adaptive management activities are recommended in response to these plant cover monitoring data since the goals are for Year one and wea are still in Year 0. Allowing sufficient time for additional growth should be all that is required at this point to improve these measurement indices.

4.1.2 Diversity

Species diversity is another measure in the ecological evaluation of this project. The long-term goal is for the project site to have a comparable diversity to the original habitat it is trying to recreate. The diversity values provided are targets only and are not criteria by which success will be judged.

The riparian zone diversity target is at least 8 species of native plants present and abundant. Abundant is defined as being present in at least 50% of the quadrats. Applying this definition to the data in Table 2 shows that the following seven riparian plants are abundant on the restoration site: alder, shore pine, hazelnut, oceanspray, nootka rose, hooker's willow and pearly everlasting. Thus, excellent progress has been made toward reaching the target diversity value.

The salt marsh zone diversity target is at least 3 species of native grasses, sedges, rushes, succulents and broadleaf herbs present. Referring to Table 2,

this target has been met due to the presence of the saltgrass, hairgrass and pickleweed.

No adaptive management recommendations are appropriate under this measurement index.

4.1.3 Invasive Species

Areal coverage of invasive species is the final measure used to evaluate the success of this project. As native vegetation matures it is expected to out compete the invasive species.

The riparian zone performance goal for invasive species is not more than 20% areal cover of knapweed, Scot's broom and Himalayan blackberry. Referring to Table 2, the riparian zone has no knapweed or Scot's broom and only 2.5% Himalayan blackberry. Therefore this invasive species performance goal has been met to this point.

However, there is a need to remove some of the other invasive species present on the site. Thistle, St. John's wort and butterfly bush should be removed to prevent them from crowding out the native plants.

The salt marsh zone performance goal for invasive species is not more than 15% areal cover of invasive plants considered noxious (i.e. *spartina antiflora*). Referring to Table 2, the upper and lower salt marsh zones have no noxious weeds present. Therefore this invasive species performance goal has been met. Similar to the riparian area, there is another invasive species that should be controlled to prevent it from encroaching on the native plants: clover.

The adaptive management recommendation under this measurement index is a targeted removal of invasive species from both the salt marsh and riparian zones: specifically clover, thistle, St. John's wort and butterfly bush.

4.2 Sediment

Erosion of salt marsh or riparian soil substrates could cause loss of habitat and vegetation. However, some equilibration of sedimentary regime is to be expected following construction. This performance goal may be accurately compared to the monitoring data at this point since the construction was completed in August of 2000.

The performance goal for sediment erosion is to have less than 2 cm of erosion in the first year of monitoring. Referring to Table 3, none of the sediment stakes have shown more 1 cm of erosion and one of the stakes (#720) has shown 2 cm of sediment accumulation. The likely source of the

accumulated sediment is the redistribution of sediment from on-site. Therefore this performance goal has been met.

Adaptive management recommendations for sediment issues consist of continuing to monitor the site to ensure none of the capped areas experience a loss of sediment, which could possibly expose underlying materials.

5.0 Maintenance / Adaptive Management

This section presents the maintenance activities that have been completed and the activities that are proposed under the adaptive management process.

5.1 Completed & On-going Activities

Soon after construction a couple of rills formed on the slopes adjacent to the public access walkway and at the ends of the constructed channels on the City parcel. Stone was placed near the access walkway and jute mat was placed at the ends of the constructed channels. These activities appear to have controlled the situation and additional sediment loss has not been apparent.

The installed irrigation system has been operated over this first summer. Some adjustments in the irrigation schedule have been necessary to optimize performance. Also there has been troubleshooting and shakeout on the performance of the timers. The amount of water each zone is receiving is evaluated and the sprinkling time is adjusted on an on-going basis. The current watering schedule is provided in Table 4.

Concurrent with plantings in the salt marsh areas, goose exclusion devices (GED) were constructed. Initially these consisted simply of rebar with string wrapped around the top and sides to enclose the planted area. The string was reasonably effective at excluding geese, however rabbits were able to get in to feed upon the grasses. Therefore chicken wire was used to enclose the upper salt marsh. This appears to prevent the rabbits from eating the grasses.

The City contracted with David Adams to be the site steward. David frequently visits the site and maintains the GED, removes noxious weeds as necessary, and gathers other pertinent information on the condition of the site. David also provides advice and expertise on adaptive management options.

5.2 Recommended Adaptive Management Activities

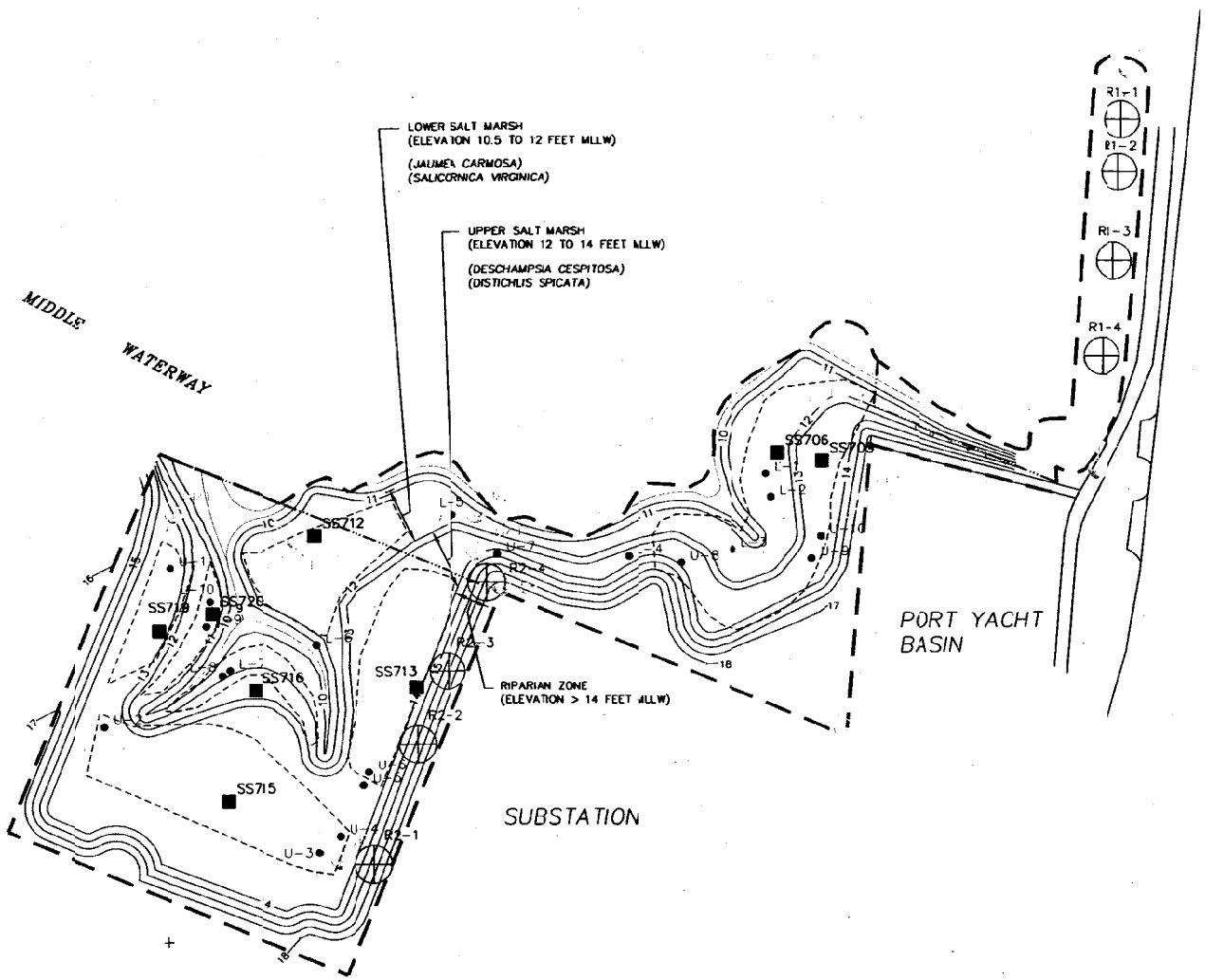
The overall health and vigor of the vegetation at this restoration site is very good. While some of the numerical performance goals have not yet been met, it does not appear to be because of a lack of health of the plantings. Therefore, allowing additional time for the plants to mature and meet the goals seems to be the most prudent course of action.

As discussed in several sections above, there are several plant species that could crowd out the desirable species if they are not controlled. Therefore we intend to initiate a weeding effort targeted at clover, thistle, St. John's wort and butterfly bush.

Additional activities recommended are continuations of current on-going activities. Specifically, remove noxious weeds frequently, monitor moisture in site soils during operation of irrigation system, monitor sedimentation and erosion, maintain GED, and continue quarterly / annual monitoring.

6.0 Acknowledgements

Many organizations and individuals have contributed to this project and the City would like recognize: the Washington State Department of Ecology for grant funding; Hart Crowser, Inc and Pentec Environmental for design services; Citizen's for a Healthy Bay for organizing and providing volunteers for planting; Chuck van Volkenburg for use of his land for the public access walkway; and the numerous volunteers who helped plant the native vegetation.



LEGEND

- RIPARIAN QUADRANTS 28.3 m
- SALT MARSH QUADRANTS 0.25 m
- SEDIMENT STAKES
- PHOTO POINTS
- SALT MARSH PLANTED AREAS WITH CLOSE EXCLUDER
- PROJECT BOUNDARY

N

0 30 60
Scale in Feet

CITY OF TACOMA
DEPARTMENT OF PUBLIC WORKS

MIDDLE WATERWAY RESTORATION PROJECT YEAR 0 MONITORING REPORT

DATE 10-12-01		SCALE 1"=30'
DES JOL	MANAGER ENGINEERING DIVISION	
DR REC	CITY ENGINEER	SHEET 1 OF 1
CK JGP	DIRECTOR OF PUBLIC WORKS	YEAR-0.DWG DWG NAME

Table 1 Quadrat Location Control

Transect / Quadrat ID	Northing	Easting	Elevation
R1-1	706875	1162073	16.8
R1-2	706856	1162052	16.7
R1-3	706824	1162016	16.5
R1-4	706792	1161975	16.3
R2-1	706880	1161502	15.3
R2-2	706902	1161566	16.6
R2-3	706917	1161604	16.7
R2-4	706934	1161653	17.0
U-1	707070	1161538	13.4
U-2	707035	1161452	13.7
U-3	706905	1161486	13.7
U-4	706903	1161500	13.5
U-5	706913	1161528	13.3
U-6	706916	1161535	13.2
U-7	706949	1161668	12.7
U-8	706875	1161735	13.4
U-9	706826	1161787	13.2
U-10	706831	1161799	13.4
L-1	706876	1161802	11.3
L-2	706865	1161795	11.4
L-3	706860	1161760	11.2
L-4	706898	1161717	11.9
L-5	706981	1161666	11.3
L-6	706984	1161564	11.0
L-7	707008	1161521	11.4
L-8	707009	1161516	11.5
L-9	707034	1161529	10.9
L-10	707042	1161540	10.6

Table 2

Quantitative Vegetation Monitoring Results

Transect:	Riparian 1 (11th Street ROW)				Riparian 2 (North of Substation)				Riparian 1 (11th Street ROW)				Riparian 2 (North of Substation)				
Quadrat #	R1-1	R1-2	R1-3	R1-4	R2-1	R2-2	R2-3	R2-4	R1-1	R1-2	R1-3	R1-4	R2-1	R2-2	R2-3	R2-4	Avg Cover
	Daubenmire Cover Class								Daubenmire Midpoints								%
Native Trees																	
big leaf maple	0-5	0	0-5	0-5	0	0	0	0	2.5	0.0	2.5	2.5	0.0	0.0	0.0	0.0	0.9
alder	0	0-5	0	0	0-5	0-5	0-5	0	0.0	2.5	0.0	0.0	2.5	2.5	2.5	0.0	1.3
madrone	0	0	0	0	0	0	0	0-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.3
shore pine	0	0-5	0	0-5	0	0-5	0	0-5	0.0	2.5	0.0	2.5	0.0	2.5	0.0	2.5	1.3
oak	0	0	0	0	0	0-5	0	0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.3
Native Shrubs																	
hazelnut	0-5	0-5	0	0-5	0-5	0-5	0-5	0-5	2.5	2.5	0.0	2.5	2.5	2.5	2.5	2.5	2.2
oceanspray	0	0-5	0-5	0	0-5	0-5	0	0-5	0.0	2.5	2.5	0.0	2.5	2.5	0.0	2.5	1.6
nootka rose	0-5	0-5	5-15	5-15	0-5	0-5	0-5	0	2.5	2.5	12.5	12.5	2.5	2.5	2.5	0.0	4.7
hooker's willow	0	0-5	0	0	0-5	0-5	15-25	0-5	0.0	2.5	0.0	0.0	2.5	2.5	20.5	2.5	3.8
horse tails	5-15	5-15	0-5	0	0	0	0	0	12.5	12.5	2.5	0.0	0.0	0.0	0.0	0.0	3.4
pearly everlasting	5-15	5-15	5-15	5-15	0	0	0	0	12.5	12.5	12.5	12.5	0.0	0.0	0.0	0.0	6.3
Total Native vegetative cover									32.5	40.0	32.5	32.5	2.5	17.5	28.0	12.5	26.0
Invasive species																	
himalyan blackberry	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
scot's broom	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
knapweed	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
thistle	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
St John's Wort	0	0	0	0	0	5-15	0-5	0-5	0.0	0.0	0.0	0.0	0.0	12.5	2.5	2.5	2.2
phlox	0	0	0	0	0	0	5-15	0-5	0.0	0.0	0.0	0.0	0.0	0.0	12.5	2.5	1.9
butterfly bush	5-15	5-15	5-15	5-15	0	0	0	0	12.5	12.5	12.5	12.5	0.0	0.0	0.0	0.0	6.3
grasses	15-25	15-25	5-15	0-5	0-5	0-5	0-5	0-5	20.5	20.5	12.5	2.5	2.5	2.5	2.5	2.5	8.3
lady's thumb	0-5	0-5	0-5	0-5	0	0	0	0	2.5	2.5	2.5	2.5	0.0	0.0	0.0	0.0	1.3
Total vegetative cover									73.0	80.5	65.0	55.0	20.0	37.5	50.5	25.0	50.8
Other																	
Bare substrate	5-15	5-15	5-15	5-15	75-95	75-95	50-75	75-95	12.5	12.5	12.5	12.5	85.0	85.0	65.0	85.0	46.3

Table 2 (cont.)

Quantitative Vegetation Monitoring Results

Transect:	Upper Salt Marsh Transect																					
Quadrat #	U-1	U-2	U-3	U-4	U-5	U-6	U-7	U-8	U-9	U-10		U-1	U-2	U-3	U-4	U-5	U-6	U-7	U-8	U-9	U-10	Avg Cover
	Daubenmire Cover Class											Daubenmire Midpoints										%
Native Species																						
hairgrass	0	0	5-15	5-15	0	5-15	0	0	5-15	0		0.0	0.0	12.5	12.5	0.0	12.5	0.0	0.0	12.5	0.0	5.0
dune grass	0	0	0	0	0	0	0	0	0	0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
saltgrass	0	5-15	5-15	0	0	0	0	0-5	0	5-15		0.0	12.5	12.5	0.0	0.0	0.0	0.0	2.5	0.0	12.5	4.0
Total Native vegetative cover												0.0	12.5	25.0	12.5	0.0	12.5	0.0	2.5	12.5	12.5	9.0
Invasive species																						
clover	75-95	15-25	50-75	25-50	5-15	15-25	0	0	0	0		85.0	20.5	65.0	35.0	12.5	20.5	0.0	0.0	0.0	0.0	23.9
St John's wort	0-5	0	0	0	0	0	0	0	0	0		2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
english plantain	0	0	5-15	0	0	0-5	0	0	0	0		0.0	0.0	12.5	0.0	0.0	2.5	0.0	0.0	0.0	0.0	1.5
pineapple weed	0	0	0	0	5-15	0	0	0	0	0		0.0	0.0	0.0	0.0	12.5	0.0	0.0	0.0	0.0	0.0	1.3
lady's thumb	0	0	0	0	0	0	0	0-5	0	5-15		0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	12.5	1.5
Total Vegetative cover												87.5	33.0	102.5	47.5	25.0	35.5	0.0	5.0	12.5	25.0	37.4
Other																						
Bare substrate	5-15	75-95	25-50	50-75	75-95	75-95	95-100	75-95	75-95	50-75		12.5	85.0	35.0	65.0	85.0	85.0	97.5	85.0	85.0	65.0	70.0

Table 2 (cont.) Quantitative Vegetation Monitoring Results

Transect:	Lower Salt Marsh Transect																					
Quadrat #	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	Avg Cover
	Daubenmire Cover Class											Daubenmire Midpoints										%
Native Species																						
fleshy jaumea	0	0	0	0	0	0	0	0	0	0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pickleweed	5-15	5-15	15-25	0	0	5-15	0	0-5	5-15	5-15		12.5	12.5	20.5	0.0	0.0	12.5	0.0	2.5	12.5	12.5	8.6
Total Native vegetative cover												12.5	12.5	20.5	0.0	0.0	12.5	0.0	2.5	12.5	12.5	8.6
Invasive species																						
Brass buttons	5-15	0	0	0	0	0	0	0	0	0		12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
Total Vegetative cover												25.0	12.5	20.5	0.0	0.0	12.5	0.0	2.5	12.5	12.5	9.8
Other																						
Bare substrate	75-95	75-95	75-95	95-100	95-100	75-95	95-100	75-95	75-95	75-95		85.0	85.0	85.0	97.5	97.5	85.0	97.5	85.0	85.0	85.0	88.8

Table 3 Sediment Stake Readings

	Installation	Yr 1 Qtr 1	Yr 1 Qtr 2	Yr 1 Qtr 3	Yr 1 Qtr 4	
Sediment Stake ID	10/30/2000	12/21/2000	3/29/2001	6/26/2001	8/15/2001	Net Change
705	60	61	60.5	60	61	1
706	50	50	50	50	51	1
712	50	50	49	50	51	1
713	61	61	61	61	61	0
715	51	51	51.5	52	52	1
716	51	51	51	52	52	1
719	50	50	50	51	51	1
720	50	49	50	49	48	-2

Readings are in centimeters from the top of the stake to the sediment surface.
Positive net change means the sediment surface is getting further from the top of the stake: erosion.
Negative net change means the sediment surface is getting closer to the top of the stake: accretion.

Table 4

Irrigation Plan

Zone	Minutes of sprinkle	Start time	End time	Frequency
1	20	7:47 PM	8:07 PM	1x/48 hr
2	20	9:49 PM	10:09 PM	1x/48 hr
3	20	11:50 PM	12:10 AM	1x/48 hr
4	60	5:55 PM	6:55 PM	1x/24 hr
5	20	1:52 AM	2:12 AM	1x/48 hr
6	60	3:57 PM	4:57 PM	1x/24 hr

Appendix A:

Photo Point Pictures

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: R1

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: R1

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: R1

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: R1

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: R2

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: R2

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: R2

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: R2

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: R3

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: R3

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: R3

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: R3

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: R4

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: R4

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: R4

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: R4

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: UM1

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: UM1

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: UM1

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: UM1

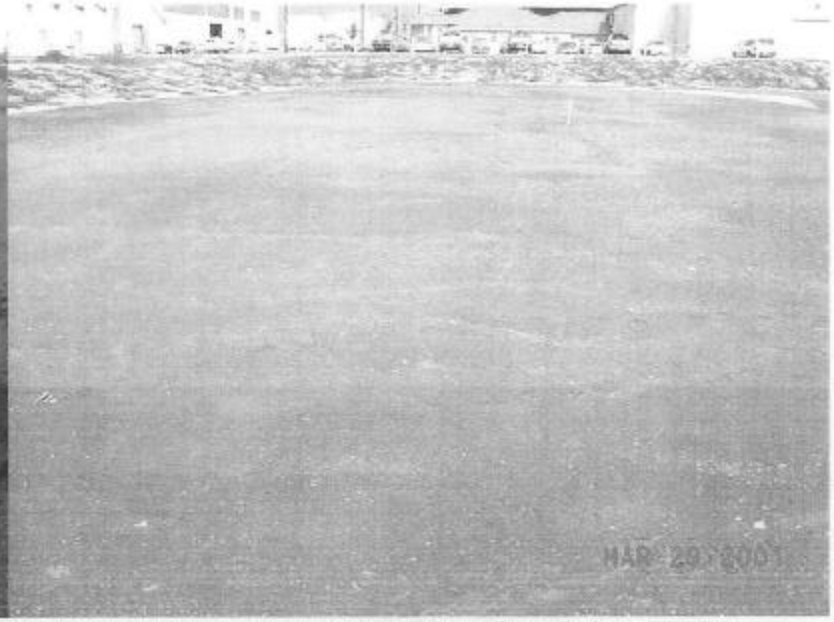
Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: UM2

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: UM2

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: UM2

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: UM2

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: UM3A



Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: UM3A

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: UM3A

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: UM3A

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: UM3B

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: UM3B

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: UM3B

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: UM3B

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: UM4

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: UM4

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: UM4

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: UM4

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: UM5

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: UM5

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: UM5

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: UM5

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: LM1A

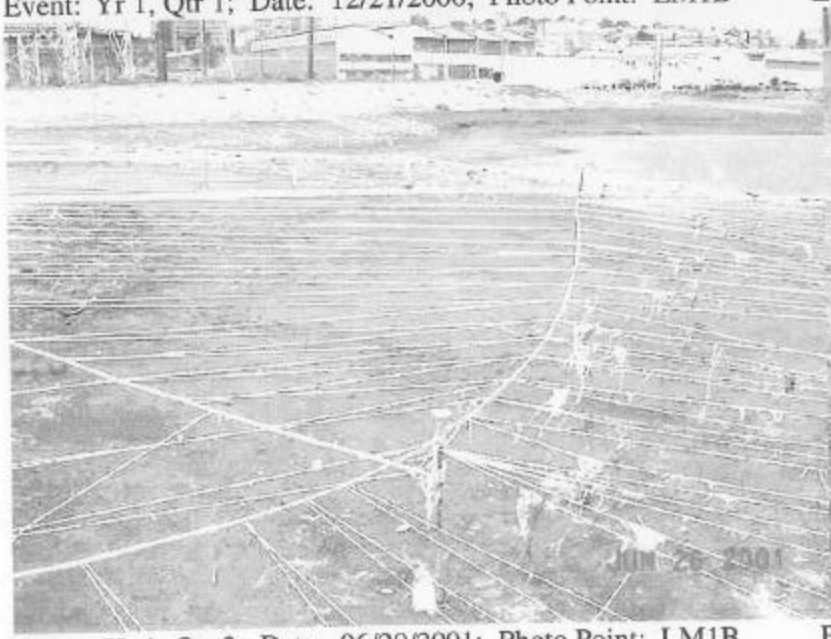
Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: LM1A

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: LM1A

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: LM1A

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: LM1B

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: LM1B



Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: LM1B

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: LM1B

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: LM2A

Event:Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: LM2A

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: LM2A

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: LM2A

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: LM2B

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: LM2B

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: LM2B

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: LM2B

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: LM3A

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: LM3A

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: LM3A

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: LM3A

Event: Yr 1, Qtr 1; Date: 12/21/2000; Photo Point: LM3B

Event: Yr 1, Qtr 2; Date: 03/29/2001; Photo Point: LM3B

Event: Yr 1, Qtr 3; Date: 06/20/2001; Photo Point: LM3B

Event: Yr 1, Qtr 4; Date: 08/15/2001; Photo Point: LM3B