

Habitat Monitoring Report: Year 2

City of Tacoma Middle Waterway Restoration Project



Photo Point LM1B (looking west to F Street)

August 2004

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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 Trustees¹ (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 a monitoring event each quarter since completion of construction:

- Year 0 - December 21, 2000; March 29, 2001; June 26, 2001; August 15, 2001;
- Year 1 - December 11, 2001; March 21, 2002; June 14, 2002; August 20, 2002;
- Year 2 - January 21, 2003, April 4, 2003; June 12, 2003, and September 9, 2003.

The methods and frequency of these monitoring events were detailed in the "Monitoring and Adaptive Management Plan" (MAMP) (Hart Crowser, February 25, 2000) prepared for this site. Quarterly monitoring events are required for the first two years. The remaining three years of required monitoring include annual monitoring events performed in late summer of each year. The next monitoring event will occur in August 2004. The final report will be submitted after the Year 5 monitoring event (2006).

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; The Puyallup Tribe of Indians and Muckleshoot Indian Tribe.

1.1 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 during project excavation. 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 of the soil is imported riparian topsoil.

2.0 Qualitative Monitoring & Results

Qualitative monitoring results are based upon observations of trained personnel during site visits and recorded by hand and digital photos. Qualitative observations were taken of vegetation, sedimentation, wildlife, and other general observations. For the City of Tacoma, these personnel are Desiree Pooley, Project Manager, John O’Loughlin, P.E., Stephanie Seivert, Lab Analyst, Lindsay Guzzo, Foss Project Intern, and Jeff Swinney, GIS crew member. The City has retained David Adams as a site steward, and his observations are also included.

2.1 Photo Points

Photo points were established as described in the MAMP and depicted in Figure 1. The location of each point was marked by a stake and surveyed. A digital photo was taken from each photo point during each monitoring event. Year 2 photos are presented in Appendix A by photo point location.

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. In general, riparian slopes and flats have complete ground coverage.

It was previously noted that few volunteer plants were establishing in the salt marsh areas. However, after the review of Year 2 photos and field notes it is apparent that the salt marsh is beginning to fill in with native vegetation volunteers even outside of the goose exclusion areas. In early 2003, site steward, David Adams, enclosed a transitional area between the upper and lower salt marsh areas with goose exclusion that had previously been “unprotected”. This action encouraged volunteer plant growth and the spread of native planted vegetation more than other comparable “unprotected” areas. However, volunteer plants are establishing at acceptable rates in both protected and unprotected areas of the salt marsh.

2.2 Vegetation

Several general trends have been observed over the course of Year 2 monitoring events:

- Nootka rose and Hooker’s willow continue to thrive.
- Red alder have survived the caterpillar infestation with minimal loss.
- Pickleweed is growing very well in the lower salt marsh and numerous volunteers are seen on the slopes outside of the goose exclusion zones.
- Salt grass in the upper salt marsh is spreading well via rhizomes and continues to venture out beyond the confines of the goose exclusion zones with success.
- Volunteer vegetation is noted in all areas of the project site.
- Evidence of geese, rabbits, and opossums has been seen within the goose exclusion areas, but no real “damage” has been observed.
- Invasives continue to be controlled via manual removal in both riparian and salt marsh areas.
- Of the invasive vegetation present prior to construction, Himalayan blackberry, Scot’s broom and knapweed have not re-established to any significant extent.
- Noticeable vegetative growth is now observed in plants that were previously establishing their post-planting root mass.

2.3 Sediment

Certain areas of the restoration site have experienced limited sediment loss since construction was completed. Readings taken in 2003, suggest that overall the project trend is accretion of sediment. This could be attributed to the increase in vegetative cover. The erosion seen at photo point LM2B has appeared to equalize as the slope is slowly becoming vegetated (see Appendix

A for photo). Other areas of isolated erosion in the salt marsh appear to be associated with overland flows of either precipitation or irrigation.

2.4 Wildlife

Many animals have visited the site during Year 2. Direct observations and/or evidence of the following animals have been documented:

- Salmon fry
- Spotted sandpiper
- Crow
- House finch
- Brewer's blackbird
- Seagulls
- Great Blue Heron
- Canada geese
- Song sparrow
- King fisher
- Rabbit
- White-crowned sparrow
- Robin
- Killdeer
- Violet-green swallow
- Opossum or other digging animal

2.5 General Observations

In August 2003, Tacoma Public Utilities (TPU) performed a small cleanup that involved excavation of the top foot of material approximately 6 feet onto the site (See Appendix B for photos). Confirmation samples were taken post-excavation by TPU to ensure the completeness of the cleanup.

Trash accumulates in areas of the site along East "F" Street as well as along 11th Street. The trash along East "F" Street appears to have been dumped while the trash along 11th Street seems to accumulate arbitrarily.

Washington State Department of Natural Resources (DNR) is moving ahead with the cleanup of sediments at the head of the Middle Waterway, directly adjacent to our site. Coordination with DNR is imperative to ensure protection of our site, plantings, and irrigation system.

Liquid asphalt containers are now being stored in the gravel lot to the northwest of the site. A City of Tacoma source control representative contacted persons on-site to educate them about the nature and purpose of our restoration site. Source control representatives continue to monitor site activities.

The Middle Waterway Restoration site continues to be monitored as one of six sites for the Commencement Bay Restoration Fish Monitoring effort led by the Northwest Fisheries Science Center. The site is also regularly monitored through Citizens for a Healthy Bay's Adopt-A-Wildlife-Area program.

3.0 Quantitative Monitoring Methods

Quantitative monitoring involves collection and analysis of numerical data concerning habitat features such as vegetation, sedimentation, and sampling of groundwater seeps if present. Quantitative monitoring data was collected by City of Tacoma employees: Desiree Pooley with assistance from Jeff Swinney.

3.1 Vegetation

Quantitative vegetation monitoring for Year 2 was conducted on September 9, 2003. Transects and quadrats established during Year 0 (illustrated in Figure 1) were again monitored.

Twenty-eight sample plots (quadrats) were established at random along the transects. The riparian area contained 8 quadrats (R1 1-4 & R2 1-4) and ten each were established in the upper (U 1-10) and lower (L 1-10) salt marsh areas. Quadrats L-4, L-5, and L-6 along the lower salt marsh transect and quadrats U-5 and U-7 along the upper salt marsh transect were outside the planted areas. The locations of each quadrat were surveyed in and the location information is supplied in Table 1.

Table 1. Quadrat Location Control Readings

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

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 Plants of the Pacific Northwest Coast (Pojar & MacKinnon, 1994). The total native vegetative cover is calculated for each transect.

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 and initial readings recorded. Because these stakes were installed shortly after the end of construction it is appropriate to address this reading as Year 3. Each stake was marked in centimeters starting at the top of the stake, however, over time the marks have worn off. During Year 3 monitoring all stakes were read with a tape measure in centimeters from the bottom up.

3.3 Groundwater 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 MAMP established performance goals for the quantitative measures presented in the previous section. These goals were established for 12 months of growth and development. As of September 2003, when the quantitative data was collected, the riparian plants had been in place for 34 months and the salt marsh plants had been in place for only 28 months. Therefore, the observations will be compared with Year 2 performance goals.

4.1 Vegetation

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

4.1.1 Plant Cover

Total areal cover within each quadrat and mean percent cover are 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 second year's goals should be modest.

The Year 2 performance goals for the riparian area are:

- 1) Between 40 and 50% areal coverage of native or naturalized non-native plants within each quadrat and
- 2) Greater than 40% average areal coverage for all quadrats.

Table 2 shows that all riparian quadrats meet the first goal. The range of areal coverage is 110% - 220%, far exceeding the goal range of 40 – 50%. The second performance goal has also been achieved. 151% is the average areal coverage of all riparian quadrats. This number is somewhat skewed by the abundance of grasses, although, even the total native vegetative cover average (63%) exceeds the second goal.

The success of the riparian areas could be attributed to:

- Frequent maintenance and vigilance by David Adams and the City's Washington Conservation Corps crew.
- Regular plant irrigation during the dry months

Generally riparian plant growth has been very good. No adaptive management action is warranted due to these results.

The Year 2 performance goals for the salt marsh areas are:

- 1) Between 40 and 50% areal coverage of native or naturalized non-native plants, and
- 2) Greater than 50% average areal coverage for all quadrats.

Table 2 shows that nine of the twenty quadrats (45%) in both salt marsh areas meet the first goal with a range of 43% - 87.5%. Six of the nine quadrats meeting this goal are located in the lower salt marsh area. This is the opposite of last year's results and reflects the removal of invasives in the upper salt marsh and the large growth of pickleweed in the lower salt marsh. Eleven quadrats: L-4, L-5, L-6, L-7, U-1, U-2, U-4, U-5, U-6, U-7, and U-9 do not meet the goal. Of these, five quadrats (U-5, U-7, L-4, L-5, L-6) are located outside of the planted areas. However, quadrats U-1, U-6 and U-9 came very close to meeting the 40% goal. The combined overall average areal coverage in the salt marsh areas is just over 40% and that again does not meet the second performance goal.

Potential factors that have affected the progress thus far:

- The vegetation, overall, was in a less developed state when it was planted than had been anticipated when the goal was set.
- The salt marsh areas were planted in defined areas to facilitate goose exclusion device 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.
- The lack of parent material to facilitate volunteer vegetation.
- None of the fleshy jaumea plants survived the first year.

Despite only meeting 45% of performance goal one, with the deficit appearing mostly in the upper salt marsh area, the salt grass that is present is spreading very well where as the tufted hairgrass has not experienced the same reproductive success. The pickleweed in the lower salt marsh area is beginning to form mats as it does in undisturbed areas.

An adaptive management action based on these results could include planting more upper salt marsh plants. However, additional planting is anticipated after completion of the Middle Waterway Area C superfund cleanup led by DNR (Summer 2004). Therefore no adaptive management is advisable at this time until the superfund process is sorted out.

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 between 8 and 10 species of native or naturalized non-native plants present and abundant. Abundant is defined as being present in at least 50-60% of the quadrats. Applying this definition to

the data in Table 2 shows that the following eight riparian plants are abundant on the restoration site: red alder, shore pine, madrone, hazelnut, willowherb, nootka rose, common horsetail and pearly everlasting. Thus, the target diversity value has been achieved.

The salt marsh zone diversity target is between 4 and 5 species of native or naturalized non-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, other grasses, 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, Scot's broom (0.6%) and Himalayan blackberry (2.5%). Therefore, this invasive species performance goal has been met for Year 2.

However, there is a need to remove other invasive species present on-site. Butterfly bush should be removed to prevent it from crowding out the native plants. Tansy ragwort, Canada thistle, Himalayan blackberry, St. John's wort, Scot's broom and any other noxious weeds should be removed and disposed of properly to prevent the spread on-site and off-site.

The salt marsh area performance goal for invasive species is not more than 15% areal cover of invasive plants considered noxious (i.e. *spartina alterniflora*). Referring to Table 2, the upper and lower salt marsh zones have two noxious weeds present, common dandelion and pineapple weed (as determined by reference to Pierce County and Washington State noxious weed lists). Areal coverage of all noxious weeds present are under 15%. Therefore this invasive species performance goal has been met.

The adaptive management recommendation under this measurement index is the continued removal or other means of control (where removal is not beneficial to existing native plants) of invasive species from both the salt marsh and riparian zones: Canada thistle, St. John's wort, Tansy ragwort, Himalayan blackberry, Scot's broom, 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 sediment on-site is expected during the first couple of years. The performance goal for sediment erosion is to have less than 1 cm of erosion per year, on average, between Year 2 and Year 5 monitoring events. As construction was completed in August 2000 and stakes were placed in October 2000, the 2003 (Year 3) readings have no performance measure. Table 3 presents Year 3 sediment stake readings, the net change over the year, and the opportunity to compare these readings with the installation value for informational purposes only.

Table 3. Sediment Stake Readings for Year 3

Sediment Stake ID	Installation	Yr 3 Qtr 1	Yr 3 Qtr 2	Yr 3 Qtr 3	Yr 3 Qtr 4	Year 3 Net Change
705	60	not read	60.3	60	59.2	-0.8
706	50	not read	51.4	50.5	51.3	1.3
712	50	not read	50.1	50.2	50	0
713	61	not read	59.6	60	59.9	-1.1
715	51	not read	50.8	50.5	50.8	-0.2
716	51	not read	50.8	50.8	50.9	-0.1
719	50	not read	48.2	47.7	47.5	-2.5
720	50	not read	48.2	47.7	47.5	-2.5

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.

The site will continue to be monitored for sedimentation and erosion during Years 4 and 5 to ensure none of the capped areas experience a loss of sediment, which could 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

The installed irrigation system continues to operate during the dry months. Some adjustments in the irrigation schedule have been necessary to optimize performance. The amount of water each zone is receiving is evaluated and the sprinkling time is adjusted on an on-going basis. Measures have been taken to encourage the plant roots to locate deeper under the soil surface by watering less frequently for longer periods of time.

The Washington Conservation Corps (WCC) crew, co-sponsored by the City, performed routine maintenance and invasive species removal for four days during 2003.

The City continues to contract with David Adams as the site steward. David frequently visits the site and maintains the goose exclusion devices (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.

Concurrent with plantings in the salt marsh areas, GEDs were constructed around the upper and lower salt marsh areas. In two areas of the lower salt marsh, the chicken wire installed was extended vertically to discourage geese from browsing at high tide. As mentioned earlier, a transitional area between the upper and lower salt marsh areas was connected with GED materials. This allowed the vegetation to grow without predation.

5.2 Recommended Adaptive Management Activities

The overall health and vigor of the vegetation at this restoration site is very good. While some areal coverage performance goals were not met in the salt marsh area, it does not appear to be because of a lack of health of the plantings.

As discussed above, there are several non-native plant species that could crowd out the desirable species if they are not controlled. Therefore we intend to continue our maintenance efforts targeting: Canada thistle, St. John's wort, Himalayan blackberry, Scot's broom, Tansy ragwort, and butterfly bush.

It is also recommended that the following activities continue:

- Monitor moisture in site soils during operation of irrigation system
- Monitor sedimentation and erosion
- Maintain GED
- Continue quantitative and qualitative monitoring efforts
- Continue to remove trash as needed

Table 2
Quantitative Vegetation Monitoring Results

Transect: Quadrat #	Riparian 1 (11th Street ROW)			Riparian 2 (North of Substation)			Riparian 1 (11th Street ROW)			Riparian 2 (North of Substation)			Year 2 Avg Cover %	Year 2 Frequency						
	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		
Native Trees																				
<i>Scientific name</i>																				
Acer Macrophyllum	0-5	0	0	0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	25%	
Red alder	0	0-5	0	0	75-95	25-50	5-15	5-15	0	0	0	0	85.0	35.0	12.5	12.5	12.5	18.4	63%	
Pacific madrone	0	0-5	0-5	0	0	0-5	0-5	0	0	0	0	0	0	0	0	0	0	1.6	63%	
Shore pine	0	5-15	0	0-5	0	0-5	0	0	0	0	0	0	2.5	2.5	0.0	2.5	2.5	2.8	63%	
Black Cottonwood	0	0	0	0	0	0-5	0	0	0	0	0	0	0	0	0	0	0	0.6	25%	
Ash	0	0	0	0	0-5	0	0-5	0	0	0	0	0	0	0	0	0	0	0.9	38%	
Birch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	13%	
Oak	0	0	0	0	0	0-5	0	0	0	0	0	0	0	0	0	0	0	0.3	13%	
<i>Scientific name</i>																				
Native Shrubs																				
Corylus cornuta var. californica	0-5	0	0	0-5	0-5	0-5	0-5	0	0	0	0	0	2.5	2.5	2.5	2.5	0.0	1.6	63%	
Holodiscus discolor	0	0	0	0	0-5	0-5	0	0-5	0	0	0	0	0	0	0	0	0	0.9	38%	
Rosa nutkana	0-5	0-5	0-5	5-15	0-5	0-5	0-5	0	0	0	0	0	2.5	2.5	2.5	2.5	0.0	3.4	88%	
Nootka rose	0-5	0	0	0	0	0-5	0	0	0	0	0	0	0	0	0	0	0	0.6	25%	
Thimbleberry	0	5-15	0	0	15-25	0	75-95	0	0	0	0	0	20.5	0.0	85.0	0.0	14.8	38%		
Hooker's willow	0	0	0	0	0	5-15	0	15-25	0	0	0	0	0	0	0	0	20.5	4.1	25%	
Scouler's willow	0	0	0	0	0-5	0	0	5-15	0	0	0	0	0	0	0	0	12.5	1.9	25%	
Pacific willow	0	0	0	0	0-5	0	0	0	0	0	0	0	0	0	0	0	12.5	1.9	25%	
Other Native Flora																				
Willowherb	0	0	0	0-5	0-5	0	0	0-5	0	0	0	0	2.5	2.5	0.0	2.5	0.0	1.3	50%	
Common horsetail	0-5	0-5	0-5	0	0-5	25-50	0-5	0	0	0	0	0	2.5	0.0	2.5	0.0	5.9	75%		
Pearly everlasting	0-5	0	0	0-5	0-5	0-5	0-5	0-5	0	0	0	0	2.5	2.5	2.5	2.5	2.5	1.9	75%	
Coastal strawberry	0	0	0	0	0-5	0	0-5	0	0	0	0	0	0	0	0	0	0	0.6	25%	
Total Native Vegetative Cover	17.5	35.0	7.5	25.0	130.5	110.0	60.5	62.6								62.6				
Non-native Species																				
<i>Scientific name</i>																				
Rubus discolor	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0	0	0	0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	100%
Himalayan blackberry	0	0	0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	25%	
Scot's broom	0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9	38%	
Cytisus scoparius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.8	63%	
Cirsium arvense	0	0	0-5	0	5-15	0-5	0-5	0-5	0	0	0	0	12.5	2.5	2.5	2.5	2.5	2.8	63%	
Hypericum perforatum	0-5	5-15	5-15	5-15	0-5	0-5	0-5	0-5	0	0	0	0	20.5	0.0	85.0	0.0	14.8	38%		
Butterfly bush	75-95	75-95	75-95	50-75	25-50	15-25	15-25	5-15	0	0	0	0	35.0	20.5	20.5	20.5	12.5	51.1	100%	
Grass	0	0	0	0	0	0	0	0-5	0	0	0	0	0	0	0	0	0	0.6	25%	
Lupine	0-5	0-5	0-5	0-5	0-5	0-5	0	0-5	0	0	0	0	2.5	2.5	2.5	2.5	2.5	2.2	88%	
English plantain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	13%	
Small Hop-clover	0	0	0	0	0	0	0	0	0	0	0	0	12.5	35.0	2.5	12.5	7.8	50%		
White Clover	0	0	0	0	5-15	25-50	0-5	5-15	0	0	0	0	2.5	12.5	0.0	0.0	1.9	25%		
Trifolium repens	0	0	0	0	0-5	5-15	0	0	0	0	0	0	0	0	0	0	0	0.3	13%	
Ranunculus repens	0	0	0	0	0	0-5	0	0	0	0	0	0	0	0	0	0	0	0.3	13%	
Convolvulus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	13%	
Rumex crispus	0	0-5	0-5	0	0	0	0	0-5	0	0	0	0	2.5	0.0	0.0	0.0	2.5	1.3	50%	
Tanacetum bipinnatum	0	0	0	0	0	0-5	0	0	0	0	0	0	0	0	0	0	0	0.3	13%	
Unknown ¹	0	0	0	0	0	0-5	0	0	0	0	0	0	0	0	0	0	0	0.3	13%	
Unknown ²	0	0	0	0	0	0-5	0	0	0	0	0	0	0	0	0	0	0	1.6	13%	
Unknown ³	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	13%	
Achillea millefolium	0	0	0-5	0	0	0	0	0	0	0	0	0	2.5	0.0	0.0	0.0	2.5	1.3	50%	
Yarrow	0-5	0	0	0	0-5	0-5	0	0-5	0	0	0	0	0	0	0	0	0	2.5	88%	
Rush	0-5	0-5	0	0	0-5	0-5	0-5	0-5	0	0	0	0	2.5	2.5	2.5	2.5	2.5	2.2	88%	
Common dandelion	0-5	0-5	0	0-5	0-5	0-5	0-5	0-5	0	0	0	0	2.5	2.5	2.5	2.5	2.5	2.2	88%	

**Table 2 Continued
Quantitative Vegetation Monitoring Results**

Transect: Quadrat #	Riparian 1 (11th Street ROW)			Riparian 2 (North of Substation)			Riparian 1 (11th Street ROW)			Riparian 2 (North of Substation)			Year 2 Avg. Cover %	Year 2 Frequency					
	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	
	Daubenmire Cover Class																		
Gnaphalium microcephalum	0	0	0	0	5-15	0	5-15	0	0.0	0.0	0.0	0.0	12.5	2.5	0.0	12.5	3.4	38%	
Total Vegetative Cover									117.5	142.5	120.0	110.0	220.5	205.5	163.0	128.0	150.9		
Other									0.0	0.0	0.0	0.0	35.0	20.5	2.5	35.0	13.2	63%	
Bare substrate																			
* Storage box for NWFSC sampling equipment located in this quadrat (approximate size 4.5' x 2.25')																			
¹ Similar looking to madrone																			
² Bush with red stem																			
³ Similar looking to phlox																			
Bold - Indicates plants that were planted as per the planting plan on November 4, 2000																			
<u>Underline</u> - Indicates plants that are on the Pierce County or Washington State Noxious weed list																			

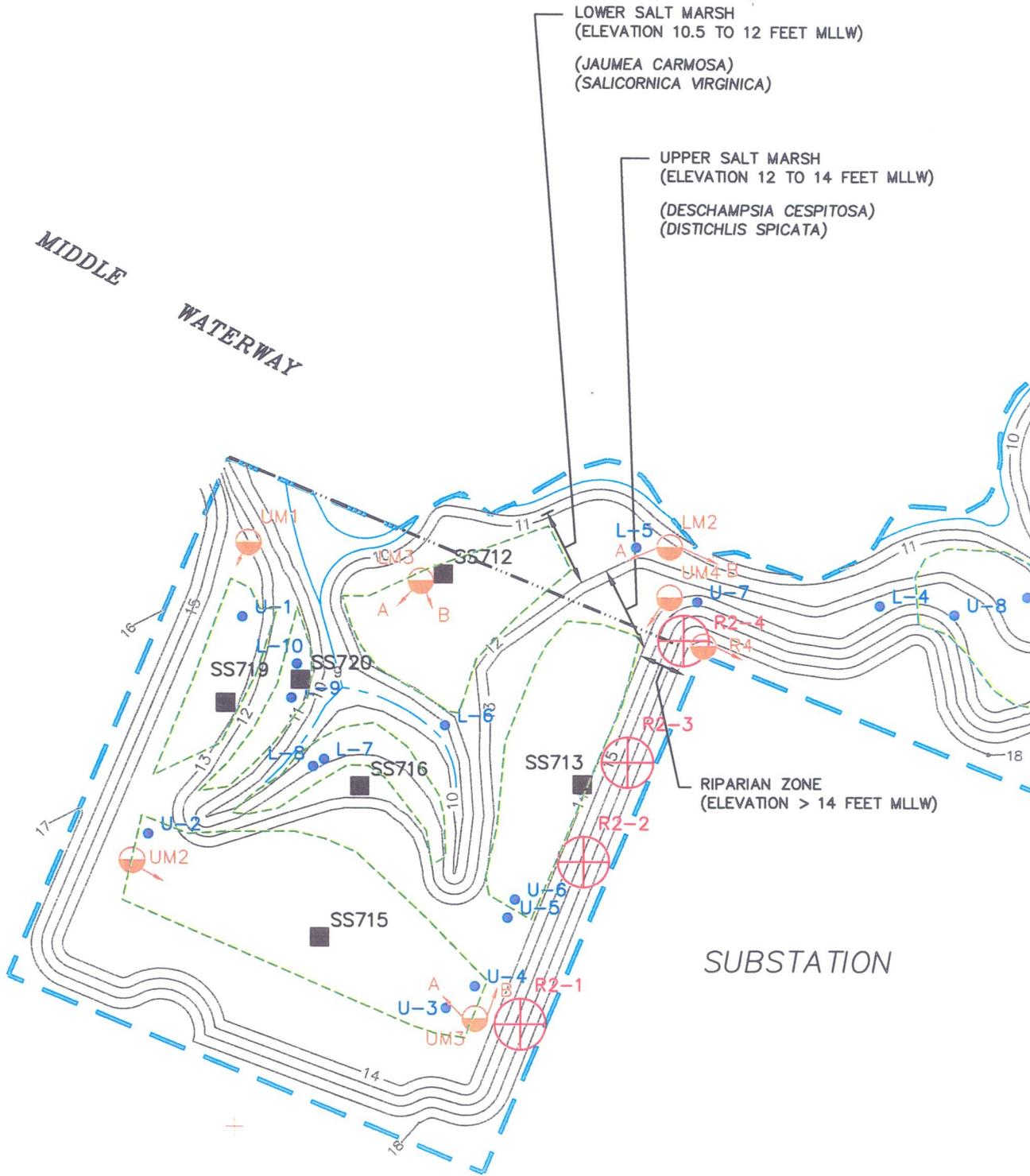
Table 2 Continued
Quantitative Vegetation Monitoring Results

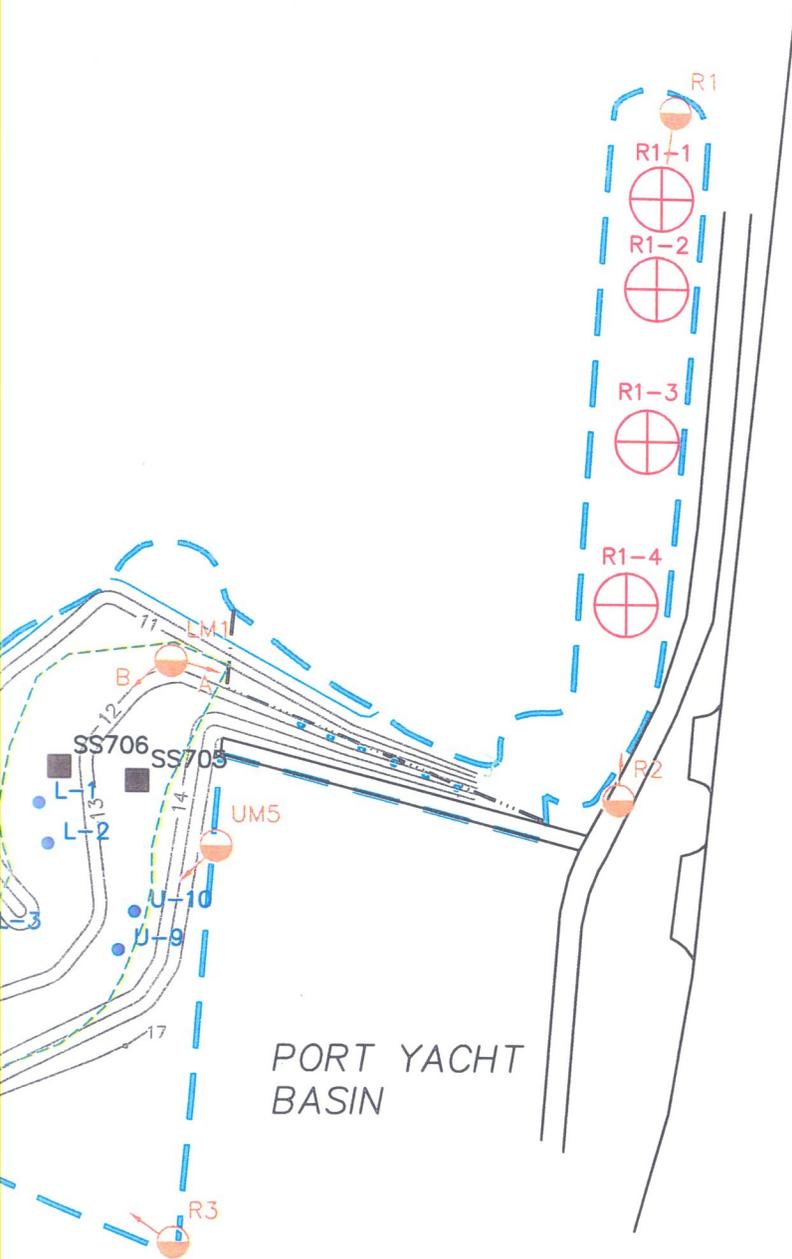
Transect	Upper Salt Marsh Transect					Daubenmire Cover Class					Year 2 Avg Cover %	Year 2 Frequency	
	U-1	U-2	U-3	U-4	U-5	U-6	U-7	U-8	U-9	U-10			
Quadrat #													
<i>Scientific name</i>													
<i>Common name</i>													
<i>Deschampsia cespitosa</i> ssp. beringensis	0	0	0-5	0	0	0	0	0	0	0	0	0	0
<i>Distichlis spicata</i> var. <i>spicata</i>	0	0-5	0-5	0	0	0	0	0	0	0	0	0	0
Total Native Vegetative Cover													
<i>Scientific name</i>													
<i>Common name</i>													
<i>Atriplex patula</i>	25-50	0	0	0	0-5	0	0	0	0	0	0	0	0
<i>Melilotus alba</i>	0	0	0	0-5	0	0	0	0	0	0	0	0	0
<i>Trifolium repens</i>	0	0	0	15-25	0	0	0	0	0	0	0	0	0
<i>Plantago lanceolata</i>	0	0	25-50	0	0	0	0	0	0	0	0	0	0
<i>Marricaria maritima</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Taraxacum officinale</i>	0	0-5	0	0	0	0	0	0	0	0	0	0	0
Total Vegetative Cover													
Other													
Bare substrate	25-50	75-95	25-50	15-25	75-95	50-75	95-100	0-5	5-15	25-50			
Bald - Indicates plants that were planted as per the planting plan on May 26, 2001													
Underline - Indicates plants that are on the Pierce County or Washington State Noxious weed list													
	35.0	17.5	42.5	25.5	5.0	35.0	0.0	87.5	38.0	65.0	35.1		
	35.0	85.0	35.0	20.5	85.0	65.0	97.5	2.5	12.5	35.0	47.3		100%

Table 2 Continued
Quantitative Vegetation Monitoring Results

Transsect:	Lower Salt Marsh Transsect										Year 2 Avg Cover %	Year 2 Frequency			
	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10					
Quadrat #															
	Daubenmire Cover Class														
Native Species															
<i>Scientific name</i>															
<i>Common name</i>															
<i>Jaumea carnosa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
<i>Fleshy jaumea</i>	50-75	50-75	50-75	0-5	15-25	0-5	50-75	75-95	75-95	75-95	75-95	75-95	75-95	75-95	90%
<i>Salicornia virginica</i>															
Total Native Vegetative Cover															
	65.0	65.0	65.0	2.5	65.0	2.5	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	45.6
Non-native Species															
<i>Scientific name</i>															
<i>Common name</i>															
<i>Atriplex patula</i>	0	0	0	0-5	0	0	0	0	0	0	0	0	0	0	0
<i>Orache</i>															
Total Vegetative Cover															
	65.0	65.0	65.0	5.0	65.0	2.5	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	45.8
Other															
Bare substrate	15-25	15-25	15-25	95-100	95-100	75-95	75-95	5-15	5-15	15-25	15-25	5-15	0-5	0-5	100%
Bold - Indicates plants that were planted as per the planting plan on May 26, 2001															

FIGURE 1





LEGEND

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



0 30 60
Scale In Feet

CITY OF TACOMA
DEPARTMENT OF PUBLIC WORKS

MIDDLE WATERWAY RESTORATION PROJECT

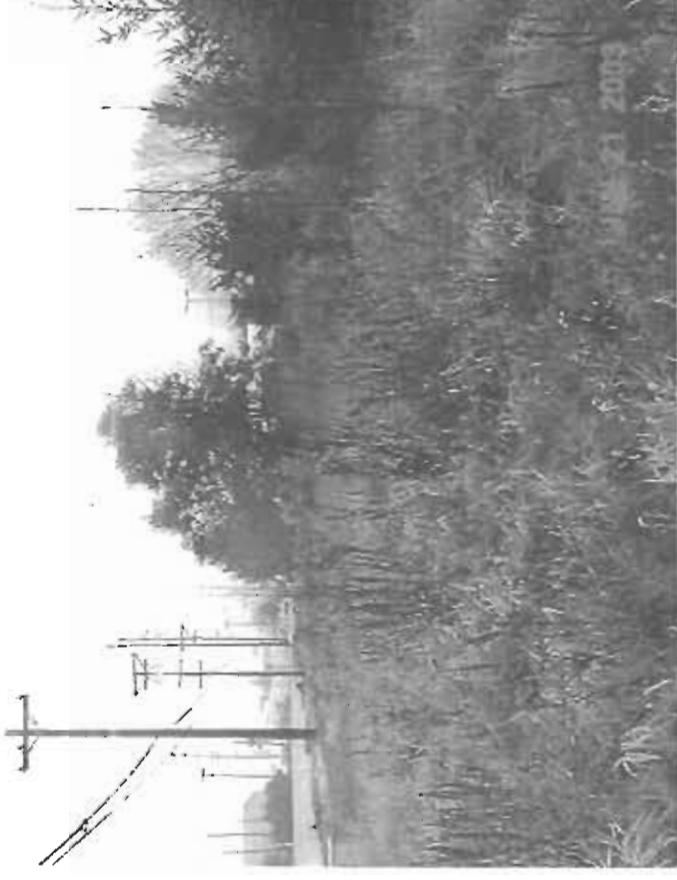
DATE	10-12-01	SCALE	1"=30'
DES	JOL	MANAGER ENGINEERING DIVISION	
DR	REG	CITY ENGINEER	
CK	JGP	DIRECTOR OF PUBLIC WORKS	SHEET 1 OF 1
			YEAR-0.DWG DWG. NAME



Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: R1



Event: Yr 2, Qtr 2; Date: 4/4/2003; Photo Point: R1



Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: R1



Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: R1



Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: R2

Event: Yr 2, Qtr 2; Date: 4/4/2003; Photo Point: R2



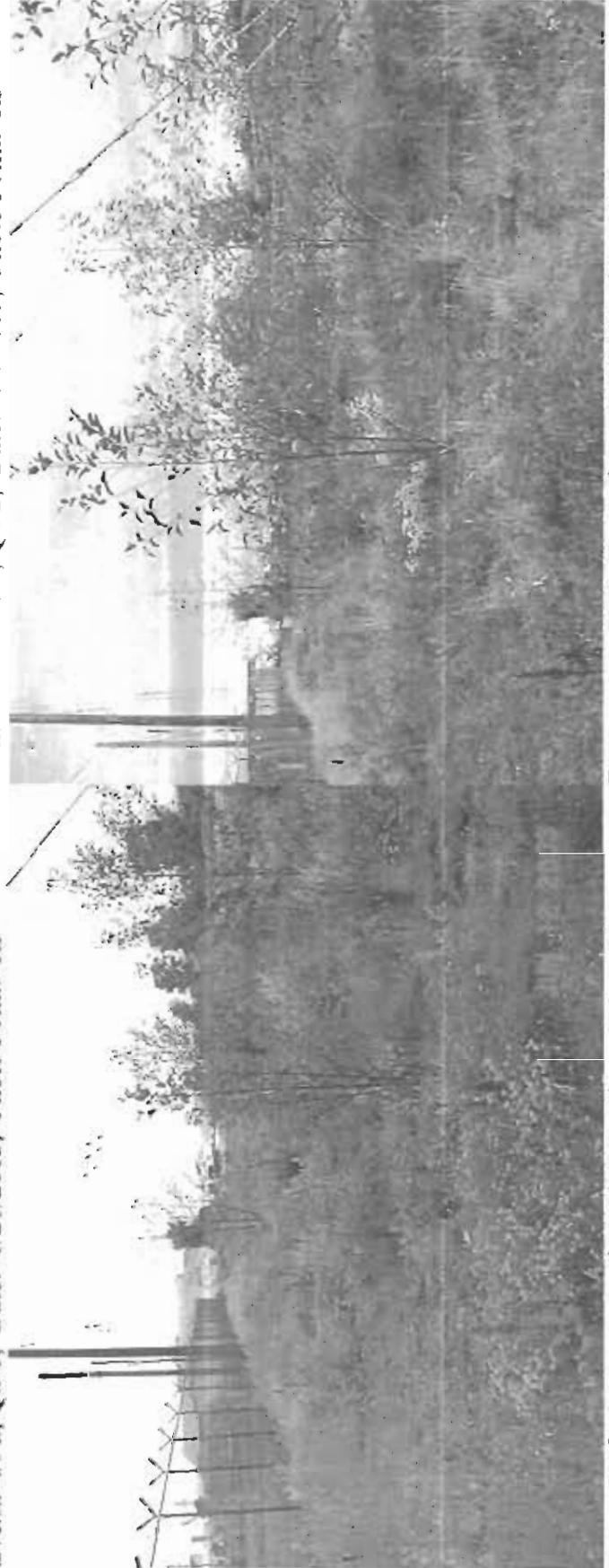
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Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: R2



Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: R3

Event: Yr 2, Qtr 2; Date: 4/4/2003; Photo Point: R3



Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: R3

Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: R3



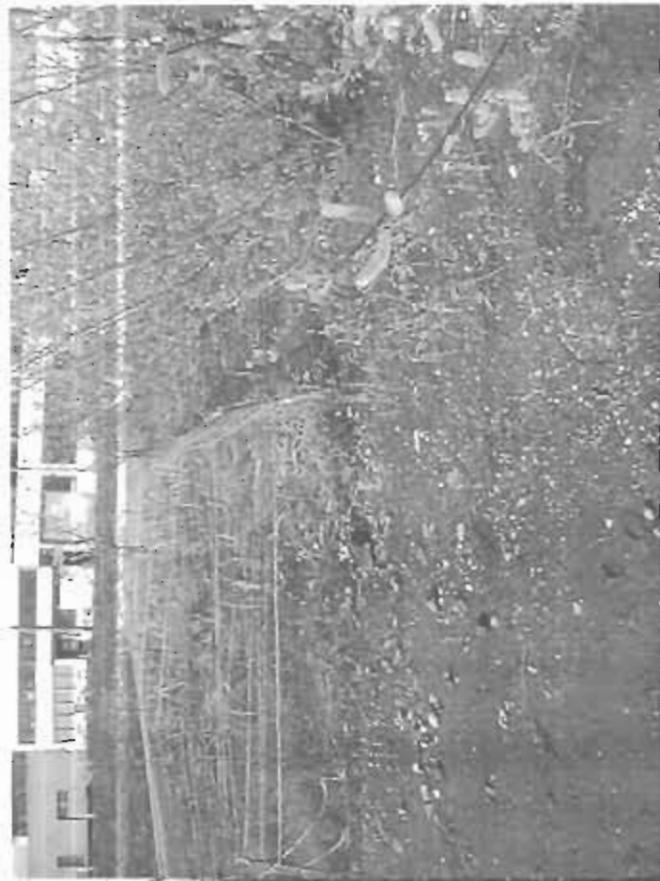
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Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: R4

Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: R4



Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: UMI

Event: Yr 2, Qtr 2; Date: 4/4/2003; Photo Point: UMI



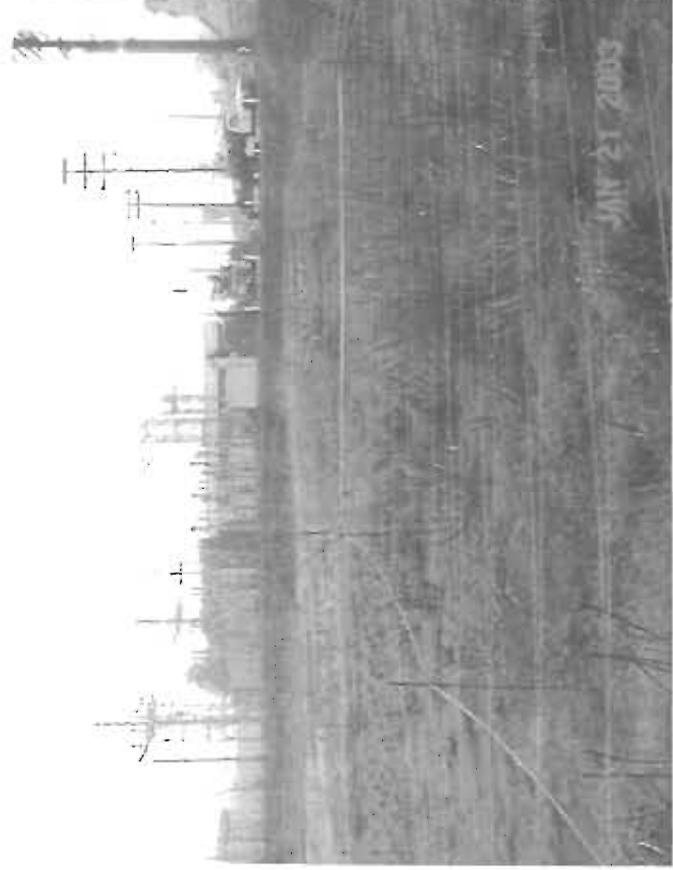
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Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: UMI



Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: UMI

Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: UMI



Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: UM2

Event: Yr 2, Qtr 2; Date: 4/4/2003; Photo Point: UM2



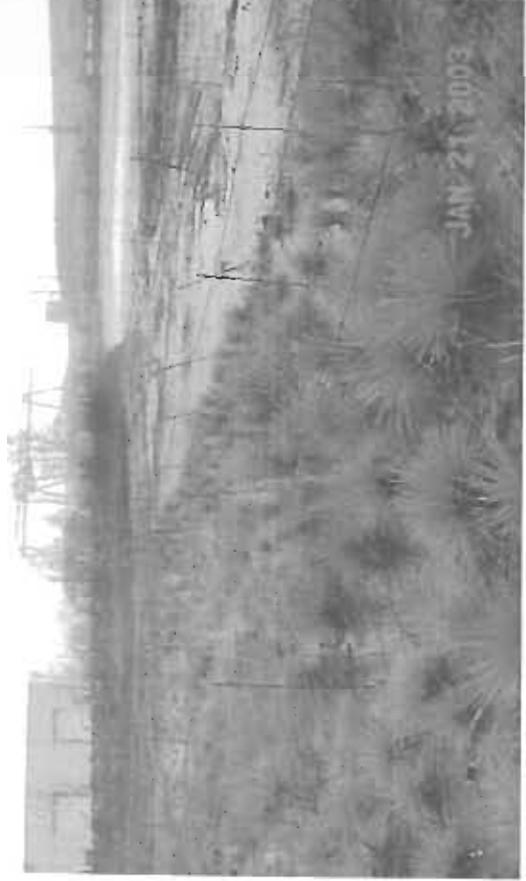
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Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: UM2



Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: UM3A

Event: Yr 2, Qtr 2; Date: 4/4/2003; Photo Point: UM3A



Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: UM3A

Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: UM3A



Event: Yr 2, Qtr 2; Date: 4/4/2003; Photo Point: UM3B



Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: UM3B



Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: UM3B



Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: UM3B



Event: Yr 2, Qtr 2; Date: 4/4/2003; Photo Point: UM4



Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: UM4



Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: UM4



Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: UM4



Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: UM5

Event: Yr 2, Qtr 2; Date: 4/4/2003; Photo Point: UM5



Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: UM5

Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: UM5



Event: Yr 2, Qtr 2; Date: 4/4/2003; Photo Point: LM1A



Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: LM1A



Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: LM1A



Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: LM1A



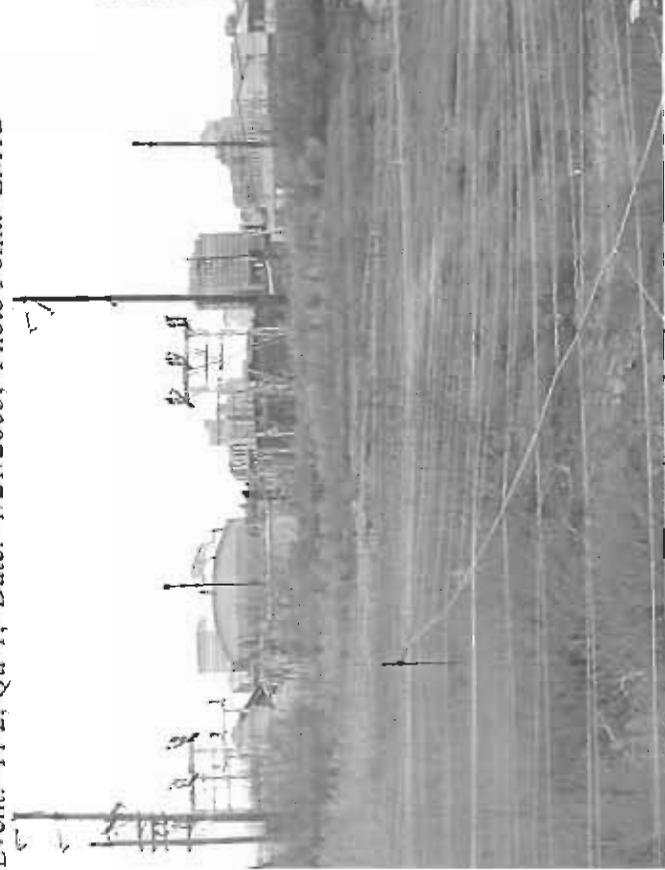
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Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: LM1B



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Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: LM1B



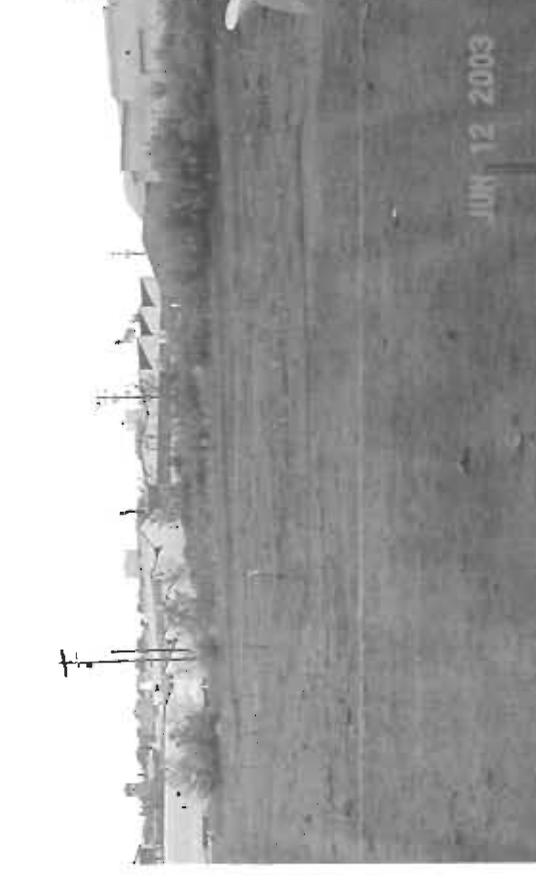
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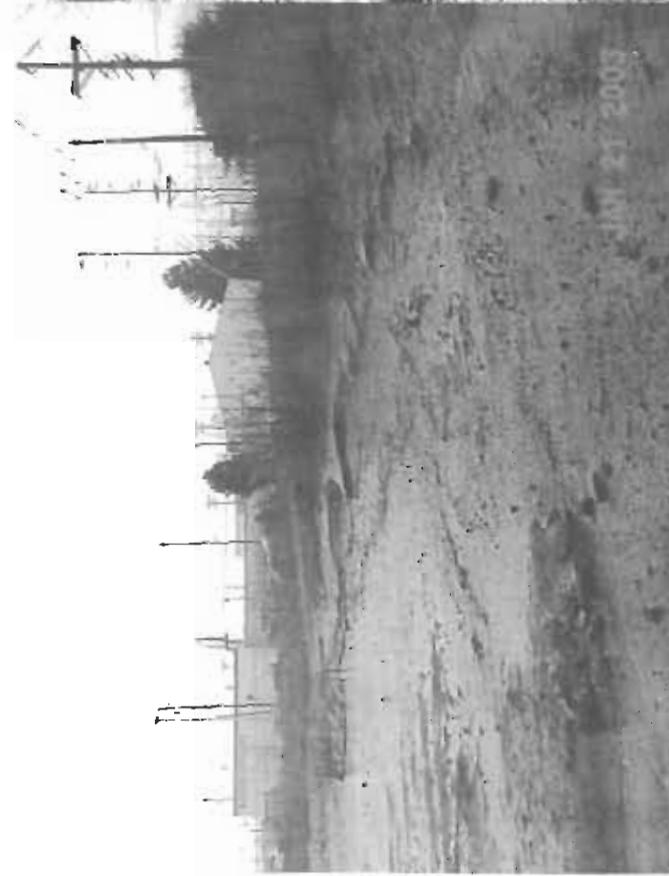
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Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: LM2A



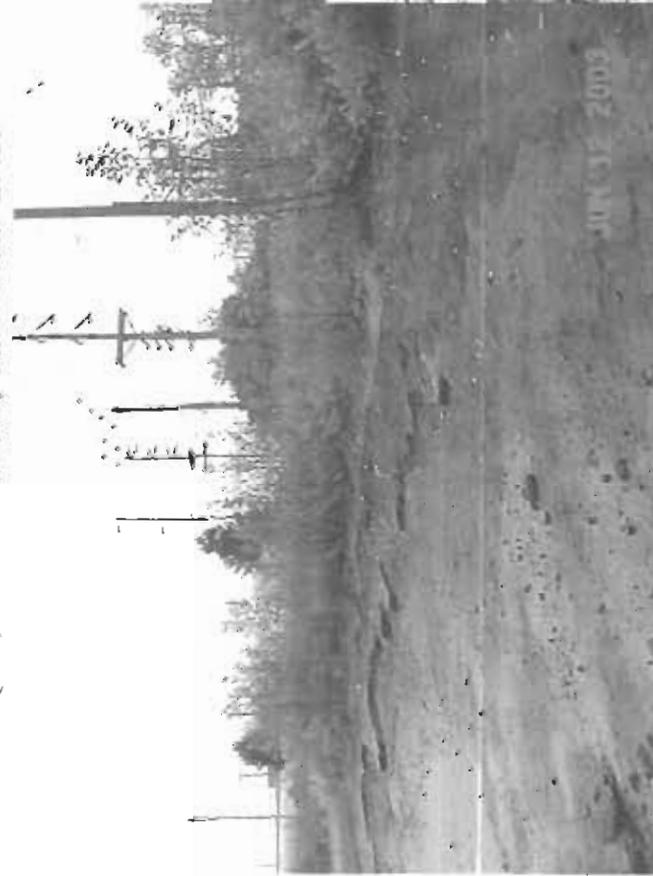
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Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: LM2B



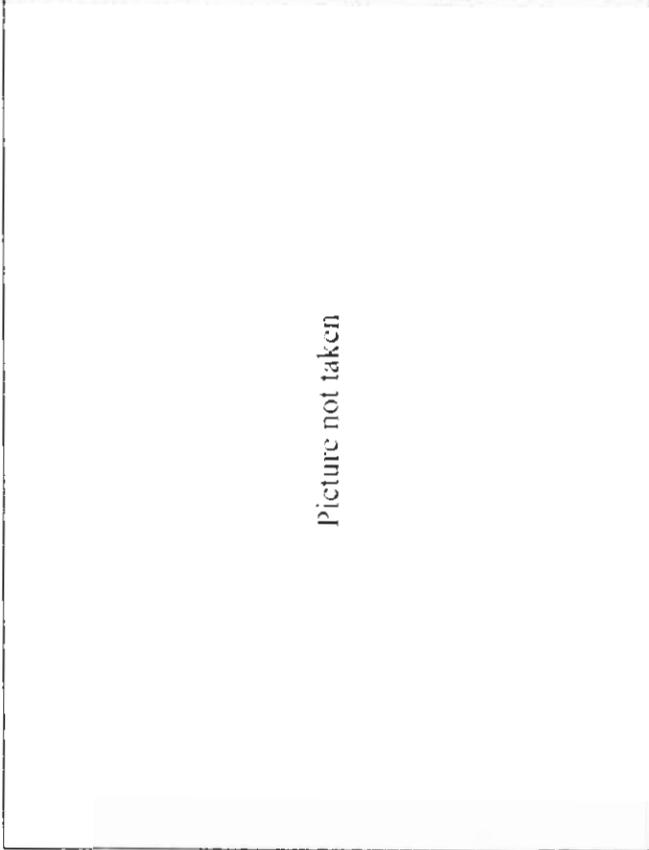
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Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: LM2B



Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: LM2B



Picture not taken

Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: LM3A



Event: Yr 2, Qtr 2; Date: 4/4/2003; Photo Point: LM3A



Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: LM3A



Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: LM3A



Event: Yr 2, Qtr 1; Date: 1/21/2003; Photo Point: LM3B



Event: Yr 2, Qtr 2; Date: 4/4/2003; Photo Point: LM3B



Event: Yr 2, Qtr 3; Date: 06/12/2003; Photo Point: LM3B



Event: Yr 2, Qtr 4; Date: 9/9/2003; Photo Point: LM3B

Appendix B

TPU Cleanup Pictures

