Suisun Marsh Vegetation Mapping
Change Detection 2000

A Report to the California Department of Water Resources

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Introduction

Digital mapping technologies hold great promise for assessing and tracking change in vegetation patterns over large-scale landscapes. Change detection was conducted for Suisun Marsh, Solano County one year after the initial aerial photo interpretation, described in Vegetation Mapping of Suisun Marsh, Solano County – A Report to the California Department of Water Resources (Keeler-Wolf et al. 2000). The goals of the change analysis were to define significant change for vegetation in the Suisun Marsh ecosystem, quantify and spatially identify such changes, improve map accuracy, and make recommendations for future revisions of the map to best support management efforts for endangered species habitat, waterfowl, and other wildlife.

Methodology

The 1999 vegetation polygons, derived from aerial photographs flown June 16, 1999, were printed from ArcView onto mylar at a scale of 1:9600 to match the aerial photography. The unique number and vegetation code were also printed on each polygon. The mylar sheets were compared with the 2000 aerial diapositives (flown July 5, 2000) on a light table. Contingent with the original methodology, every other photo was examined. Please refer to the full report for details on methodology and classification.

The change information recorded on the mylar sheets was later transferred to an ArcView shapefile. The 1999 polygon coverage (suisun_veg99_attr2.shp) was copied and renamed (suisun_veg00_attr2.shp). This new file was edited by using the appropriate scanned 2000 aerial photograph as a backdrop in ArcView.

A database was established in Microsoft Access to record which polygons were interpreted to have changed. This database (change detection.mdb) is included in the Suisun Marsh Vegetation Mapping 1999 2nd Ed - Change Detection 2000 CD. The following information was recorded:

- **Unique_id** : the exclusive polygon identifier. [Note: this unique identifier does not correlate to the polygon numbers found in the original attribute database (Attributes_dec19.mdb). To generate the final map products, adjacent polygons with identical attributes were merged into single polygons to streamline the data set. The entire coverage was renumbered; these new numbers are used here and are consistent with the Poly_# field in the suisun_veg99_attr2 file.]

- **veg_code_99** : vegetation code based on 1999 aerial photo interpretation; "000" assigned to newly created polygons.

- **veg_code_00** : vegetation code based on 2000 aerial photo interpretation.

- **poly_size** : polygon size class; sm = <1 acre; md = 1-5 acres; lg = >5 acres.

- **change_class** : percent change in acreage for the polygon; 0 = none; 1 = 5-10%; 2 = 10-20%; 3 = >20%

- **notes** : "change" indicates a true vegetation change; "mislabel" indicates a map update.

Definition of Change

The following changes were considered significant and consistently interpretable, and were updated:

- A greater than 20% change in acreage of an exiting small polygon (< 0.5-1 acre)
- A greater than 10% change in acreage of a mid-sized polygon (1-5 acres)
- A greater than 5% change in a large polygon (>5 acres)
- A type conversion of a vegetation polygon dominated by perennial species. Type conversion as defined here, occurs when a previously mapped vegetation type dominated by perennial species has changed based on the decision rules set forth in the vegetation mapping unit key defined in the Suisun Marsh Vegetation Mapping Report (Table 5), or when an annual species dominated vegetation type is converted to a perennial vegetation type.
- A persistent physical change has altered any vegetation polygon and partially or entirely replaced it with a non-vegetated area (non-vegetated areas include buildings, dredged ditches, new levees, roads, or other human engineered structures).
- A change in management style, which includes a conversion or restoration from an actively managed situation (annual burning, disking, plowing, flooding, or other management practice which annually disturbs the vegetation) to a passively or non-managed situation.

The following changes were considered non-significant and/or unreliably interpretable and were not assessed:

- Annual to annual type conversion were not considered because of the vagaries of climate on annual vegetation. **Table 1** lists these excluded types.
- Polygons that are regularly heavily managed by annual burning, disking, flooding, or other means were not considered. These changes, unless they show some direction (e.g., from passive management to active, or vice versa), are considered regular management perturbations and maintain the same general vegetation pattern through regular disturbance.

Definition of Mislabel

Improving map accuracy was also a goal of this change analysis. The careful scrutiny of the entire study area provided opportunity to identify and correct errors.

Mislabel indicates one of the following occurred in the original attribution process:

- A keystroke error
- A misinterpretation of vegetation signature

Or

- A more precise vegetation label was assigned based on the 2000 aerial photography. For example, a polygon labeled 101 Tall Wetland Graminoid in 1999 was further interpreted as 123 Typha (generic).

Table 1 – List of Annual Type Changes Excluded From Assessment

The following is a list of annual dominated vegetation types not assessed if one changed to another. Please refer to the full report for identification and discussion of these types.

142 Distichlis/Annual Grasses	312 Atriplex/Distichlis
153 Distichlis/Cotula	315 Atriplex/S. maritimus
155 Crypsis schoenoides	315 Atriplex/Sesuvium
218 Lolium (generic)	329 Polygonum-Xanthium-Echinochloa
220 Lolium/Lepidium	336 Rumex (generic)
222 Lolium/Rumex	337 Atriplex/Annual Grasses
225 Cultivated Annual Graminoid	339 Atriplex triangularis (generic)
227 Annual Grasses/Weeds	342 Cotula coronopifolia
230 Short Upland Graminoids	357 Sesuvium verrucosum*
231 Annual Grasses (generic)	358 Sesuvium/Distichlis*
232 Bromus ssp/Hordeum	359 Sesuvium/Lolium*
234 Hordeum/Lolium	405 Raphanus sativus (generic)
235 Vulpia/Euthamia	406 Brassica nigra
238 Polypogon monspeliensis (generic)	413 Centaurea (generic)
311 Atriplex triangularis	

* *Sesuvium verrucosum* is a perennial species, however common management styles in Suisun Marsh result in an annual life cycle.

Limitations of 2000 Photography

The 2000 photo set for the Suisun Marsh were diminished in quality compared with the 1999 photo set in three ways: hue, focus, and cloud shadow. It is possible that some changes were missed due to these limitations.

A small number of photos were out of focus and of no utility, however adjacent photos were substituted. Cloud shadow on the southern tip of Dutton Island, Freeman Island,

and Snag Island prohibited interpretation of vegetation type, although general vegetation patterns could be discerned.

Finally, the darkness of the entire photo set greatly limited its utility. Generally, a three inch diameter area in the center of each photo was of similar quality and hue to the 1999 photos with the remaining outer perimeter much darkened, tending toward black. Because of the flat aspect of Suisun Marsh and high incidence of active management, color and texture are the two most important features for photo interpretation of vegetation. The darkened photos made interpretation of vegetation signatures very difficult over much of each photograph.

Additionally, the 2000 photos were taken July 5, twenty days later than the 1999 photo set. Generally, the vegetation exhibited an advanced phenology, which added uncertainty to its interpretation. Conversely, some annual species were easier to interpret with the later photography, such as the *Polygonum-Xanthium-Echinochloa* type.

Results and Recommendations

The complete list of polygons modified in the change detection process is presented in **Appendix I**. The appendix is broken into two sections: (1) Change Polygons and (2) Mislabel Polygons with acreage totals at the end of each section. **Figure 1** shows the spatial distribution of this information. **Table 2** summarizes the results by vegetation type and includes the difference in acreage and polygon number between 1999 and 2000. **Table 3** is sorted by percent change in acreage and includes a brief qualitative description of the main causes of the acreage difference between 1999 and 2000. **Table 4** lists the vegetation types with no change.

Table 2

Acreage and Polygon Change by Vegetation Type

Limited to vegetation types with change detected between June 16, 1999 and July 5, 2000.
Positive numbers in the 2000-1999 column indicate an increase in acreage. Negative numbers, a decrease.

Vegetation Type	*Sum Of Acres '00*	*Sum Of Acres '99*	*2000 - 1999 Acres*	*# Polys 2000*	*# Polys 1999*	*2000 - 1999 # Polygon*
001 Bare Ground	2200.17	2191.70	8.47	914	912	2
004 Road	1063.13	1059.91	3.22	169	168	1
005 Structure	218.75	214.09	4.66	95	93	2
006 Slough	4199.12	4196.08	3.04	128	127	1
007 Tidal Mudflat	374.75	375.10	-0.35	59	59	0
009 Ditch	1537.35	1576.20	-38.85	508	511	-3
011 Flooded Managed Wetland	3795.53	3774.48	21.05	665	664	1
014 Urban Area	390.20	341.27	48.93	15	8	7
101 Tall Wetland Graminoids	46.41	30.79	15.62	16	15	1
102 Arundo donax	6.91	4.73	2.18	9	8	1
103 Phragmites australis	570.16	549.43	20.73	440	432	8
113 Scirpus americanus/S. Californicus-S. acutus	149.21	154.65	-5.44	69	70	-1
116 Scirpus californicus/S. acutus	2017.53	2026.04	-8.51	959	960	-1
120 Typha angustifolia/Polygonum-Xanthium-Echinochloa	438.12	433.51	4.61	253	250	3
123 Typha species (generic)	4152.84	4167.09	-14.25	1932	1935	-3
126 Typha angustifolia/Distichlis	991.26	970.56	20.7	618	614	4
129 Typha angustifolia/Phragmites	186.16	172.81	13.35	128	124	4
130 Medium Wetland Graminoids	4.39	1.09	3.3	3	2	1
132 Juncus balticus	335.80	337.88	-2.08	246	247	-1
137 Scirpus maritimus	1853.38	1734.87	118.51	1048	1017	31
138 Scirpus maritimus/Salicornia	559.96	537.05	22.91	271	265	6
140 Short Wetland Graminoids	17.12	20.46	-3.34	11	13	-2
141 Distichlis spicata	2836.16	2890.37	-54.21	1607	1612	-5
142 Distichlis/Annual Grasses	1955.11	1988.12	-33.01	1171	1177	-6
147 Distichlis/Lotus	187.89	190.98	-3.09	125	126	-1
148 Distichlis/Salicornia	2423.55	2416.57	6.98	1400	1408	-8
149 Distichlis/S. americanus	483.93	485.88	-1.95	252	253	-1
154 Distichlis/S. maritimus	415.58	368.15	47.43	201	191	10
156 Distichlis (generic)	795.95	791.27	4.68	399	397	2
157 Scirpus (californicus or acutus)-Typha sp.	2092.79	2069.32	23.47	800	794	6
158 Scirpus (californicus or acutus)/Wetland Herbs	428.41	414.58	13.83	219	215	4
160 Distichlis-Juncus-Triglochin-Glaux	343.76	346.06	-2.3	140	141	-1
162 Scirpus (californicus or acutus)/Rosa	373.30	368.90	4.4	178	178	0
211 Elytrigia pontica	83.64	90.23	-6.59	18	21	-3

Vegetation Type	Sum Of Acres '00	Sum Of Acres '99	2000 - 1999 Acres	# Polys 2000	# Polys 1999	2000 - 1999 # Polygon
226 Perennial Grass	448.57	444.33	4.24	127	126	1
227 Annual Grasses/Weeds	1568.91	1582.50	-13.59	634	637	-3
231 Annual Grasses generic	7431.67	7574.25	-142.58	2742	2773	-31
310 Medium Wetland Herbs	330.94	301.22	29.72	217	193	24
311 Atriplex triangularis	516.64	604.54	-87.9	344	356	-12
312 Atriplex/Distichlis	415.44	406.80	8.64	205	205	0
320 Frankenia (generic)	112.54	114.07	-1.53	68	70	-2
323 Lepidium/Distichlis	198.68	198.82	-0.14	151	150	1
324 Lepidium (generic)	664.21	646.43	17.78	440	430	10
329 Polygonum-Xanthium-Echinochloa	1279.64	1208.47	71.17	658	642	16
337 Atriplex/Annual Grasses	311.85	330.22	-18.37	211	224	-13
339 Atriplex triangularis(generic)	94.33	100.49	-6.16	56	61	-5
344 Lotus corniculatus	251.17	250.35	0.82	169	169	0
346 Salicornia virginica	6087.72	6132.05	-44.33	3553	3560	-7
347 Salicornia/Annual Grasses	2292.34	2306.33	-13.99	1568	1574	-6
348 Salicornia/Atriplex	637.35	664.85	-27.5	339	347	-8
356 Salicornia/Sesuvium	121.57	122.76	-1.19	73	74	-1
357 Sesuvium verrucosum	405.08	408.63	-3.55	203	205	-2
358 Sesuvium/Distichlis	30.78	28.73	2.05	18	17	1
361 Salicornia (generic)	549.64	556.49	-6.85	323	328	-5
364 Salicornia/Polygonum-Xanthium-Echinochloa	112.48	109.15	3.33	79	79	0
365 Salicornia/Cotula	263.19	264.26	-1.07	194	195	-1
401 Upland Herbs	188.05	188.80	-0.75	103	104	-1
402 Conium maculatum	249.76	247.44	2.32	172	172	0
403 Foeniculum vulgare	140.39	140.93	-0.54	95	95	0
604 Rosa californica	139.37	146.33	-6.96	83	84	-1
605 Rosa/Baccharis	60.18	62.46	-2.28	32	32	0
801 Eucalyptus globulus	205.72	204.67	1.05	119	118	1
900 Oaks	2.39	2.99	-0.6	2	3	-1

Table 3

Percent Change in Acreage by Vegetation Type With Qualitative Summary

Sorted by Percent Change in Acreage

Limited to vegetation types with change detected between June 16, 1999 and July 5, 2000.

Vegetation Type	*2000 - 1999 Acres*	*Percent Change Acreage**	*Qualitative Description of Change*
130 Medium Wetland Graminoids	3.3	0.7517	Mislabels of Annual Grasses
101 Tall Wetland Graminoids	15.62	0.3366	Mostly mislabel of Salicornia/Atriplex
102 Arundo donax	2.18	0.3155	Area increased to within minimum mapping unit
014 Urban Area	48.93	0.1254	Construction at Cordelia
154 Distichlis/S. maritimus	47.43	0.1141	Mostly invasion of Scirpus maritimus in Distichlis
310 Medium Wetland Herbs	29.72	0.0898	Change - various vegetation types; mislabels
129 Typha angustifolia/Phragmites	13.35	0.0717	Change - various vegetation types
358 Sesuvium/Distichlis	2.05	0.0666	Invasion of Distichlis into Sesuvium
137 Scirpus maritimus	118.51	0.0639	Invasion of Salicornia (40 ac), of Distichlis (30 ac); 23 ac lost to various changes; 55 ac mislabels of Annual Grass
329 Polygonum-Xanthium-Echinochloa	71.17	0.0556	Mostly mislabels of Atriplex
138 Scirpus maritimus/Salicornia	22.91	0.0409	Increase of Scirpus maritimus in Salicornia types
103 Phragmites australis	20.73	0.0364	Area increase; invasion
158 Scirpus (californicus or acutus)/Wetland Herbs	13.83	0.0323	Mislabels of Rosa or Polygonum- Xanthium-Echinochloa
364 Salicornia/Polygonum-Xanthium-Echinochloa	3.33	0.0296	Mostly mislabels
324 Lepidium (generic)	17.78	0.0268	Area increase; invasion of Lepidium into various vegetation types
005 Structure	4.66	0.0213	Construction at Benecia
126 Typha angustifolia/Distichlis	20.7	0.0209	Area increase; invasion of Typha into Distichlis; new delineation
312 Atriplex/Distichlis	8.64	0.0208	Invasion of Distichlis into Atriplex

** Values listed are 100th of a percent.*

Vegetation Type	*2000 - 1999 Acres*	*Percent Change Acreage**	*Qualitative Description of Change*
162 Scirpus (californicus or acutus)/Rosa	4.4	0.0118	Mislabels
157 Scirpus (californicus or acutus)-Typha sp.	23.47	0.0112	Mostly mislabels
120 Typha angustifolia/Polygonum-Xanthium-Echinochloa	4.61	0.0105	Change - various vegetation types
226 Perennial Grass	4.24	0.0095	Change - various vegetation types; mislabels
402 Conium maculatum	2.32	0.0093	Mostly invasion into Elytrigia
156 Distichlis (generic)	4.68	0.0059	Change - various vegetation types
011 Flooded Managed Wetland	21.05	0.0055	Mostly mislabels
801 Eucalyptus globulus	1.05	0.0051	Mislabel - new delineation
001 Bare Ground	8.47	0.0038	Mechanical clearing
344 Lotus corniculatus	0.82	0.0033	Mostly mislabels
004 Road	3.22	0.0030	Construction at Joice Island
148 Distichlis/Salicornia	6.98	0.0029	Changed to Scirpus maritimus or mislabels
006 Slough	3.04	0.0007	All mislabels or keystroke errors
323 Lepidium/Distichlis	-0.14	-0.0007	Invasion by Polygonum- Xanthium-Echinochloa
007 Tidal Mudflat	-0.35	-0.0009	Calculation error
123 Typha species (generic)	-14.25	-0.0034	Mostly invaded by Phragmites
403 Foeniculum vulgare	-0.54	-0.0038	Ditch/levee construction on Joice Island
401 Upland Herbs	-0.75	-0.0040	Converted to Urban
149 Distichlis/S. americanus	-1.95	-0.0040	Invaded by Lepidium latifolium

** Values listed are 100th of a percent.*

Vegetation Type	*2000 - 1999 Acres*	*Percent Change Acreage**	*Qualitative Description of Change*
365 Salicornia/Cotula	-1.07	-0.0040	Changed to Medium Wetland Herbs
116 Scirpus californicus/S. acutus	-8.51	-0.0042	Replaced by Phragmites
347 Salicornia/Annual Grasses	-13.99	-0.0061	Mostly increase in Scirpus maritimus cover
132 Juncus balticus	-2.08	-0.0062	Mislabels; invasion by Typha
160 Distichlis-Juncus-Triglochin-Glaux	-2.3	-0.0066	Keystroke error
346 Salicornia virginica	-44.33	-0.0072	Mostly increase in Scirpus maritimus cover; 15 ac mislabels
227 Annual Grasses/Weeds	-13.59	-0.0086	Mostly invaded by Distichlis and Lepidium
357 Sesuvium verrucosum	-3.55	-0.0087	Invasion by Phragmites and Distichlis
356 Salicornia/Sesuvium	-1.19	-0.0097	Invasion by Phragmites
361 Salicornia (generic)	-6.85	-0.0123	Invasion of Lepidium and Medium Wetland Herbs
320 Frankenia (generic)	-1.53	-0.0134	Invasion by Lepidium latifolium
147 Distichlis/Lotus	-3.09	-0.0162	Invaded by Lepidium latifolium
142 Distichlis/Annual Grasses	-33.01	-0.0166	Mostly changed to Scirpus maritimus & Salicornia types
141 Distichlis spicata	-54.21	-0.0188	Mostly invaded my Scirpus maritimus and Typha
231 Annual Grasses generic	-142.58	-0.0188	Invasion of Salicornia & Distichlis; converted to structures, urban, bare ground; mislabels
009 Ditch	-38.85	-0.0246	Mostly mislabels; construction at Joice Island
113 Scirpus americanus/S. Californicus-S. acutus	-5.44	-0.0352	All mislabels
605 Rosa/Baccharis	-2.28	-0.0365	Ditch/levee construction on Joice Island
348 Salicornia/Atriplex	-27.5	-0.0414	Mostly mislabels

** Values listed are 100th of a percent.*

Vegetation Type	*2000 - 1999 Acres*	*Percent Change Acreage**	*Qualitative Description of Change*
604 Rosa californica	-6.96	-0.0476	Mostly mislabels
337 Atriplex/Annual Grasses	-18.37	-0.0556	Mostly mislabels of various vegetation types
339 Atriplex triangularis(generic)	-6.16	-0.0613	Change - various vegetation types; mislabels
211 Elytrigia pontica	-6.59	-0.0730	Invaded by Conium; mislabels of Annual Grasses
311 Atriplex triangularis	-87.9	-0.1454	Mostly mislabels of Polygonum- Xanthium-Echinochloa; some invasion of Distichlis
140 Short Wetland Graminoids	-3.34	-0.1632	Classification upgrades
900 Oaks	-0.6	-0.2007	Removed for construction in Cordelia

** Values listed are 100th of a percent.*

Table 4 – List of Vegetation Types With No Identified Change

The following is a list of vegetation types with no significant change detected between June 16, 1999 and July 5, 2000. Refer to the Methodology section for more details.

002 Fallow Disced Field	238 Polypogon monspeliensis (generic)
003 Parking Lot	300 Wetland Herbs
008 Railroad Track	301 Tall Wetland Herbs
010 Trail	315 Atriplex/S. maritimus
012 Freshwater Drainage	316 Atriplex/Sesuvium
013 Water Treatment Pond	317 Frankenia/Agrostis
104 Phragmites/Scirpus	318 Frankenia/Distichlis
105 Phragmites/Xanthium	321 Grindelia stricta var stricta
112 Scirpus americanus/Potentilla	336 Rumex (generic)
114 Scirpus americanus (generic)	338 Potentilla anserina (generic)
121 Typha angustifolia/S. americanus	340 Short Wetland Herbs
125 Typha angustifolia (dead stalks)	342 Cotula coronopifolia
127 Scirpus americanus/Lepidium	350 Salicornia/Crypsis
133 Juncus balticus/Conium	359 Sesuvium/Lolium
134 Juncus balticus/Lepidium	360 Spergularia/Cotula
135 Juncus balticus/Potentilla	371 Potamogeton pectinatus
139 Scirpus maritimus/Sesuvium	405 Raphanus sativus (generic)
145 Distichlis/Juncus	406 Brassica nigra (generic)
153 Distichlis/Cotula	410 Medium Upland Herbs
155 Crypsis schoenoides	413 Centaurea (generic)
161 Cynodon dactylon	421 Carpobrotus edulis
202 Cortaderia selloana	502 Salix exigua
210 Medium Upland Graminoids	514 Atriplex lentiformis (generic)
215 Leymus (generic)	601 Medium Upland Shrubs
218 Lolium (generic)	603 Baccharis/Annual Grasses
220 Lolium/Lepidium	606 Rubus discolor
222 Lolium/Rumex	700 Willow Trees
223 Phalaris aquatica	702 Salix laevigata/S. lasiolepis
225 Cultivated Annual Graminoid	705 Salix lasiolepis/Quercus agrifolia
228 Agrostis avenacea	800 Eucalyptus
230 Short Upland Graminoids	901 Quercus agrifolia
232 Bromus spp/Hordeum	903 Quercus lobata
234 Hordeum/Lolium	910 Landscape Trees
235 Vulpia/Euthamia	911 Ailanthus altissima

There are 250 polygons included in the change detection analysis, eighty-three, or 33%, of these map updates (mislabels). There are 167 polygons (0.54% of polygons in study area) identified as having changed between June 16, 1999 and July 5, 2000. These total 514.69 acres or 74-hundreths of a percent (0.74%) of the 69,322 acres mapped in this project. The average percent change in acreage for the 55 vegetative and 8 non-vegetative types assessed is 0.02% with 0.75% the maximum gain (Medium Wetland Graminoids), and –0.60% the maximum loss (Oaks). The minimum change is 0.0007% (*Lepidium/Distichlis* and Slough).

The spatial distribution of both Change and Mislabel polygons is shown in **Figure 1**. Overall, the Change polygons are spread evenly throughout the study area, although only seven occur in tidal wetlands, totaling 12 acres. Approximately seven acres are due to change – increases in *Phragmites australis* (along slough edges), *Lepidium latifolium*, *Typha sp.* and *Scirpus californicus/S. acutus*. Twenty-five, or 15%, of the 167 Change polygons occur on Chipps and Van Sickle Islands, mostly due to increases in *Distichlis spicata* and *Scirpus maritimus*. *Scirpus californicus/S. acutus, Typha sp.* and *Phragmites australis* increased, as well.

The greatest change in actual acreage is a 143 acre loss of Annual Grasses primarily due to conversion to structures, urban areas and bare ground, and to the invasion of *Salicornia* and *Distichlis* types. Mislabels accounted for 58 of these acres (40%). *Scirpus maritimus* has the greatest increase in cover (119 acres) though roughly 55 acres was attributed to mislabels. Mislabeling of this type was relatively common because its phenology while drying can be misinterpreted as annual grass. Further, it is difficult to know if the increased occurrence of *S. maritimus* resulted from actual invasions Although a perennial species, *S. maritimus* is highly managed making the timing of photography an important factor.

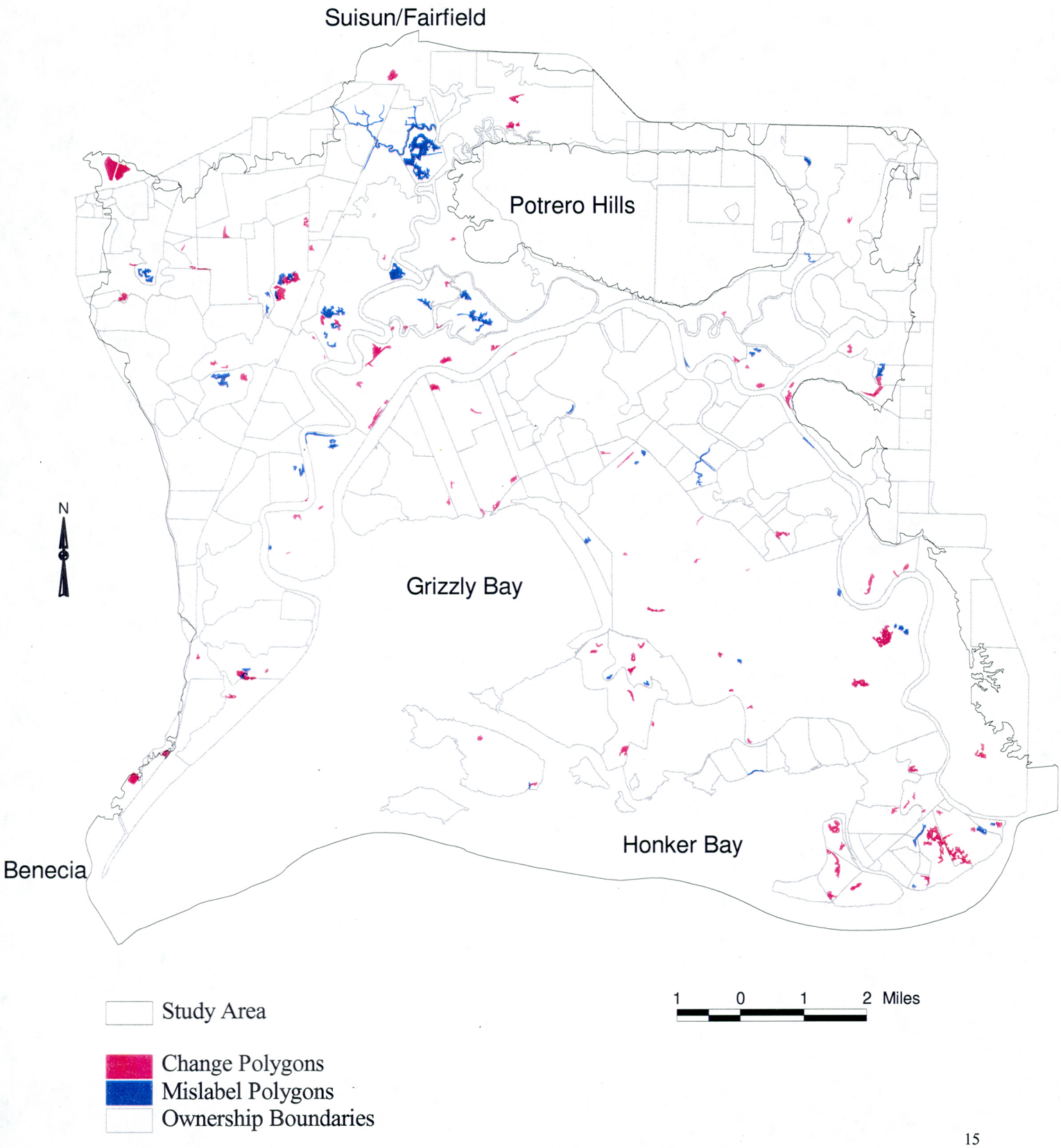
There was a net loss of 65 acres for *Salicornia* types (excluding *Salicornia/Atriplex* which accounted for 22 acres of mislabeled Tall Wetland Graminoids) with an average percent change of 0.0158%. Sixty-nine percent, or 45 acres, changed to *Scirpus maritimus* or to a *S. maritimus* type. Seventeen of the 65 acres were mislabels.

Also of note, *Lepidium latifolium* increased by 18 acres exclusively within managed wetlands; non-managed wetlands had no significant increase or decrease of *Lepidium* coverage. *Phragmites australis* increased in cover by 20 acres through expansion of existing stands and invasion of other vegetation types.

Construction activities resulted in significant changes within the Suisun Marsh study area. A warehouse was erected at Lake Herman Road and Industrial Way, converting 5 acres of annual grassland into a structure. In Cordelia, several oak trees were removed and 44 acres of annual grassland graded in preparation for development. On the Joice Island Unit of the Grizzly Island Wildlife Area, levee and ditch construction in Pond D divided 170 acres of wetland habitat dominated by *Salicornia virginica and Distichlis spicata*. Vegetative response is not yet detectable.

Figure 1

Distribution of Polygons Included in 2000 Change Detection



Given that it was possible to detect change in less than one percent of the vegetation for the Suisun Marsh study area, it is recommended that the change detection and map update process occur every three years with a contingency of more frequent updating for years with significant flood, fire, restoration or other event. Further, to ensure maximum utility from the change detection process, it is imperative that the aerial photography be of comparable quality and timing as the 1999 photo set.

The entire change detection process required approximately 320 person-hours by qualified personnel.

Conclusions

The Suisun marsh appears to be relatively stable between 1999 and 2000. Change was detected for 0.74% of the study area. Three-hundred-fifty-five acres, or 0.50%, of the mapped acreage was updated by correction of errors or more precise interpretation. The quality and timing of the aerial photography potentially limited the effectiveness of the chosen change detection methodology. The greatest cause for change (excluding probable misinterpretation) occurred as a result of human activities - clearing for development, and levee construction.

Literature Cited

Keeler-Wolf, T., M. Vaghti, and A. Kilgore. 2000. Vegetation Mapping of Suisun Marsh, Solano County – A Report to the California Department of Water Resources. Unpublished administrative report on file at Wildlife and Habitat Data Analysis Branch, California Department of Fish and Game, Sacramento.

Appendix I – Complete List of Polygons Identified in Change Detection Analysis

Change Polygons

Unique ID	*Vegetation Type in 1999*	*Vegetation Type in 2000*	*Change Class*	*Polygon size**	*Acres*
25690	1 Bare Ground	157 Scirpus (californicus or acutus)-Typha sp.	none	md	3.95
24904	1 Bare Ground	346 Salicornia virginica	none	lg	6.95
10364	103 Phragmites australis	103 Phragmites australis	3	md	3.22
10135	103 Phragmites australis	103 Phragmites australis	>20%	md	1.61
10445	103 Phragmites australis	103 Phragmites australis	>20%	sm	0.68
10260	103 Phragmites australis	103 Phragmites australis	10-20%	md	1.13
10202	103 Phragmites australis	103 Phragmites australis	>20%	sm	0.6
12699	11 Flooded Managed Wetland	157 Scirpus (californicus or acutus)-Typha sp.	none	md	3.64
11966	116 Scirpus californicus/S. acutus	103 Phragmites australis	none	md	4.93
11368	116 Scirpus californicus/S. acutus	103 Phragmites australis	>20%	md	1.86
11397	116 Scirpus californicus/S. acutus	116 Scirpus californicus/S. acutus	>20%	md	4.76
13509	123 Typha species (generic)	102 Arundo donax	none	md	2.18
14078	123 Typha species (generic)	103 Phragmites australis	none	sm	0.87
14808	123 Typha species (generic)	123 Typha species (generic)	>20%	md	1.45
14607	123 Typha species (generic)	129 Typha angustifolia/Phragmites	none	sm	0.48
14927	123 Typha species (generic)	129 Typha angustifolia/Phragmites	none	md	1.51
13694	123 Typha species (generic)	129 Typha angustifolia/Phragmites	none	lg	9.49
13678	123 Typha species (generic)	129 Typha angustifolia/Phragmites	none	md	1.16
15719	126 Typha angustifolia/Distichlis	126 Typha angustifolia/Distichlis	>20%	md	1.21
15917	126 Typha angustifolia/Distichlis	126 Typha angustifolia/Distichlis	>20%	md	4.4
16097	129 Typha angustifolia/Phragmites	103 Phragmites australis	none	md	1.98
16067	129 Typha angustifolia/Phragmites	129 Typha angustifolia/Phragmites	>20%	md	2.07

Polygon sizes: sm = < 1 acre; md = 1 - 5 acres; lg = > 5 acres

Unique ID	Vegetation Type in 1999		Vegetation Type in 2000		Change Class	Polygon size*	Acres
17208	137	Scirpus maritimus	103	Phragmites australis	none	lg	6.27
17096	137	Scirpus maritimus	120	Typha angustifolia/Polygonum-Xanthium-Echinochloa	none	md	1.17
17303	137	Scirpus maritimus	141	Distichlis spicata	none	md	1.5
16681	137	Scirpus maritimus	141	Distichlis spicata	none	md	2.77
17158	137	Scirpus maritimus	154	Distichlis/S. maritimus	none	md	2.85
17028	137	Scirpus maritimus	154	Distichlis/S. maritimus	>20%	lg	5.39
16654	137	Scirpus maritimus	154	Distichlis/S. maritimus	none	lg	7.98
16639	137	Scirpus maritimus	329	Polygonum-Xanthium-Echinochloa	none	md	1.5
16492	137	Scirpus maritimus	329	Polygonum-Xanthium-Echinochloa	none	md	1.45
17867	140	Short Wetland Graminoids	324	Lepidium (generic)	none	md	1.99
18819	141	Distichlis spicata	126	Typha angustifolia/Distichlis	none	md	3.88
18296	141	Distichlis spicata	126	Typha angustifolia/Distichlis	none	md	4.69
18091	141	Distichlis spicata	137	Scirpus maritimus	none	md	2.68
18436	141	Distichlis spicata	137	Scirpus maritimus	none	md	4.74
18130	141	Distichlis spicata	137	Scirpus maritimus	none	md	1.38
18107	141	Distichlis spicata	137	Scirpus maritimus	none	md	2.01
19357	141	Distichlis spicata	137	Scirpus maritimus	none	lg	9.9
18024	141	Distichlis spicata	137	Scirpus maritimus	none	md	2.44
18127	141	Distichlis spicata	137	Scirpus maritimus	none	md	2.77
18440	141	Distichlis spicata	154	Distichlis/S. maritimus	none	lg	5.14
18612	141	Distichlis spicata	154	Distichlis/S. maritimus	none	lg	5.77
19367	141	Distichlis spicata	154	Distichlis/S. maritimus	none	md	1.85
18988	141	Distichlis spicata	154	Distichlis/S. maritimus	none	md	1.37
19019	141	Distichlis spicata	154	Distichlis/S. maritimus	none	lg	15.37

Polygon sizes: sm = < 1 acre; md = 1 - 5 acres; lg = > 5 acres

Unique ID	Vegetation Type in 1999		Vegetation Type in 2000		Change Class	Polygon size*	Acres
18271	141	Distichlis spicata	346	Salicornia virginica	none	md	1.62
19563	142	Distichlis/Annual Grasses	129	Typha angustifolia/Phragmites	none	md	2.13
19889	142	Distichlis/Annual Grasses	137	Scirpus maritimus	none	md	3.99
19974	142	Distichlis/Annual Grasses	137	Scirpus maritimus	none	md	1.75
20263	142	Distichlis/Annual Grasses	137	Scirpus maritimus	none	md	1.1
20057	142	Distichlis/Annual Grasses	142	Distichlis/Annual Grasses	10-20%	md	3.37
19968	142	Distichlis/Annual Grasses	148	Distichlis/Salicornia	none	lg	17.33
20235	142	Distichlis/Annual Grasses	154	Distichlis/S. maritimus	none	lg	7.05
20274	142	Distichlis/Annual Grasses	346	Salicornia virginica	none	md	2.29
21028	147	Distichlis/Lotus	324	Lepidium (generic)	none	md	3.09
21925	148	Distichlis/Salicornia	126	Typha angustifolia/Distichlis	none	md	2.28
21788	148	Distichlis/Salicornia	137	Scirpus maritimus	none	lg	8.33
21848	148	Distichlis/Salicornia	137	Scirpus maritimus	none	lg	5.06
21852	148	Distichlis/Salicornia	310	Medium Wetland Herbs	none	md	1.62
21974	148	Distichlis/Salicornia	324	Lepidium (generic)	none	sm	0.85
22418	148	Distichlis/Salicornia	346	Salicornia virginica	none	md	1.87
21947	148	Distichlis/Salicornia	346	Salicornia virginica	none	md	1.49
22687	149	Distichlis/S. americanus	323	Lepidium/Distichlis	none	md	1.95
23029	154	Distichlis/S. maritimus	141	Distichlis spicata	none	md	1.68
23288	156	Distichlis (generic)	148	Distichlis/Salicornia	none	lg	6.62
23564	157	Scirpus (californicus or acutus)-Typha sp.	157	Scirpus (californicus or acutus)-Typha sp.	10-20%	md	2.6
23698	157	Scirpus (californicus or acutus)-Typha sp.	157	Scirpus (californicus or acutus)-Typha sp.	>20%	md	1.84
25773	211	Elytrigia pontica	402	Conium maculatum	none	md	2.8
26066	226	Perennial Grass	226	Perennial Grass	>20%	md	3.8

Polygon sizes: sm = < 1 acre; md = 1 - 5 acres; lg = > 5 acres

Unique ID	Vegetation Type in 1999		Vegetation Type in 2000		Change Class	Polygon size*	Acres
26479	227	Annual Grasses/Weeds	141	Distichlis spicata	none	md	1.49
26527	227	Annual Grasses/Weeds	141	Distichlis spicata	none	md	1.83
26749	227	Annual Grasses/Weeds	324	Lepidium (generic)	none	md	1.26
26397	227	Annual Grasses/Weeds	347	Salicornia/Annual Grasses	none	md	1.55
28984	231	Annual Grasses generic	1	Bare Ground	none	md	3.7
27844	231	Annual Grasses generic	1	Bare Ground	none	lg	9.04
27014	231	Annual Grasses generic	137	Scirpus maritimus	none	sm	0.41
27534	231	Annual Grasses generic	137	Scirpus maritimus	none	md	1.09
29533	231	Annual Grasses generic	14	Urban Area	none	lg	15.11
27777	231	Annual Grasses generic	14	Urban Area	none	lg	28.68
27013	231	Annual Grasses generic	14	Urban Area	none	md	1.42
28851	231	Annual Grasses generic	141	Distichlis spicata	none	md	1.8
29370	231	Annual Grasses generic	141	Distichlis spicata	none	md	2.56
29110	231	Annual Grasses generic	142	Distichlis/Annual Grasses	none	md	2.17
27898	231	Annual Grasses generic	154	Distichlis/S. maritimus	none	md	1.13
29432	231	Annual Grasses generic	154	Distichlis/S. maritimus	none	md	1.48
29449	231	Annual Grasses generic	156	Distichlis (generic)	none	md	1.78
27018	231	Annual Grasses generic	346	Salicornia virginica	none	md	2.95
26808	231	Annual Grasses generic	346	Salicornia virginica	none	md	2.82
29426	231	Annual Grasses generic	346	Salicornia virginica	none	md	1.91
28916	231	Annual Grasses generic	347	Salicornia/Annual Grasses	none	lg	5.76
29485	231	Annual Grasses generic	5	Structure	none	md	2.6
27805	231	Annual Grasses generic	5	Structure	none	md	2.06
29755	310	Medium Wetland Herbs	120	Typha angustifolia/Polygonum-Xanthium-Echinochloa	none	md	1.54

Polygon sizes: sm = < 1 acre; md = 1 - 5 acres; lg = > 5 acres

Unique ID	Vegetation Type in 1999		Vegetation Type in 2000		Change Class	Polygon size*	Acres
29754	310	Medium Wetland Herbs	329	Polygonum-Xanthium-Echinochloa	none	md	1.54
29798	310	Medium Wetland Herbs	329	Polygonum-Xanthium-Echinochloa	none	md	2.78
30066	311	Atriplex triangularis	14	Urban Area	none	sm	0.96
30008	311	Atriplex triangularis	312	Atriplex/Distichlis	none	lg	6.24
29972	311	Atriplex triangularis	312	Atriplex/Distichlis	none	md	3.99
29971	311	Atriplex triangularis	346	Salicornia virginica	none	md	1.1
30249	312	Atriplex/Distichlis	324	Lepidium (generic)	none	sm	0.91
30310	312	Atriplex/Distichlis	324	Lepidium (generic)	none	sm	0.68
30496	320	Frankenia (generic)	324	Lepidium (generic)	none	sm	0.62
30553	320	Frankenia (generic)	324	Lepidium (generic)	none	sm	0.91
30594	323	Lepidium/Distichlis	323	Lepidium/Distichlis	10-20%	md	1.7
30595	323	Lepidium/Distichlis	329	Polygonum-Xanthium-Echinochloa	none	md	1.46
31068	324	Lepidium (generic)	310	Medium Wetland Herbs	none	md	1.43
30832	324	Lepidium (generic)	310	Medium Wetland Herbs	none	sm	0.69
30977	324	Lepidium (generic)	310	Medium Wetland Herbs	none	sm	0.54
31057	324	Lepidium (generic)	310	Medium Wetland Herbs	none	sm	0.95
30731	324	Lepidium (generic)	324	Lepidium (generic)	>20%	sm	0.97
31472	329	Polygonum-Xanthium-Echinochloa	156	Distichlis (generic)	none	md	1.91
31883	337	Atriplex/Annual Grasses	324	Lepidium (generic)	none	md	1.99
31926	337	Atriplex/Annual Grasses	346	Salicornia virginica	none	md	1.48
32121	339	Atriplex triangularis(generic)	14	Urban Area	none	md	1.41
32114	339	Atriplex triangularis(generic)	324	Lepidium (generic)	none	md	1.6
32560	344	Lotus corniculatus	346	Salicornia virginica	none	md	1.92
33454	346	Salicornia virginica	137	Scirpus maritimus	none	md	4.11

Polygon sizes: sm = < 1 acre; md = 1 - 5 acres; lg = > 5 acres

Unique ID	Vegetation Type in 1999		Vegetation Type in 2000		Change Class	Polygon size*	Acres
33677	346	Salicornia virginica	137	Scirpus maritimus	none	md	2.02
33203	346	Salicornia virginica	137	Scirpus maritimus	none	sm	0.88
33602	346	Salicornia virginica	137	Scirpus maritimus	none	md	3.83
33675	346	Salicornia virginica	137	Scirpus maritimus	none	md	1.95
33065	346	Salicornia virginica	137	Scirpus maritimus	none	lg	13.23
33031	346	Salicornia virginica	137	Scirpus maritimus	none	md	4.21
33941	346	Salicornia virginica	138	Scirpus maritimus/Salicornia	none	lg	5.81
32976	346	Salicornia virginica	148	Distichlis/Salicornia	none	lg	5.21
35574	346	Salicornia virginica	226	Perennial Grass	>20%	md	3.56
35272	346	Salicornia virginica	310	Medium Wetland Herbs	>20%	md	4.95
34586	346	Salicornia virginica	310	Medium Wetland Herbs	none	sm	0.42
35392	346	Salicornia virginica	310	Medium Wetland Herbs	none	md	2.28
36233	347	Salicornia/Annual Grasses	138	Scirpus maritimus/Salicornia	none	md	1.06
36911	347	Salicornia/Annual Grasses	138	Scirpus maritimus/Salicornia	none	md	3.92
37147	347	Salicornia/Annual Grasses	138	Scirpus maritimus/Salicornia	none	md	3.66
37635	347	Salicornia/Annual Grasses	231	Annual Grasses generic	none	md	1.74
37489	347	Salicornia/Annual Grasses	310	Medium Wetland Herbs	none	sm	0.56
36925	347	Salicornia/Annual Grasses	310	Medium Wetland Herbs	none	md	4.51
37319	347	Salicornia/Annual Grasses	346	Salicornia virginica	none	md	1.05
37692	347	Salicornia/Annual Grasses	347	Salicornia/Annual Grasses	>20%	md	1.89
38002	348	Salicornia/Atriplex	310	Medium Wetland Herbs	none	sm	0.96
38114	348	Salicornia/Atriplex	310	Medium Wetland Herbs	none	md	1.08
37984	348	Salicornia/Atriplex	310	Medium Wetland Herbs	none	sm	0.39
38046	348	Salicornia/Atriplex	310	Medium Wetland Herbs	none	md	3.02
38196	356	Salicornia/Sesuvium	103	Phragmites australis	none	md	1.19

Polygon sizes: sm = < 1 acre; md = 1 - 5 acres; lg = > 5 acres

Unique ID	*Vegetation Type in 1999*	*Vegetation Type in 2000*	*Change Class*	*Polygon size**	*Acres*
38431	357 Sesuvium verrucosum	103 Phragmites australis	none	md	1.5
38347	357 Sesuvium verrucosum	358 Sesuvium/Distichlis	none	md	2.05
38765	361 Salicornia (generic)	310 Medium Wetland Herbs	none	sm	0.45
38783	361 Salicornia (generic)	310 Medium Wetland Herbs	none	md	1.48
38781	361 Salicornia (generic)	310 Medium Wetland Herbs	none	sm	0.52
38710	361 Salicornia (generic)	324 Lepidium (generic)	none	md	2.07
38736	361 Salicornia (generic)	324 Lepidium (generic)	none	md	2.2
38864	364 Salicornia/Polygonum-Xanthium-Echinochloa	329 Polygonum-Xanthium-Echinochloa	none	md	4.25
38957	365 Salicornia/Cotula	310 Medium Wetland Herbs	none	md	1.07
39166	401 Upland Herbs	14 Urban Area	none	sm	0.75
40628	900 Oaks	14 Urban Area	none	sm	0.6
41162	None	103 Phragmites australis	none	md	1.07
41166	None	116 Scirpus californicus/S. acutus	none	md	2.15
41175	None	129 Typha angustifolia/Phragmites	none	md	1.65
41174	None	137 Scirpus maritimus	none	md	2.74
41167	None	137 Scirpus maritimus	none	md	2.45
41161	None	137 Scirpus maritimus	none	lg	5.04
41160	None	138 Scirpus maritimus/Salicornia	none	md	4.98
41159	None	141 Distichlis spicata	none	sm	0.92
41171	None	141 Distichlis spicata	none	lg	10.72
41168	None	156 Distichlis (generic)	none	md	4.37
41164	None	323 Lepidium/Distichlis	none	md	1.23
41158	None	4 Road	none	md	3.22
41157	None	9 Ditch	none	md	2.3
Total Acreage					**514.69**

Polygon sizes: sm = < 1 acre; md = 1 - 5 acres; lg = > 5 acres

Mislabel Polygons

Unique ID	*Vegetation Type in 1999*		*Vegetation Type in 2000*		*Change Class*	*Polygon Size**	*Acres*
10006	101	Tall Wetland Graminoids	123	Typha species (generic)	none	md	2.69
10003	101	Tall Wetland Graminoids	123	Typha species (generic)	none	md	1.09
10004	101	Tall Wetland Graminoids	157	Scirpus (californicus or acutus)-Typha sp.	none	md	2.65
10724	113	Scirpus americanus/S. Californicus-S. acutus	157	Scirpus (californicus or acutus)-Typha sp.	none	lg	5.44
12803	120	Typha angustifolia/Polygonum-Xanthium-Echinochloa	158	Scirpus (californicus or acutus)/Wetland Her	none	md	1.54
15178	123	Typha species (generic)	137	Scirpus maritimus	none	md	1.75
16140	129	Typha angustifolia/Phragmites	120	Typha angustifolia/Polygonum-Xanthium-Echinochloa	none	md	2.63
16368	132	Juncus balticus	123	Typha species (generic)	none	md	2.08
17133	137	Scirpus maritimus	227	Annual Grasses/Weeds	none	md	1.46
17858	140	Short Wetland Graminoids	157	Scirpus (californicus or acutus)-Typha sp.	none	md	1.35
21922	148	Distichlis/Salicornia	137	Scirpus maritimus	none	sm	0.52
22170	148	Distichlis/Salicornia	137	Scirpus maritimus	none	md	2.29
21921	148	Distichlis/Salicornia	137	Scirpus maritimus	none	md	2.08
23013	154	Distichlis/S. maritimus	157	Scirpus (californicus or acutus)-Typha sp.	none	lg	6.08
24628	160	Distichlis-Juncus-Triglochin-Glaux	120	Typha angustifolia/Polygonum-Xanthium-Echinochloa	none	md	2.3
24805	162	Scirpus (californicus or acutus)/Rosa	158	Scirpus (californicus or acutus)/Wetland Her	none	md	1.87
25788	211	Elytrigia pontica	231	Annual Grasses generic	none	md	1.36
25790	211	Elytrigia pontica	231	Annual Grasses generic	none	md	2.43
26110	226	Perennial Grass	310	Medium Wetland Herbs	none	md	2.74
26880	231	Annual Grasses generic	130	Medium Wetland Graminoids	none	md	3.3
27731	231	Annual Grasses generic	137	Scirpus maritimus	none	md	1.82
28265	231	Annual Grasses generic	137	Scirpus maritimus	none	md	1.6

Polygon sizes: sm = < 1 acre; md = 1 - 5 acres; lg = > 5 acres

Unique ID	Vegetation Type in 1999		Vegetation Type in 2000		Change Class	Polygon Size*	Acres
26848	231	Annual Grasses generic	137	Scirpus maritimus	none	lg	5.59
27813	231	Annual Grasses generic	137	Scirpus maritimus	none	md	2.8
27692	231	Annual Grasses generic	137	Scirpus maritimus	none	md	2.08
27633	231	Annual Grasses generic	137	Scirpus maritimus	none	lg	13.46
27518	231	Annual Grasses generic	137	Scirpus maritimus	none	md	1.98
27514	231	Annual Grasses generic	137	Scirpus maritimus	none	lg	17.12
27299	231	Annual Grasses generic	137	Scirpus maritimus	none	sm	0.78
27190	231	Annual Grasses generic	137	Scirpus maritimus	none	sm	0.52
26968	231	Annual Grasses generic	137	Scirpus maritimus	none	md	2.2
28112	231	Annual Grasses generic	138	Scirpus maritimus/Salicornia	none	md	3.48
27875	231	Annual Grasses generic	329	Polygonum-Xanthium-Echinochloa	none	sm	0.88
29732	310	Medium Wetland Herbs	324	Lepidium (generic)	none	md	1.73
29744	310	Medium Wetland Herbs	324	Lepidium (generic)	none	md	1.08
29722	310	Medium Wetland Herbs	344	Lotus corniculatus	none	md	2.25
30096	311	Atriplex triangularis	310	Medium Wetland Herbs	none	sm	0.97
30069	311	Atriplex triangularis	310	Medium Wetland Herbs	none	md	1.09
30109	311	Atriplex triangularis	310	Medium Wetland Herbs	none	md	1.33
30192	311	Atriplex triangularis	329	Polygonum-Xanthium-Echinochloa	none	md	1.41
30007	311	Atriplex triangularis	329	Polygonum-Xanthium-Echinochloa	none	lg	10.52
29871	311	Atriplex triangularis	329	Polygonum-Xanthium-Echinochloa	none	md	1.93
29857	311	Atriplex triangularis	329	Polygonum-Xanthium-Echinochloa	none	lg	42.73
30196	311	Atriplex triangularis	329	Polygonum-Xanthium-Echinochloa	none	md	4.9
31774	329	Polygonum-Xanthium-Echinochloa	158	Scirpus (californicus or acutus)/Wetland Her	none	lg	8.13
32019	337	Atriplex/Annual Grasses	141	Distichlis spicata	none	md	4.53

Polygon sizes: sm = < 1 acre; md = 1 - 5 acres; lg = > 5 acres

Unique ID	*Vegetation Type in 1999*	*Vegetation Type in 2000*	*Change Class*	*Polygon Size**	*Acres*
32003	337 Atriplex/Annual Grasses	154 Distichlis/S. maritimus	none	md	1.37
31991	337 Atriplex/Annual Grasses	226 Perennial Grass	none	md	2.34
31920	337 Atriplex/Annual Grasses	310 Medium Wetland Herbs	none	sm	0.37
32014	337 Atriplex/Annual Grasses	310 Medium Wetland Herbs	none	md	1.97
31968	337 Atriplex/Annual Grasses	310 Medium Wetland Herbs	none	md	1.13
31919	337 Atriplex/Annual Grasses	310 Medium Wetland Herbs	none	sm	0.6
31899	337 Atriplex/Annual Grasses	310 Medium Wetland Herbs	none	sm	0.85
31890	337 Atriplex/Annual Grasses	310 Medium Wetland Herbs	none	sm	0.28
31882	337 Atriplex/Annual Grasses	310 Medium Wetland Herbs	none	sm	0.36
31989	337 Atriplex/Annual Grasses	329 Polygonum-Xanthium-Echinochloa	none	md	1.1
32069	339 Atriplex triangularis(generic)	329 Polygonum-Xanthium-Echinochloa	none	sm	0.62
32119	339 Atriplex triangularis(generic)	329 Polygonum-Xanthium-Echinochloa	none	sm	0.65
32120	339 Atriplex triangularis(generic)	329 Polygonum-Xanthium-Echinochloa	none	md	2.06
35135	346 Salicornia virginica	137 Scirpus maritimus	none	md	3.11
35872	346 Salicornia virginica	137 Scirpus maritimus	none	md	1.74
35001	346 Salicornia virginica	310 Medium Wetland Herbs	none	md	2.03
32860	346 Salicornia virginica	329 Polygonum-Xanthium-Echinochloa	none	md	1.38
34019	346 Salicornia virginica	329 Polygonum-Xanthium-Echinochloa	none	md	1.27
35462	346 Salicornia virginica	364 Salicornia/Polygonum-Xanthium-Echinochloa	none	lg	7.58
37806	348 Salicornia/Atriplex	101 Tall Wetland Graminoids	none	md	4.12
37943	348 Salicornia/Atriplex	101 Tall Wetland Graminoids	none	md	3.7
37957	348 Salicornia/Atriplex	101 Tall Wetland Graminoids	none	lg	5.07
38151	348 Salicornia/Atriplex	101 Tall Wetland Graminoids	none	lg	9.16
40315	6 Slough	1 Bare Ground	none	lg	7.01

Polygon sizes: sm = < 1 acre; md = 1 - 5 acres; lg = > 5 acres

Unique ID	*Vegetation Type in 1999*	*Vegetation Type in 2000*	*Change Class*	*Polygon Size**	*Acres*
40305	6 Slough	1 Bare Ground	none	lg	5.74
40316	6 Slough	11 Flooded Managed Wetland	none	md	4.01
40387	6 Slough	11 Flooded Managed Wetland	none	lg	20.68
40179	604 Rosa californica	162 Scirpus (californicus or acutus)/Rosa	none	lg	6.27
40838	9 Ditch	6 Slough	none	md	4.54
40923	9 Ditch	6 Slough	none	md	1.36
40945	9 Ditch	6 Slough	none	lg	10.93
41032	9 Ditch	6 Slough	none	lg	21.15
40783	9 Ditch	6 Slough	none	md	2.99
41169	None	126 Typha angustifolia/Distichlis	none	lg	8.5
41170	None	158 Scirpus (californicus or acutus)/Wetland Her	none	md	2.29
41165	None	801 Eucalyptus globulus	none	md	1.03
41163	None	9 Ditch	none	md	1.53
Total Acreage					**335.45**

Polygon sizes: sm = < 1 acre; md = 1 - 5 acres; lg = > 5 acres

Appendix II

Acreage by Vegetation Type - 2000

Vegetation Classification		*Acreage Summary*
001	Bare Ground	2200.17
002	Fallow Disced Field	171.48
003	Parking Lot	263.39
004	Road	1063.13
005	Structure	218.75
006	Slough	4199.12
007	Tidal Mudflat	374.75
008	Railroad Track	105.73
009	Ditch	1537.35
010	Trail	5.21
011	Flooded Managed Wetland	3795.53
012	Freshwater Drainage	35.96
013	Water Treatment Pond	4.37
014	Urban Area	390.2
101	Tall Wetland Graminoids	46.41
102	Arundo donax	6.91
103	Phragmites australis	570.16
104	Phragmites/Scirpus	134.12
105	Phragmites/Xanthium	9.57
112	Scirpus americanus/Potentilla	266.97
113	Scirpus americanus/S. Californicus-S. acutus	149.21
114	Scirpus americanus (generic)	704.01
116	Scirpus californicus/S. acutus	2017.53
120	Typha angustifolia/Polygonum-Xanthium-Echinochloa	438.12
121	Typha angustifolia/S. americanus	1134.55
123	Typha species (generic)	4152.84
125	Typha angustifolia (dead stalks)	116.09
126	Typha angustifolia/Distichlis	991.26
127	Scirpus americanus/Lepidium	41.41
129	Typha angustifolia/Phragmites	186.16
130	Medium Wetland Graminoids	4.39
132	Juncus balticus	335.8
133	Juncus balticus/Conium	62.77
134	Juncus balticus/Lepidium	16.03
135	Juncus balticus/Potentilla	11.1
137	Scirpus maritimus	1853.38

Vegetation Classification		*Acreage Summary*
138	Scirpus maritimus/Salicornia	559.96
139	Scirpus maritimus/Sesuvium	233.78
140	Short Wetland Graminoids	17.12
141	Distichlis spicata	2836.16
142	Distichlis/Annual Grasses	1955.11
145	Distichlis/Juncus	390.17
147	Distichlis/Lotus	187.89
148	Distichlis/Salicornia	2423.55
149	Distichlis/S. americanus	483.93
153	Distichlis/Cotula	180.08
154	Distichlis/S. maritimus	415.58
155	Crypsis schoenoides	92.5
156	Distichlis (generic)	795.95
157	Scirpus (californicus or acutus)-Typha sp.	2092.79
158	Scirpus (californicus or acutus)/Wetland Her	428.41
160	Distichlis-Juncus-Triglochin-Glaux	343.76
161	Cynodon dactylon	16.24
162	Scirpus (californicus or acutus)/Rosa	373.3
202	Cortaderia selloana	9.78
210	Medium Upland Graminoids	141.74
211	Elytrigia pontica	83.64
215	Leymus (generic)	21.53
218	Lolium (generic)	247.4
220	Lolium/Lepidium	55.24
222	Lolium/Rumex	13.44
223	Phalaris aquatica	24.89
225	Cultivated Annual Graminoid	540.96
226	Perennial Grass	448.57
227	Annual Grasses/Weeds	1568.91
228	Agrostis avenacea	34.99
230	Short Upland Graminoids	3.28
231	Annual Grasses generic	7431.67
232	Bromus spp/Hordeum	8.04
234	Hordeum/Lolium	1.71
235	Vulpia/Euthamia	1.33
238	Polypogon monspeliensis (generic)	54.36
300	Wetland Herbs	46.96
301	Tall Wetland Herbs	8.06
310	Medium Wetland Herbs	330.94
311	Atriplex triangularis	516.64

Vegetation Classification		*Acreage Summary*
312	Atriplex/Distichlis	415.44
315	Atriplex/S. maritimus	64.78
316	Atriplex/Sesuvium	9.49
317	Frankenia/Agrostis	2.07
318	Frankenia/Distichlis	53.16
320	Frankenia (generic)	112.54
321	Grindelia stricta var stricta	2.03
323	Lepidium/Distichlis	198.68
324	Lepidium (generic)	664.21
329	Polygonum-Xanthium-Echinochloa	1279.64
336	Rumex (generic)	20.17
337	Atriplex/Annual Grasses	311.85
338	Potentilla anserina (generic)	60.48
339	Atriplex triangularis(generic)	94.33
340	Short Wetland Herbs	65.33
342	Cotula coronopifolia	393.75
344	Lotus corniculatus	251.17
346	Salicornia virginica	6087.72
347	Salicornia/Annual Grasses	2292.34
348	Salicornia/Atriplex	637.35
350	Salicornia/Crypsis	2.12
356	Salicornia/Sesuvium	121.57
357	Sesuvium verrucosum	405.08
358	Sesuvium/Distichlis	30.78
359	Sesuvium/Lolium	15.68
360	Spergularia/Cotula	5.44
361	Salicornia (generic)	549.64
364	Salicornia/Polygonum-Xanthium-Echinochloa	112.48
365	Salicornia/Cotula	263.19
371	Potamogeton pectinatus	32.5
401	Upland Herbs	188.05
402	Conium maculatum	249.76
403	Foeniculum vulgare	140.39
405	Raphanus sativus (generic)	294.77
406	Brassica nigra (generic)	31.91
410	Medium Upland Herbs	40.65
413	Centaurea (generic)	76.91
421	Carpobrotus edulis	7.03
502	Salix exigua	1.53
514	Atriplex lentiformis (generic)	31.37

Vegetation Classification		*Acreage Summary*
601	Medium Upland Shrubs	7.1
603	Baccharis/Annual Grasses	85.78
604	Rosa californica	139.37
605	Rosa/Baccharis	60.18
606	Rubus discolor	119.16
700	Willow Trees	11.33
702	Salix laevigata/S. lasiolepis	4.92
705	Salix lasiolepis/Quercus agrifolia	3.42
800	Eucalyptus	5.13
801	Eucalyptus globulus	205.72
900	Oaks	2.39
901	Quercus agrifolia	10.95
903	Quercus lobata	1.35
910	Landscape Trees	10.21
911	Ailanthus altissima	0.75
912	Fraxinus latifolia	2.91