H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

MARSH PLANT ASSOCIATIONS OF SOUTH SAN FRANCISCO BAY: 2004 COMPARATIVE STUDY

Prepared by:

H. T. HARVEY & ASSOCIATES

Ronald R. Duke, M.A., Principal
Patrick J. Boursier, Ph.D., Division Head
John Bourgeois, M.S., Project Manager
Andrew Dilworth, B.S., Plant Ecologist
Mark Lagarde, B.S., GIS Specialist

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City of San Jose
Environmental Services Department
San Jose/Santa Clara Water Pollution Control Plant
700 Los Esteros Road
San Jose, CA 95134

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3150 Almaden Expressway, Suite 145 • San Jose, CA 95118 • 408-448-9450 • Fax: 408-448-9454

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EXECUTIVE SUMMARY

Large-scale plant community changes in the remaining marshes of South San Francisco Bay were first observed in the 1970's. Early studies conducted for the South Bay Dischargers Authority in 1984 confirmed those habitat changes. In 1989, as part of a monitoring program required by the San Francisco Bay Regional Water Quality Control Board, the City of San Jose commissioned a more detailed study of the marshes potentially affected by the freshwater discharge from the Water Pollution Control Plant (WPCP). Subsequent mapping studies were conducted in 1991, 1994, and annually thereafter. These studies documented changes in the distribution and aerial extent of salt, brackish and freshwater marsh. This study is the continuation of the WPCP monitoring program.

The 2004 plant association mapping was done on digital 1-meter Multispectral (4-bands) CIR & True Color IKONOS satellite imagery. All vegetation mapping was done by plant biologists in the field and spot-checked by senior biologists. Acreage calculations by plant associations, dominant species and habitat type maps and acreage tables were produced in Geographic Information Systems (GIS) software. Comparisons were made between the 2004 mapping and previous years' mapping.

The total marsh area mapped in 2004 was 1,740 acres for the Main Study Area and 276 acres for the Reference Site. Brackish marsh plant associations dominated the Upper Reaches of the Main Study Area as well as the Reference Area. The Transition Reach segments comprise a mix of brackish and salt marsh while the Lower Reach segments are primarily dominated by salt marsh plant species; the Lower Reach has only 34 acres of brackish marsh habitat. Although a similar distribution of habitats is noted in the Reference Area, brackish marsh habitats comprise a much greater proportion of the area than in the Main Study Area.

The surface area of marsh habitat has increased by 315.7 acres between 1989 and 2004 within the Main Study Area (Upper, Transition and Lower Reaches Combined) (Table 4). During the same period, 86.9 acres of new marsh has formed in the Reference Area (Table 5). This equates to a 24% increase in marsh acreage in the Main Study Area and a 52% increase in marsh acreage in the Reference Area between 1989 and 2004. From 1989 to 2004, a total of 124.0 acres of salt marsh habitat has converted to brackish marsh habitat in the Main Study Area, and 30.6 acres of salt marsh habitat converted to brackish marsh in the Reference Area. However, during the same time period, 34.5 acres of brackish marsh has converted to salt marsh habitat in the Main Study Area and 3.9 acres in the Reference Area. Therefore, within the Main Study area 89.6 acres of net conversion from salt marsh habitat to brackish marsh habitat has occurred since 1989. In the Reference Area, 26.7 acres of net conversion from salt marsh habitat to brackish marsh habitat has occurred since 1989. This represents a much greater relative percentage in net conversion of salt marsh compared to the overall amount of salt marsh habitat within the Reference Area (31%) than with in the Main Study Area (9%).

The entire study area has become less saline since 1989. Newly-forming freshwater marsh habitat in both the Reference Area and the Main Study Area indicates that freshwater influences are affecting all marshes in the vicinity. From 1989 - 2001, the net salt marsh acreage within the

Main Study Area was relatively stable during this period of increased freshwater impacts. In 2002, brackish marsh conversion to salt marsh increased the total area of salt marsh habitat and yielded a net apparent increase in salt marsh. Most of that conversion was due to the dieback of alkali bulrush and replacement by pickleweed and cordgrass as dominant plant species. Most of the conversion of brackish marsh to salt marsh occurred in the Transition and Lower Reaches; areas that had been rapidly converting from salt to brackish marsh habitat during the previous six years. In 2003, some of that salt marsh converted back to brackish marsh, especially in the Transition Reach. However, the amount of net salt marsh conversion in the Main Study Area is still less that that observed in 2001. In 2004, there were approximately 3 less acres of salt-to-brackish conversion, and 6 more acres of brackish-to-fresh conversion in the Transition Reach than in 2003.

Between 1989 and 1999 the relative change in habitat types through time was less in the Main Study Area than in the Reference Area although the rate of new marsh formation in the Main Study Area had exceeded that of the Reference Area. This indicates that much of the conversion of salt marsh habitats within the South San Francisco Bay area was likely driven by large-scale influences affecting the entire system. However, overall gains in salt marsh habitat in the last four years (2001 to 2004) highlights the influence of multiple factors affecting changes in marsh vegetation communities in South San Francisco Bay.

Freshwater discharges from the WPCP appear to have influenced plant species distribution within Artesian Slough. This slough begins at the discharge point for the WPCP, and is primarily freshwater marsh habitat. Without the WPCP discharge we would expect that Artesian Slough would consist of a mixture of brackish and salt marsh habitats. However, WPCP discharges have been relatively constant since 1990 while salt marsh conversion has fluctuated. Therefore, it is likely that much of the interannual variation in habitats within the South Bay marshes is due to the on-going resizing of the channels from the reductions in tidal prism in the South Bay, as well as large-scale environmental factors (*e.g.*, changes in annual rainfall patterns and bay salinity due to delta outflows).

INTRODUCTION

Large-scale plant community changes in the marshes of South San Francisco Bay were first observed in the 1970's (H. T. Harvey & Associates 1984). Brackish marsh plants were colonizing areas that had previously been vegetated with salt marsh plants. Based upon those observations, causal mechanisms for the vegetation change were reviewed. A potential cause of that change was freshwater input from the San Jose/Santa Clara Water Pollution Control Plant (WPCP).

Early studies confirmed the observed changes in plant species composition (H. T. Harvey & Associates 1984). Efforts were made to determine the extent of changes through time by examining historical aerial photography (CH2MHill 1989). These studies relied on aerial photographs of different scales, and since they were historical, could not be field-truthed. However, the data indicated that large-scale vegetation changes (both marsh type conversion and new marsh formation) were occurring in the marshes of South San Francisco Bay.

In 1989, as part of a monitoring program required by the San Francisco Bay Regional Water Quality Control Board (RWQCB), the City of San Jose commissioned a more detailed study of the marshes potentially affected by the freshwater discharge from the WPCP (H. T. Harvey & Associates 1990a). Simultaneously, and also at the behest of the RWQCB, the Sunnyvale WPCP commissioned a study of the vegetation of the marshes in Guadalupe and Alviso Sloughs. Both of these studies included the collection of new aerial photography and detailed mapping of dominant plant species in the field. These data now provide the baseline for comparison of changes in plant species distribution in the marshes of South San Francisco Bay.

Subsequent mapping studies were conducted by the City of San Jose in 1991, 1994, and annually thereafter. These studies documented changes in the distribution and extent of salt, brackish and freshwater marsh (CH2MHill 1989, H.T. Harvey & Associates 1990a, 1990b, 1991, 1995, 1997, 1998, 1999, 2000, 2001a, 2002 and 2003). Starting in 1994 it was recognized that the Alviso Slough mapping, conducted for the Sunnyvale WPCP, could serve as a reference area for the City of San Jose's vegetation mapping. To use Alviso Slough as a reference area for these studies, it was assumed that discharges from the WPCP did not flow 'upstream' into Alviso Slough, and directly impacts its marshes. This assumption is addressed in the mapping analysis. Furthermore, Alviso Slough does receive direct freshwater discharge from the Guadalupe River; just as the main study area receives freshwater discharge from Coyote Creek. Therefore, all mapping efforts since 1995 have included the main study area and this additional reference area (Alviso Slough).

The dominant plant species of tidal salt marshes in South San Francisco Bay include pickleweed (mainly *Salicornia virginica*) and cordgrass (*Spartina* sp.). Pickleweed dominated salt marsh provides habitat for a unique assemblage of animal species including the federally and state-endangered salt marsh harvest mouse (*Reithrodontomys raviventris raviventris)* and California Clapper Rail (*Rallus longirostris obsoletus*). (An expanded description of the habitat requirements for these wildlife species can be found in the Discussion section at the end of the report.) Therefore, it is important to determine the area of vegetation change as well as to

identify the factors responsible for the observed conversion of salt marsh habitat to brackish and freshwater marsh habitats. Furthermore, it is important to understand the extent that this conversion may be caused by natural, region-wide environmental change versus anthropogenic changes such as freshwater discharge from the WPCP and dry-weather releases from local reservoirs.

Research has shown that a number of variables control the distribution of plant species in coastal marshes. The most obvious of these factors, surface water and soil salinity, have been shown to correlate significantly with vegetation distributions (Callaway and Sabraw 1994, Allison 1992, Callaway et al. 1989, Zedler 1983, Zedler and Beare 1986). For example, Zedler (1983) documented the conversion of a pickleweed-dominated salt marsh to a cattail-dominated (*Typha domingensis*) freshwater marsh along the San Diego River. She found that the conversion was highly correlated with prolonged reservoir discharges that continued well beyond the normal rainy season, thereby decreasing salinities.

However, many other factors also influence marsh species composition including: depth and duration of flooding over the marsh surface (Webb and Mendelssohn 1996, Webb et al. 1995, Pennings and Callaway 1992, Mendelssohn and McKee 1988), accumulation of phytotoxins such as hydrogen sulfide in marsh soils (Webb and Mendelssohn 1996, Webb et al. 1995, Koch and Mendelssohn 1989, DeLaune et al. 1983, King et al. 1982), interstitial nutrient concentrations (Koch et al. 1990, Bradley and Morris 1980, Koch and Mendelssohn 1989, Morris 1980), and soil mineral and organic matter content (Nyman et al. 1990, DeLaune et al. 1979). Natural variability in abiotic factors such as precipitation, tidal fluctuation, and evapotranspiration, as well as anthropogenic changes to those factors such as freshwater discharges, non-point source pollution (nutrients and sediments), and regional/global climate changes (drought, temperature, sea level) influence these variables. Warren and Niering (1993) found increased flooding frequency, from sea level rise, altered tidal marsh plant associations in the northeastern United States.

Competition between different plant species (interspecific) with similar environmental tolerances also influences their distributions. Although environmental tolerance and competitive ability are inversely related (Grace and Wetzel 1981, Zedler 1982, Bertness 1991), competition still plays a role among species with similar tolerances. For example, Zedler (1982) found that competitive interactions occur in salt marshes, and concluded that pickleweed does compete with cordgrass for light and to some extent, nutrients.

This study continues the vegetation monitoring of the marshes in South San Francisco Bay that began in 1989. The vegetation mapping conducted by this study determines the spatial location and extent of change in plant communities. This study does not monitor or experimentally manipulate variables that can be responsible for the observed changes. Therefore, the vegetation mapping of the marshes in South San Francisco Bay tracks any changes over time; comparisons are limited to interannual rates of change between the main study area and a reference area.

SURVEY METHODS

STUDY AREA

For the purposes of data collection and analysis, we divided the study area into 28 segments as defined in the 1989 study (H. T. Harvey & Associates 1990a; Figure 1). We then sub-divided the study area into four reaches (Upper Reach segments, Transition Reach segments, Lower Reach segments, and Alviso Slough segments [as the Reference Reach]) to provide a more easily comprehensible method of analyzing the data and presenting the results (Figure 1). The Upper (approximately 520 acres), Transition (approximately 380 acres), and Lower Reach (approximately 760 acres) segments, referred to as the Main Study Area are located within the Coyote Creek watershed and include Segments 1-5 and 8-26 (Figure 1). Segments 27-30 (Reference Area - approximately 250 acres) are located along the lower Guadalupe River, also known as Alviso Slough (Figure 1). This study assumes that the WPCP discharge does not significantly influence the Reference Area, and therefore provides a suitable control site for documenting vegetation changes in South San Francisco Bay.

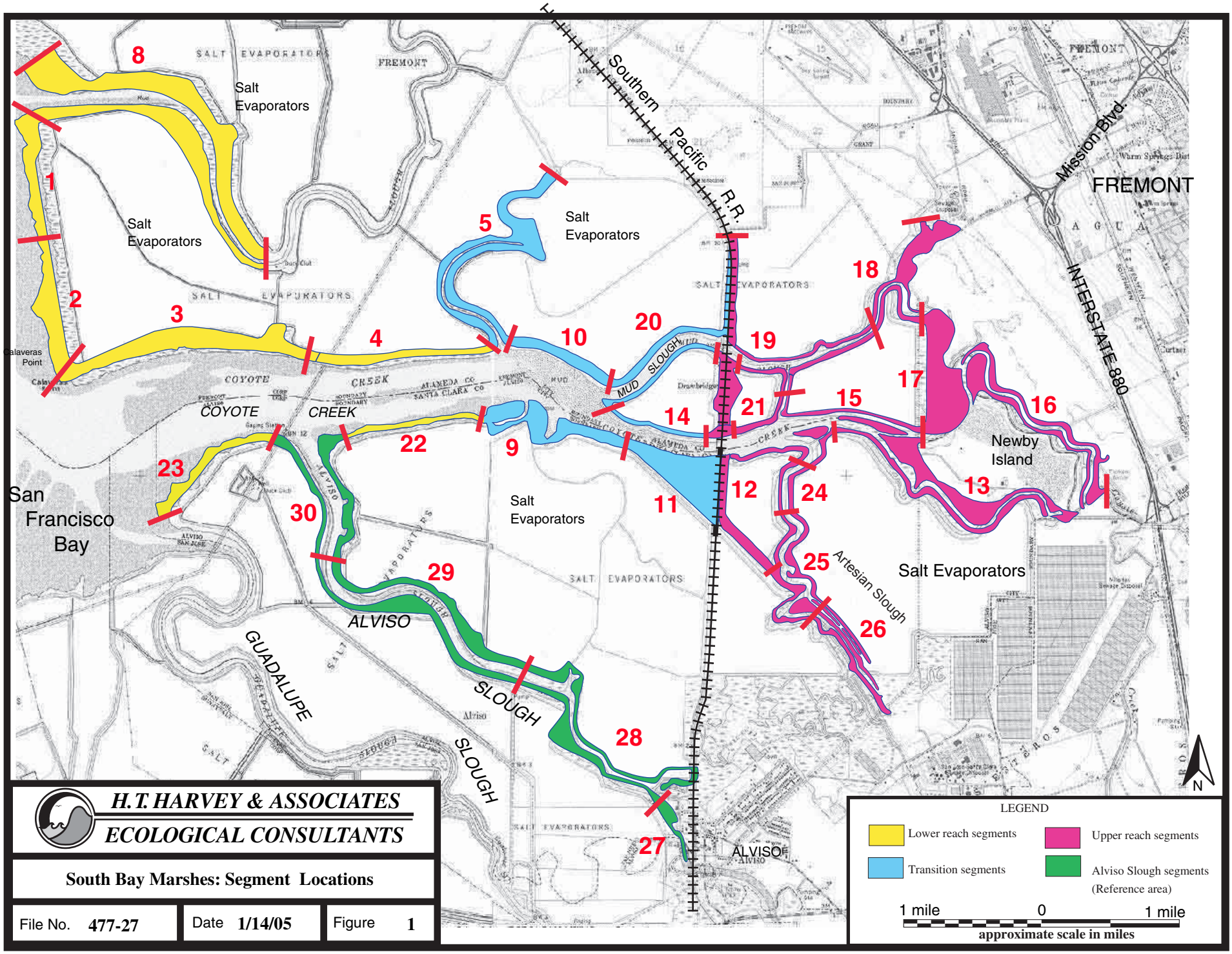
BASE IMAGERY

The City of San Jose acquired IKONOS imagery from a satellite pass that occurred at noon on May 8, 2004. The tidal elevation at this time was –0.9 MLLW near the mouth of Coyote Creek in the Alviso complex. The 1-meter Multispectral (4-bands) color infrared (CIR) & True Color orthorectified IKONOS satellite imagery is projected in UTM NAD83 (meters) Zone 10 North.

VEGETATION ASSOCIATION MAPPING AND AREA CALCULATIONS

Habitat mapping was based upon the imagery obtained and completed at a scale to 1:2400 (1" = 200') using the IKONOS imagery as a base layer. Habitat mapping was assisted using two laptop computers (Panasonic Toughbook 18) equipped with geographic information systems (GIS) software (ArcView 9). These computers and software allow the IKONOS imagery to be used for mapping in the field, or in the office.

The initial mapping was conducted off-site. Initial habitat boundaries and classifications were identified using the IKONOS imagery and was based on the signatures of the photographic imagery. Topographic features, marsh boundaries, and tentative habitat types (based on photographic signatures) were mapped in the office prior to field visits.



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South Bay Marshes: Segment Locations

File No. 477-27	Date 1/14/05	Figure 1

Complete ground-truthing of the preliminary mapping was conducted during site visits to the project area during July and August 2004. Marsh vegetation was observed primarily from areas directly adjacent to the marshes in order to maintain consistency with the methods employed in previous years and also follows U.S. Fish and Wildlife Service (USFWS) guidelines and regulations. Therefore, marshes were observed primarily from levee roadways, railroad beds, unimproved salt pond levees and Pacific Gas and Electric (PG&E) walkways. Only when necessary and allowed by USFWS regulations were vegetation associations verified by walking in those marshes areas that were not clearly visible from adjacent levees and upland areas. Access to the Study Area was obtained from the USFWS San Francisco Bay National Wildlife Refuge (Clyde Morris 510.792.0222) and Cargill Salt Division, Newark, CA (Mr. Chuck Taylor 510.797.1820).

The GIS database was downloaded and backed-up weekly. The digitized boundaries of habitat areas were reviewed for consistency and quality. Plant association acreages and color-coded figures for the entire Study Area were generated in GIS (ArcView 9.0). Plant association acreages and color-coded figures for the entire Study Area were generated by GIS systems ArcInfo and ArcView.

VEGETATION ASSOCIATION CATEGORIZATION METHODS

Any species that occurred as a dominant, co-dominant or sub-dominant in any portion of the study area was mapped. For the purposes of this study a dominant species had a percent cover of 51-100%, co-dominant species have roughly equal percent coverage, and sub-dominant species have between 15 and 49 percent cover.

Each species was then assigned to a vegetation association comprised of one dominant, a dominant and subdominant, or two or more co-dominant species. The three types of vegetation associations are described below:

Dominant – An area that consists of one dominant species that comprises approximately 85-100% of the cover is named solely for that species, so that the vegetation association called Pickleweed consists of from 85-100% Pickleweed and less than 15% of other unspecified species.

Dominant/sub-dominant – If one species comprises between approximately 51-85% of the cover in a particular area, and another species comprises 15-49% cover in that same area, then this is dominant/sub-dominant vegetation association. The association is named for both species, with the more abundant species listed first. The category called Pickleweed/Alkali bulrush could therefore consist of 51-85% cover of Pickleweed and 15-49% cover of Alkali bulrush.

Co-dominant – Two co-dominant associations were identified: Pickleweed-Cordgrass (*Spartina foliosa*) Mix and Saltgrass (*Distichlis spicata*)-Gumplant (*Grindelia* sp.) Mix. The species mixes represent approximately equal amount of each species and their combined total coverage exceeds 85%.

The upland species category consists of species not considered by the USFWS (1988) to be wetland indicators. These include ruderal species such black mustard (*Brassica nigra*), ripgut grass (*Bromus diandrus*), bristly ox-tongue (*Picris echioides*), sweet fennel (*Foeniculum vulgare*), and coyote brush (*Baccharis pilularis*). The peripheral halophyte category consists of a patchwork of species that occur along salt marsh edges, such as levee slopes. This mixture, in which no one species generally exceeds 15% of the cover, includes pickleweed and various peripheral halophyte species such as alkali heath (*Frankenia salina*), Australian saltbush (*Atriplex semibaccata*) and slender-leaved iceplant (*Mesembryanthemum nodiflorum*).

Plant species associations were grouped into dominant species categories (*e.g.*, alkali bulrush/peppergrass association is an alkali bulrush dominant species category). These dominant species categories were then assigned to one of four habitat types: salt marsh, brackish marsh, freshwater marsh and upland. A number of assumptions about grouping dominant species into appropriate habitat types were made. These include:

- Relative salt tolerance of dominant plant species;
- Edaphic characteristics of the South Bay Marshes that may control plant species distribution;
- Historic relationships within this study, and;
- Relationships between dominant plant species and wildlife use.

Certain plant species for which salinity tolerance data are lacking (e.g. peppergrass) were categorized into habitat types based on relative location in the marsh plain or known wildlife use. This assumption and the potential uncertainties related to assigning plant species to habitat type categories has been understood throughout the study period and was stated in the 1989 (baseline) study (H. T. Harvey & Associates 1990a). The habitat classification scheme first used in the baseline study is carried through to this study to collect comparable data.

AREA COMPARISONS

Analysis of potential marsh conversion within the Main Study and Reference Areas involved a multi-step process that began at a total marsh area level and proceeded to a more specific, segment-level analysis. The first task involved comparing the relative acreage change in marsh type and dominant species categories between years. The current year's results are compared to baseline year 1989. When a significant shift in marsh acreage occurred, the dominant species categories responsible for that shift were also identified.

In order to identify where significant acreage changes had occurred, the marsh was divided into four areas based upon segment location: Upper, Transition, Lower and Reference (Alviso Slough) (Figure 1) as described earlier. These are outlined in Table 1.

Table 1. South Bay Marsh Segments and Their Reaches.

Segment	Reaches
Lower (Mouth of Coyote Creek)	1, 2, 3, 4, 8, 22 and 23
Transition (Drawbridge)	5, 9, 10, 11, 14 and 20
Upper (Newby Island)	12, 13, 15, 16, 17, 18, 19, 21, 24, 25 and 26
Reference (Alviso Slough)	27, 28, 29 and 30

A comparison of marsh habitat acreage data from all years (1989, 1991, 1994, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, and 2004) by location (reach) was also conducted to compare trends between reaches. The final step in the analysis overlaid the data from the 1989 mapping onto 2004 data in ArcView to determine, with confidence, the location and size of change in marsh area and habitat type.

Dominant species and habitat maps were produced for each of the four segment locations. The maps were produced from an ArcView database and the full mapping for all segments by plant species association is available electronically.

This year (2004), additional areas of the South Bay were mapped under a separate contract by the same study team using the same IKONOS images (donated by the City of San Jose). The mapping, while consistent with the procedures used for this study, was completed at a less detailed level (*i.e.*, only 15 habitat categories were mapped). That effort, which was conducted as part of the long-term restoration planning for the South Bay Salt Pond Restoration Project, is described in the Existing Biological Conditions document currently in preparation for that project.

RESULTS

The vegetation mapping results can be found in the detailed habitat maps and raw data in the Appendices of this report:

- Appendix A. Vegetation and Marsh Habitat Maps from 2004
- Appendix B. Spatial Analysis (marsh conversion and gain/loss) from 1989 to 2004
- Appendix C. Detailed Acreage Matrices by Segment and Species
- Appendix D. Plant List of Species Observed Vegetation Monitoring

None of the observed changes in the 2004 mapped are attributable to the change in mapping methodology this year. The use of IKONOS images mapped in GIS in the field with field computers only increased our confidence in the results presented herein.

GENERAL SPECIES DISTRIBUTION, DOMINANT SPECIES CATEGORY AND HABITAT ACREAGES FOR 2004

Main Study Area

The spatial distribution of dominant plant species and habitat types for the 2004 data are presented in Appendix A for each of the three segment locations within the Main Study Area (figure scales vary). This year, 55 overall vegetation associations (*e.g.*, alkali bulrush/peppergrass) were mapped. For the purposes of this report, the vegetation associations were grouped by dominant species into 21 vegetation categories (*e.g.*, alkali bulrush) (Figures A1-A4). The area of habitat types and associated dominant plant species for the Main Study Area are shown in Table 2. The dominant plant species within the Main Study Area are alkali bulrush and pickleweed (Table 2); these two species comprise approximately 67% of the marsh within the Main Study Area.

The Upper Reach segments (Appendix A, Figures A-3 and A-7) consist primarily of brackish marsh associations dominated by either pure stands or mixtures of alkali bulrush and peppergrass (*Lepidium latifolium*). The Lower Reach segments (nearest San Francisco Bay; Appendix A, Figures A-1 and A-5) are comprised primarily of single-species stands or mixtures of the salt marsh plant species dominated by pickleweed and cordgrass. Although cordgrass and pickleweed are most abundant in the Lower Reach segments, both occur at low abundance even in the furthest upstream segments (although sometimes in patches too small to map). Conversely, peppergrass is most abundant in the Upper Reach segments, but is found throughout most of the Main Study Area (Appendix A, Figures A-1 through A-3). Alkali bulrush occurs throughout the Main Study Area and is the dominant plant species of brackish marsh associations in South San Francisco Bay. The Transition Reach, intermediate to the furthest upstream and downstream reaches, supported significant amounts of both salt and brackish species, which sometimes occurred in mixed associations (both brackish and salt marsh plant species) (Appendix A, Figures A-2 and A-6).

Table 2. Summary of Acreages of the Main Study Area by Dominant Species Categories for Each Habitat Type for 2004.

Dominant Species Category	2004
Salt Marsh Categories	
Cordgrass	134.5
Pickleweed	680.0
Pickleweed-Cordgrass Mix	76.8
Alkali Heath	18.8
Gumplant	27.8
Jaumea	1.5
Peripheral Halophytes	30.1
Misc. Others	0.3
Sub-Total	**969.8**
Brackish Marsh Categories	
Alkali Bulrush	479.0
Peppergrass	181.7
Spearscale	14.2
Misc. Others	0.0
Sub-Total	**674.9**
Freshwater Marsh Categories	
California Bulrush	82.7
Cattail	12.7
Misc. Others	0.1
Sub-Total	**95.5**
TOTAL	**1740.2**

Reference Area (Alviso Slough)

The spatial distribution of dominant plant species and habitat types in the Reference Area are presented in Appendix A (Figures A-4 and A-8). The 2004 plant association areas for Alviso Slough are presented in Table 3. Plant species within the Reference Area have a general distribution similar to the Main Study Area in terms of a progression from freshwater to brackish and salt marsh species extending from upstream to the confluence with Coyote Creek. However, instead of pickleweed, alkali bulrush is the dominant plant species within the Reference Area. In previous years, brackish marsh habitat has comprised nearly three times the area of salt marsh habitat. However, salt marsh habitat in Alviso Slough has increased gradually since 2000, largely in the form of new marsh created near the confluence with Coyote Creek.

Brackish marsh associations occur throughout Alviso Slough. Patches of alkali bulrush occur as far downstream as Segment 30 (near the confluence with Coyote Creek). Freshwater marsh associations are concentrated in the upstream portions of the slough (nearest the Union Pacific Railroad [UPRR] crossing) and salt marsh associations dominate the downstream areas.

Table 3. Summary of Acreages of the Reference Area (Alviso Slough) by Dominant Species Categories for Each Habitat Type for 2004.

Dominant Species Category	2004
Salt Marsh Categories	
Cordgrass	20.7
Pickleweed	50.1
Peripheral Halophytes	11.4
Saltgrass	5.5
Sub-Total	**87.7**
Brackish Marsh Categories	
Alkali Bulrush	113.8
Peppergrass	45.3
Spearscale	0.2
Misc. Others	0.0
Sub-Total	**159.3**
Freshwater Marsh Categories	
California Bulrush	18.3
Cattail	11.4
Misc. Others	0.0
Sub-Total	**29.7**
TOTAL	**276.7**

Summary

Brackish marsh plant associations dominated the Upper Reach of the Main Study Area as well as the Reference Reach. The Transition Reach comprises both salt and brackish marsh habitats. Only the Lower Reach segments remain primarily dominated by salt marsh plant species. Although a similar distribution of habitats is noted in the Reference Area, brackish marsh habitats comprise a much greater proportion of the Reference Area.

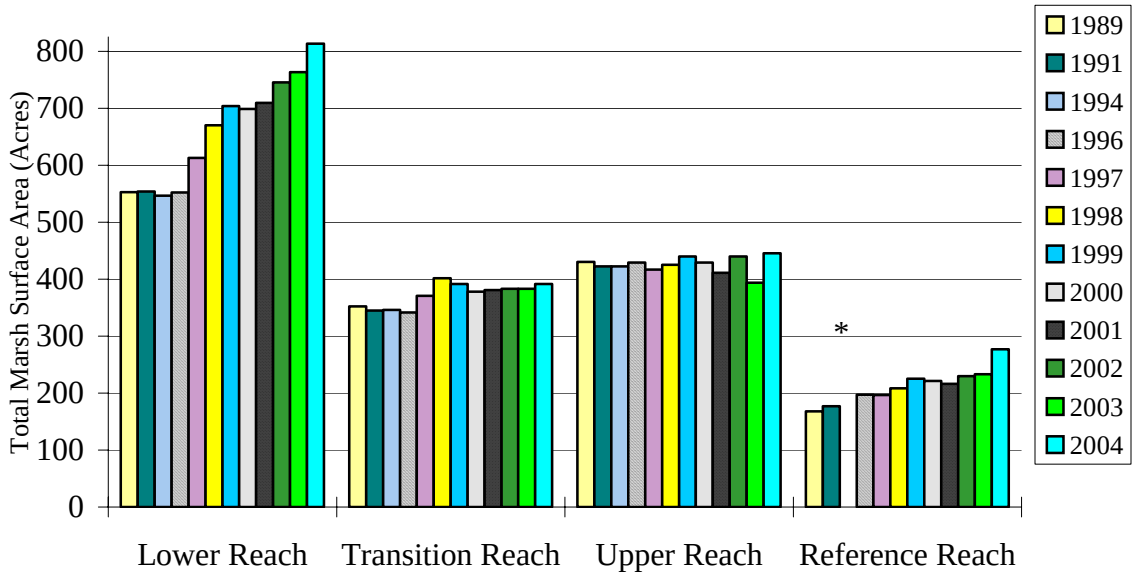
TEMPORAL AND SPATIAL CHANGES IN MARSH HABITAT ACREAGES FROM 1989 THROUGH 2004

This comparison does not include data from segments 24, 25 and 26 (Artesian Slough) of the Main Study Area and segment 27 (vicinity of the Gold Street Bridge) of the Reference Area since they were not mapped in 1989. Additionally, the Reference Area was not mapped in 1994; therefore only data from the Main Study Area in 1994 is included in the temporal and spatial evaluation. Data from 1991, 1994 and 1996 – 1999 are not derived from orthorectified images.

New Marsh Formation (Salt, Brackish, and Freshwater Marsh Combined)

Marsh area remained relatively stable from 1989 to 1996 in the Main Study Area (Figure 2). The formation of new marsh habitat in the Main Study Area has occurred primarily between 1996 and 2004 in the Lower Reach and between 1996 and 1998 in the Transition Reach (Figure 2). Gains in marsh area between 1989 and 2004 were greatest in the Lower Reach (approximately 260 acres), while just under 40 acres of new marsh formation has occurred in the Transition Reach. The majority of new marsh formation has occurred in the Lower Reach along the north side of Coyote Creek, immediately upstream of Calaveras Point. Marsh area has increased steadily in the Lower Reach from 1996 through 2004 however a slight decrease occurred between 1999 and 2000 (Figure 2). In contrast, in the Transition Reach marsh area increased in 1997 and 1998 but decreased slightly in 1999, 2000 and 2001 (Figure 2). The marsh area in the Transition Reach has remained stable from 2001 to 2004. Compared to the Lower and Transition Reaches, the surface area of marsh in the Upper Reach has remained relatively stable (apart from a brief decline in 2003) throughout this 15-year study (Figure 2).

Figure 2. Total Marsh Acreage Comparison between 1989 and 2004, by Reach



***No data collected in 1994 within Reference Area.**

A trend of increasing marsh area is apparent from 1989 through 1999 in the Reference Area (Figure 2). However, a decline in total marsh acreage in the Reference Area occurred between 1999 and 2001 followed by annual increases in area from 2001 to 2004.

The surface area of marsh habitat has increased by 315.7 acres between 1989 and 2004 within the Main Study Area (Upper, Transition and Lower Reaches Combined) (Table 4). During the same period, 86.9 acres of new marsh has formed in the Reference Area (Table 5). This equates to a 24% increase in marsh acreage in the Main Study Area and a 52% increase in marsh acreage in the Reference Area between 1989 and 2004.

Table 4. Summary of Acreages of the Main Study Area* by Dominant Species Categories for Each Habitat Type for 2004.

Dominant Species Category	1989	2003	2004	Percent Change (1989-2004)
Salt Marsh Categories				
Cordgrass	84.2	116.0	134.5	60%
Pickleweed	669.1	640.6	679.2	2%
Pickleweed-Cordgrass Mix**	-	79.0	76.7	-
Alkali Heath**	-	9.0	11.8	-
Gumplant**	-	34.2	27.8	-
Peripheral Halophytes	25.6	28.6	28.8	9%
Misc Others	0.1	2.7	1.8	1,700%
Sub-Total	**779.0**	**910.1**	**960.6**	**23%**
Brackish Marsh Categories				
Alkali Bulrush	489.6	462.6	472.4	-4%
Peppergrass	66.1	133.9	167.3	153%
Spearscale**	-	5.6	14.2	-
Misc. Others	-	-	-	-
Sub-Total	**555.7**	**602.1**	**653.9**	**18%**
Freshwater Marsh Categories				
California Bulrush	-	22.3	28.9	-
Cattail	-	5.6	7.0	-
Misc. Others	-	<0.1	<0.1	-
Sub-Total	-	**27.9**	**35.9**	-
TOTAL	**1334.7**	**1540.1**	**1650.4**	**24%**

* Comparison consists of segments 1-5, 8-23 only since segments 24-26 were not mapped in 1989
** Not a dominant species category in 1989

Table 5. Summary of Acreages of the Reference Area (Alviso Slough)* by Dominant Species Categories for Each Habitat Type for 2004.

Dominant Species Category	1989	2003	2004	Percent Change (1989-2004)
Salt Marsh Categories				
Cordgrass	28.3	23.2	20.6	-27%
Pickleweed	43.6	39.1	49.5	14%
Peripheral Halophytes	3.1	7.2	15.9	413%
Misc. Others	-	0.1	0.6	-
Sub-Total	**75.0**	**69.5**	**86.6**	**15%**
Alkali Bulrush	72.3	114.2	108.9	51%
Peppergrass	20.4	35.0	45.4	123%
Spearscale**	-	0.2	0.2	-
Misc. Others	-	-	-	-
Sub-Total	**92.7**	**149.5**	**154.5**	**67%**
California Bulrush	0.3	14.0	13.0	4,233%
Cattail	-	0.5	0.7	-
Misc. Others	-	-	0.1	-
Sub-Total	**0.3**	**14.5**	**13.8**	**4500%**
TOTAL	**168.0**	**233.5**	**254.9**	**52%**

* Comparison consists of segments 28-30.
** Not a dominant species category in 1989.

Changes in Surface Area of Salt, Brackish, and Freshwater Marsh Habitats

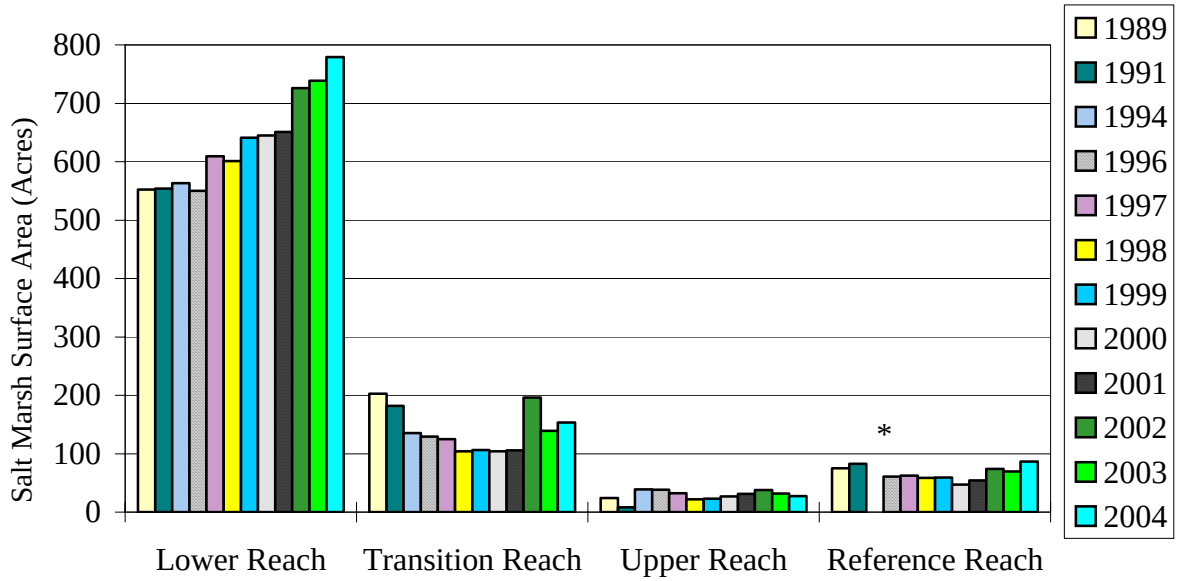
Salt Marsh. Figure 3 presents the total acreage of salt marsh habitat by year and location (reach). Salt marsh area decreased in the Transition Reach from 1989 through 2001; the rate of decrease in salt marsh area was greatest between 1989 and 1994 (Figure 3). However, a significant increase in salt marsh habitat occurred between 2001 and 2002 in the Transition Reach. Between 2002 and 2003, we measured a decrease in salt marsh in the Transition Reach; with a recovery in the amount of salt marsh in 2004, although not quite to 2002 levels (Figure 3).

Conversely, salt marsh area increased in the Lower Reach from 1989 through 2004 with most of the increase occurring between 1996 - 1999 and 2001 - 2004. Much of this increase was due to new marsh formation along the north side of Coyote Creek within segments 3 and 4. There has

been a significant net change in salt marsh habitat area from 1989 to 2004 (+181.6 acres) within the Main Study Area (Table 4). In 2002 we observed substantial gains in salt marsh habitat from both new marsh formation (which has been occurring steadily since 1997) and conversion of brackish marsh habitat to salt marsh habitat. Although we saw some conversion back to brackish marsh in 2003 that largely persisted into 2004, we also continued to see substantial gains in salt marsh habitat from new marsh formation.

Although there is substantial interannual variation, a net gain of 11.6 acres salt marsh habitat has occurred in the Reference Area between 1989 and 2004 (Table 5). The majority of salt marsh decline in the Reference Reach occurred early in the study period between 1991 and 1996 (Figure 3), including a slight decline in 2000, a rebound in 2001 and 2002, another slight decline in salt marsh area in 2003, followed by a strong rebound in 2004. This increase in 2004 is predominantly from new marsh formation near the mouth of Alviso Slough.

Figure 3. Salt Marsh Acreage Comparison between 1989 and 2004, by Reach.



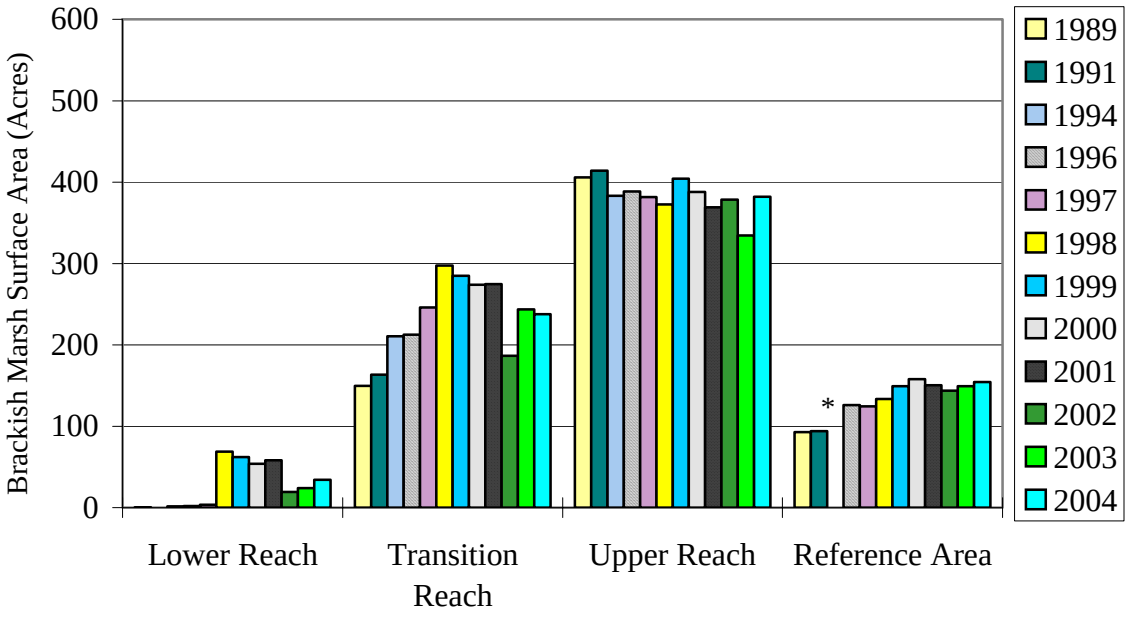
***No data collected in 1994 within Reference Area.**

Brackish and Freshwater Marsh. Figures 4 and 5 present the total acreage of brackish and freshwater marsh habitats by year and location. Brackish marsh area increased by a total of 98.2 acres (18% increase) in the Main Study Area between 1989 and 2004 (Table 4). Although the amount of alkali bulrush actually decreased during this period, peppergrass increased by over 101 acres. The Reference Area has experienced much greater increases in brackish marsh habitat during the same 14 years (Table 5). During this period, brackish marsh increased by 61.8 acres (67% increase) in the Reference Area (Table 5). This is due mostly to marsh conversion (from salt to brackish) in the Reference Area. However, a combination of marsh conversion in the Transition Reach and new brackish marsh formation in the Lower Reach accounts for most

of the new brackish marsh in the Main Study Area since 1989. Furthermore, freshwater marsh has increased in the Main Study and Reference Areas during the past 15 years (Tables 4 and 5).

In the Main Study Area, gains in brackish marsh were most dramatic from 1989 to 1998 in the Lower and Transition Reaches. Since 1998 there has been a trend of decreasing brackish marsh areas (most notably in 2002) within the Lower and Transition Reaches (Figure 4). The brackish marshes showed a recovery in 2003 in the Transition Reach following the significant decline in 2002. The area of brackish marsh has been relatively stable (with an overall downward trend since 1989) in the Upper Reach, with a notable decrease in 2003 and subsequent recovery in 2004 (Figure 4).

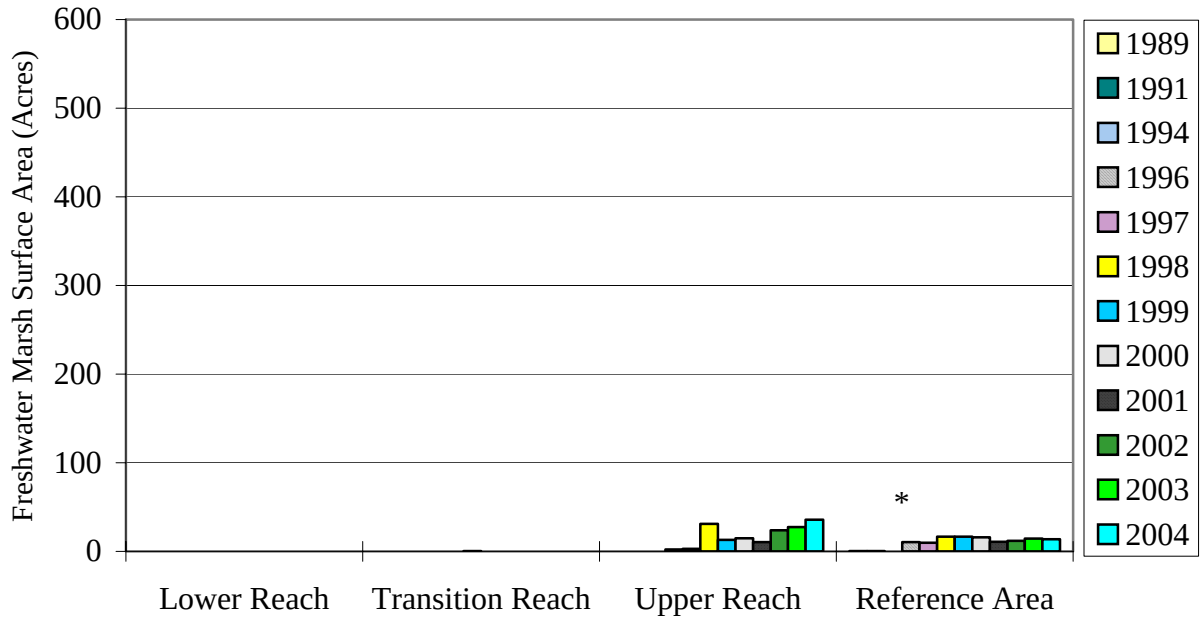
Figure 4. Brackish Marsh Acreage Comparison between 1989 and 2004, by Reach.



***No data collected in 1994 within Reference Area.**

The Reference Area exhibited a steady trend of increasing brackish marsh area from 1991 through 2000, but declined between 2000 and 2002 with a slight rebound in 2003 and 2004 (Figure 4). Increases in freshwater marsh habitat have only occurred in the Upper Reach and Reference Area (Figure 5).

Figure 5. Freshwater Marsh Acreage Comparison between 1989 and 2004, by Reach.



***No data collected in 1994 within Reference Area.**

Habitat Type Conversion

Detailed comparisons by segment location were done by overlaying the 2004 data on the 1989 data in ArcView. Table 6 provides a summary of the segment locations and shifts in acreage by marsh type from 1989 to 2004. This table differs from Tables 4 and 5 in that the changes are defined by reach. The area calculations in Table 6 were derived from a segment reach level analysis in ArcView (Appendix B).

Table 6. Detailed Evaluation of Marsh Type Conversion (in Acres) by Project Reach, 1989 to 2004.

Project Reach	Salt to Brackish or Fresh	Brackish to Fresh	Brackish to Salt	Net Salt Marsh Conversion	Proportion of Salt Marsh Converted	Proportion of Total Marsh Converted
Lower	12.00	0.00	0.03	-11.97	1.5%	1.5%
Transition	94.85	0.00	23.93	-70.92	46.2%	18.1%
Upper	17.33	14.74	10.58	-6.75	24.5%	1.5%
Reference	30.62	1.50	3.89	-26.73	30.8%	10.5%

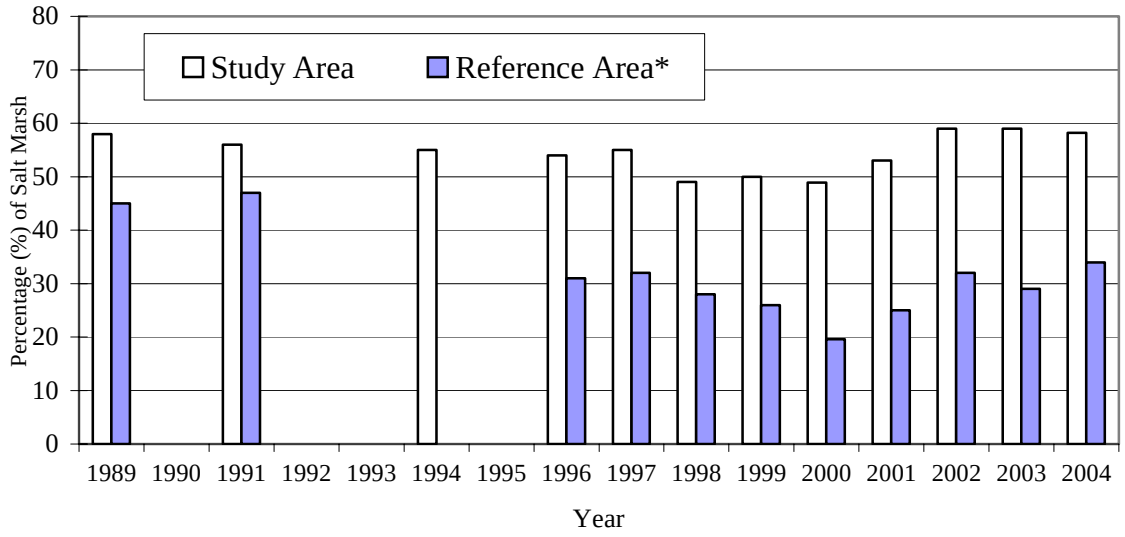
From 1989 to 2004, a total of 124.0 acres of salt marsh habitat has converted to brackish marsh habitat in the Main Study Area, and 30.6 of salt marsh habitat converted to brackish marsh in the Reference Area. However, during the same time period, 34.5 acres of brackish marsh has

converted to salt marsh habitat in the Main Study Area and 3.9 acres in the Reference Area. Therefore, within the Main Study area 89.6 acres of net conversion from salt marsh habitat to brackish marsh habitat has occurred since 1989. In the Reference Area, 26.7 acres of net conversion from salt marsh habitat to brackish marsh habitat has occurred since 1989. This represents a much greater relative percentage in net conversion of salt marsh compared to the overall amount of salt marsh habitat within the Reference Area (31%) than with in the Main Study Area (9%).

Temporal Changes in Proportional Area of Salt and Brackish Marsh between the Main Study and Reference Areas

The proportion of salt marsh and brackish marsh area relative to total marsh area was compared between the Main Study and Reference Areas from 1989 through 2004 (Figures 6 and 7). This analysis was performed to control for the difference in size between the Main Study and Reference Areas as well as to compare temporal trends in salt marsh conversion between these two areas. The percentage of salt marsh in the Main Study Area remained relatively stable from 1989 through 1997 with a decline between 1997 and 2000 (Figure 6). An increase in the percentage of salt marsh occurred from 2000 to 2002 (stabilizing in 2003 and 2004) with a return to 1989/1991 salt marsh area proportions. The relative decline in the percentage of salt marsh was greater in the Reference Area compared to the Main Study Area (Figure 6) and follows a similar temporal pattern. However, a decrease in the relative percentage of salt marsh was observed in 2003 for the Reference Area, which was not seen in the Main Study Area. However, the relative percentage of salt marsh in the Reference Area recovered in 2004, while the Main Study Area remained stable.

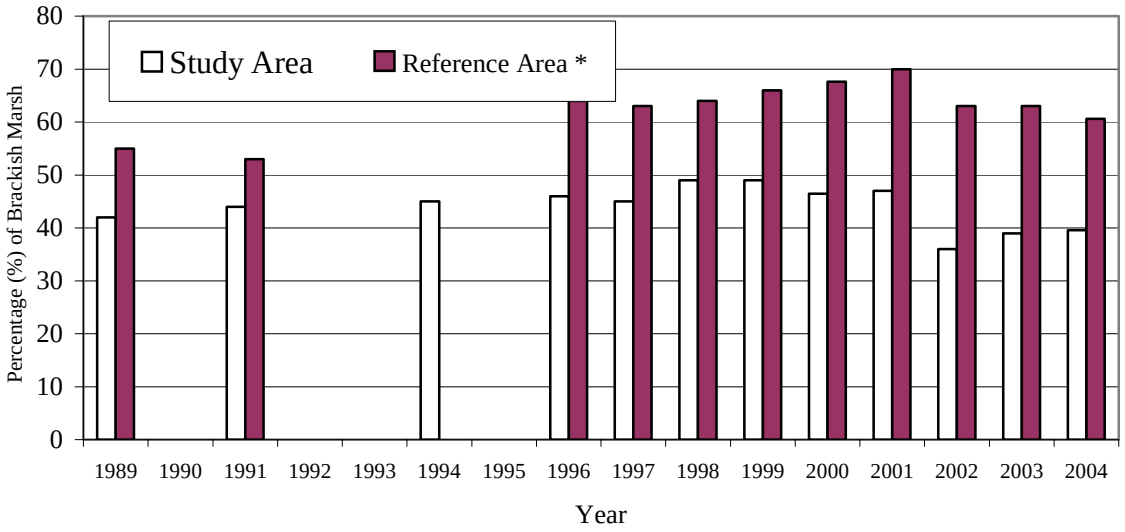
Figure 6. Temporal Comparison of the Proportion of Salt Marsh Area between the Main Study and Reference Areas



***No data collected in 1994 within Reference Area.**

The proportion of the Main Study Area that is brackish marsh has been hovering between 40-50% until 2002 (Figure 7). The 2002 sampling was the first significant decrease in the percentage (10%) of brackish marsh since the study began. The percentage of brackish marsh increased in 2003 and 2004, but did not return to the 2001 level (Figure 7). The Reference Area showed a steady increase in brackish marsh until 2001; a larger increase in the percentage of brackish marsh was observed in the Reference Area than in the Main Study Area (Figure 7) between 1989 and 2001. This increase in the proportion of brackish marsh area to total marsh area in the Reference Area occurred primarily between 1991 and 1996 and between 1998 and 2001 (Figure 7) during the same time that the percentage of salt marsh declined (Figure 6). The percentages of brackish marsh decreased in 2002 through 2004 and they represent the lowest since 1991.

Figure 7. Temporal Comparison of the Proportion of Brackish Marsh Area between the Main Study and Reference Areas



***No data collected in 1994 within Reference Area**.

DISCUSSION

NEW MARSH FORMATION

There has been a net increase of 315.7 acres (24%) of overall marsh area (new marsh formation less marsh loss) since 1989 in the Main Study Area. The majority of this increase is due to sediment accretion along slough and river channels and subsequent vegetation colonization to form new marsh area. The majority of all new marsh formation in the Main Study Area occurred in the Lower Reach (Segments 2, 3 and 4, as well as Segments 22, 23 and 30) located near the mouth of Coyote Creek (Appendix B, Figures B-5 through B-8). Substantial sedimentation along Coyote Creek has raised the elevations to a level that now supports the growth of emergent plant species.

The salt marsh habitat in the South Bay consists primarily of pickleweed (*Salicornia virginica*), and two species of cordgrass including California cordgrass (*Spartina foliosa*), and smooth cordgrass (*S. alterniflora*), and its hybrids (*Spartina alterniflora* [hybrids]), a non-native species from the east coast. It is often difficult to distinguish between the cordgrass species and the hybrids, especially without the ability to enter the marsh and examine the plants closely. Therefore, the mapping effort was not able to distinguish between these species and they were mapped collectively as cordgrass. However, based on morphological observations made in the field, we assume that the native species as well as hybrids with the invasive cordgrass are both present in the study area. Control and management of *Spartina alterniflora* [hybrids] falls primarily within the scope of the Invasive Spartina Project (California State Coastal Conservancy and U.S. Fish and Wildlife Service 2003).

The newly formed mudflat continues to be colonized by a mixture of cordgrass and annual pickleweed (*Salicornia europaea*). Only a small portion of the new marsh formation in the Lower Reach is dominated by alkali bulrush. All of the alkali bulrush polygons in the Lower Reach have pickleweed as a subdominant. It should be noted that the entire brackish marsh habitat (approximately 25.5 acres) within the Lower Reach is newly formed marsh. Furthermore, much of the newly formed alkali bulrush-dominated marsh in the Lower Reach mapped in 2001 has converted to salt marsh habitat dominated by pickleweed.

New marsh formation in the Lower Reach occurred rapidly beginning in 1997 and continued through this year. The mudflats at Calaveras Point likely reached an elevation that would support wetland plant species in 1996/97 and were rapidly colonized thereafter. The large mudflat in Coyote Creek just upstream of the confluence with Alviso Slough is now at an elevation that will support wetland plant species. Beginning in 2002, numerous small patches of cordgrass were noted on the mudflats however, the patches were very scattered and are not large enough to map. As predicted, this mudflat has colonized almost exclusively by cordgrass in 2003 and 2004. This process will continue to dramatically increase the area of vegetated marsh within the Main Study Area. These areas of newly formed marsh should be monitored closely, as they will likely be the first marshes to be impacted by any increases in tidal scour related to

the restoration of tidal action (breaching) to any salt ponds in the Alviso Complex as part of the South Bay Salt Pond Restoration project.

Wildlife Habitat Requirements

The dominant plant species of tidal salt marshes in South San Francisco Bay include pickleweed (mainly *Salicornia virginica*) and cordgrass (*Spartina* sp.). Pickleweed dominated salt marsh provides habitat for a unique assemblage of animal species including the federally and state-endangered salt marsh harvest mouse (*Reithrodontomys raviventris raviventris)* and California Clapper Rail (*Rallus longirostris obsoletus*). A brief description of the habitat requirements of these species will assist in understanding the implications of the current habitat distribution in the South Bay.

The California Clapper Rail is a secretive marsh bird currently endemic to the marshes of San Francisco Bay. It formerly bred at several other locations, including Humboldt Bay, Elkhorn Slough (Monterey County), and Morro Bay, but is now extirpated from all sites outside of San Francisco Bay. California Clapper Rails nest in salt and brackish marshes along the edge of the bay, and are most abundant in extensive salt marshes and brackish marshes dominated by cordgrass, pickleweed, and marsh gumplant, and containing complex networks of tidal channels (Harvey 1980). Shrubby areas adjacent to or within tidal marshes are important for predator avoidance at high tides.

The salt marsh harvest mouse is a small mouse endemic to salt marshes of San Francisco Bay. The salt marsh harvest mouse's current distribution includes salt marshes in San Francisco, San Pablo, and Suisun Bays. These mice are dependent on dense vegetative cover, usually in the form of pickleweed and other salt dependent or salt tolerant vegetation in both tidal and diked salt marshes (Fisler, G. F. 1965; Shellhammer, H. S. 1982; Shellhammer, H. S. 2000b; Shellhammer, H. S. and others 1988; Shellhammer, H. S. and others 1982). Pickleweed provides more horizontal branches (and therefore more cover) than other halophytic species. Closely tied to the cover of dense pickleweed, salt marsh harvest mice make little use of pure alkali bulrush or pacific cordgrass stands (Shellhammer 1977; Wondolleck and others 1976). Grasslands adjacent to pickleweed marshes are generally used only in the spring when new growth affords suitable cover and possibly forage (Johnson and Shellhammer 1988). Salt marsh harvest mice may also use adjacent grasslands on a daily basis to avoid high tide events, but only a small percentage of the edge of the South Bay has grassland or even much in the way of escape cover adjacent to it (Howard Shellhammer, pers. comm.), hence the salt marsh harvest mice have almost nowhere to go to escape from high tides. Refugial vegetation, especially that composed of peripheral halophytes, is necessary in tidal marshes and in diked marshes that flood seasonally. On the highest spring tides in winter, the lack of high-tide refugia exposes salt marsh harvest mice to intense predation, and numerous small mammals (many of which are likely salt marsh harvest mice) have been observed being depredated by gulls, herons, egrets, and raptors on such high tides in the South Bay. Marshes without appropriate cover, and narrow marshes without refugial zones into which the mice can escape during flooding or high tides, generally lack salt marsh harvest mice.

Marsh Conversion

From 1989 to 2001, losses in salt marsh habitat (in the Main Study Area) from conversion to other habitat types were balanced by increases in salt marsh habitat via new marsh formation. The majority of salt marsh habitat conversion during the past thirteen years is attributed to losses of pickleweed and cordgrass-dominated associations, and increases in alkali bulrush and peppergrass associations.

In the past several years, the total acreage of salt marsh habitat and brackish marsh habitat within the Main Study Area were nearly equal. However, in 2002, the area of salt marsh was substantially greater than the area of brackish marsh habitats within the Main Study Area. Most of that conversion was due to the dieback of alkali bulrush and replacement by pickleweed and cordgrass as dominant plant species. Most of the conversion of brackish marsh to salt marsh occurred in the Transition and Lower Reaches; areas that had been rapidly converting from salt to brackish marsh habitat during the previous seven years.

From 2002 to 2003, the area of salt marsh in the Main Study Area decreased by almost 48 acres, while the amount of brackish marsh increased by just under 62 acres. The 2004 data indicates a bit of a recovery in the area of salt marsh from the decrease in 2003 (Figures 3 and 4), especially in the Transition Reach (Table 6). In 2004, there were approximately 3 less acres of salt-to-brackish conversion, and 6 more acres of brackish-to-fresh conversion in the Transition Reach than in 2003 (Table 6). The overall area of salt marsh habitat is still substantially greater than the area of brackish marsh, and the amount of net salt marsh conversion in the Main Study Area is still less that that observed in 2001.

In Alviso Slough in 2002, the ratio between brackish and salt marsh habitat decreased and brackish marsh habitat was only about twice the area of salt marsh habitat (Figures 6 and 7). In 2003 and 2004, the ratio between the two marsh types remained consistent.

The only segments where conversion (either from salt to brackish or brackish to salt) has not occurred during the last 14 years are those segments located immediately adjacent to San Francisco Bay (Segments 1, 2 and 8). These marshes are likely outside of the immediate influence of Coyote Creek and Alviso Slough flows but are instead influenced directly by San Francisco Bay hydrology. The lack of salt marsh conversion adjacent to San Francisco Bay and in the bayward portion of Mowry Slough (Segment 8) within the Main Study Area may indicate that the factors affecting marsh conversion are limited to the Coyote Creek and Alviso Slough reaches. The two factors that differ between these areas are freshwater input and channel morphological variation.

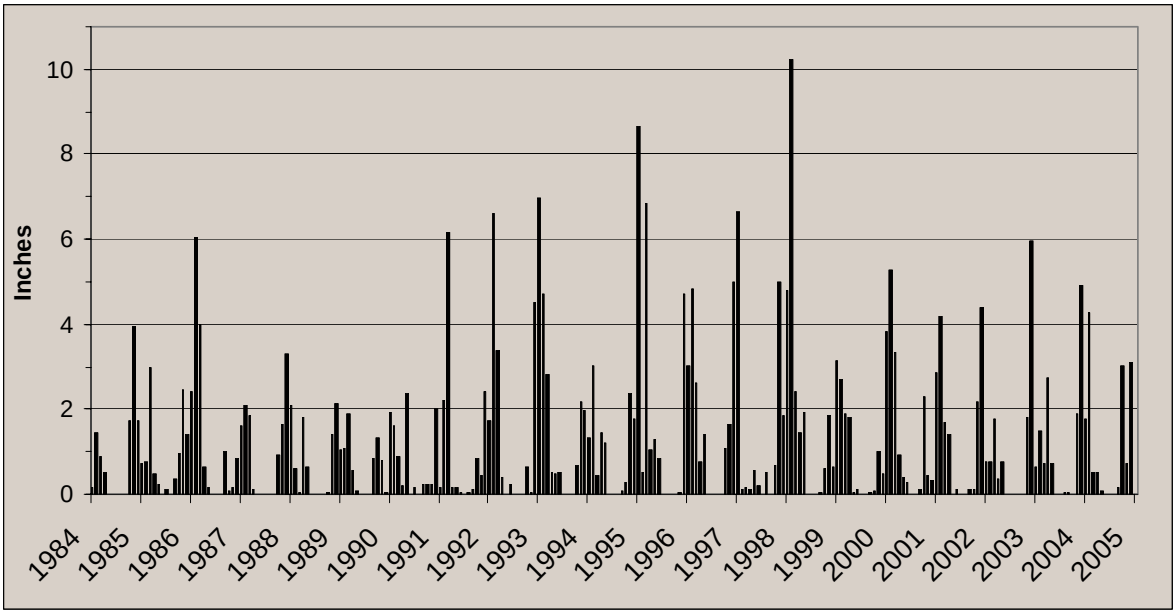
Historically, the channel-side vegetation in the transition segments may have been dominated by brackish (alkali bulrush) and freshwater species (tules), based on observations dating as far back as the mid-1800s (SFEI 1999). Salt marsh habitat dominated by pickleweed and saltgrass likely occurred inland of the channel-side vegetation (SFEI 1999). Those areas that were historically salt marsh have largely been converted to salt ponds. Many of the existing marshes, located between the levees of the salt ponds and the channels, have formed more recently. The present day channel-side brackish marshes are likely similar to the edges of the historical marshes that at

one time contained patches of lower salinity marshes within a larger matrix of salt marsh habitat (SFEI 1999). The formation of new alkali bulrush-dominated marshes in a matrix of salt marsh habitats has been observed in the Lower Reach in this study. This is further evidence of the highly dynamic nature of vegetation trends in South San Francisco Bay. These changes from historical conditions appear driven by large-scale environmental factors such as changes in local freshwater inputs and landscape-scale changes such as salt pond construction (SFEI 1999) and subsequent changes in channel morphology

From 1989 to 2001 the entire study area was becoming less saline. For example, no freshwater marsh habitat was mapped prior to 1996 in the Main Study Area or Alviso Slough (except in Segments 25 to 27, which are not part of the 10-year analysis) but now accounts for almost 90 acres within the Main Study area. However, the majority of the freshwater marsh observed on site is in those segments (25 to 27) that are excluded from the comparisons to the 1989 data, as these areas were not mapped until later years. In 2001, Segments 25, 26 and 27 (the most upstream reaches of Alviso and Artesian Sloughs) comprised the majority of the freshwater marsh habitat within the study.

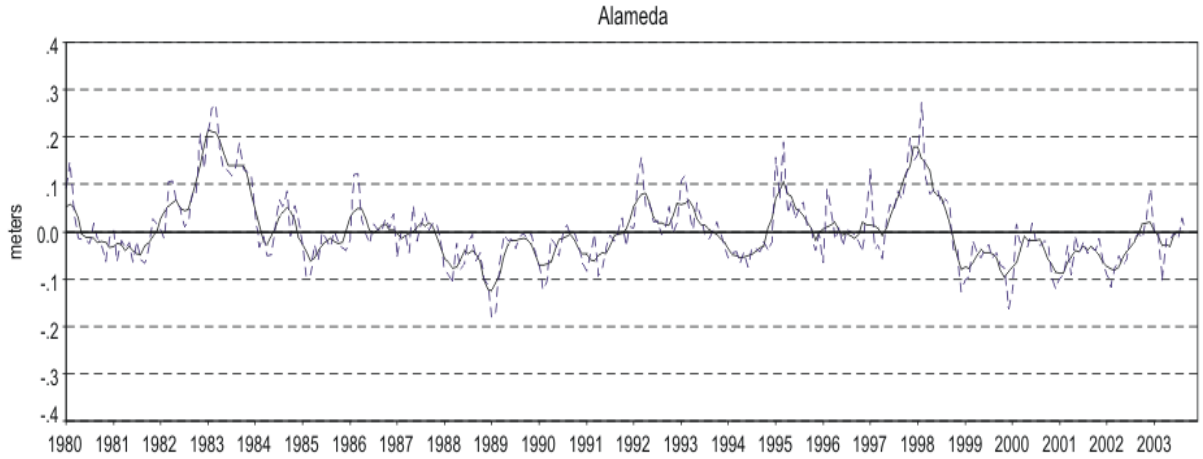
Newly-forming freshwater marsh habitat in both the Reference Area and the Main Study Area indicates that freshwater influences (*e.g.*, channel discharges) are affecting all marshes in the vicinity. Additionally, the net salt marsh acreage within the Main Study Area has been relatively stable during this period of increased freshwater impacts but increased in 2002 due to brackish marsh conversion. The conversion of brackish marsh to salt marsh in 2002 indicates that freshwater from channel discharges has likely decreased over the past several years in response to a decrease in annual precipitation since 1998 (Figure 8). The conversion back to brackish marsh in 2003 of some of the marshes converted to salt marsh in 2002 could be a direct result of the heavy late rains that occurred in April and May of 2003.

Figure 8. Monthly rainfall totals for San Jose, California January 1984 to December 2004 (National Weather Service station at San Jose).



Between 1989 and 1999, the relative change in habitat types through time was less in the Main Study Area than in the Reference Area, although the rate of new marsh formation in the Main Study Area exceeded that of the Reference Area. This indicates that much of the conversion of salt marsh habitats within the South San Francisco Bay area was likely driven by large-scale influences (both environmental and anthropogenic) that were affecting the entire system. In 2001 small gains in salt marsh habitat occurred in both the Main Study Area and Reference Area. In 2002 even greater gains in salt marsh habitat were observed. In 2003 and 2004, some of the gains in salt marsh observed in 2002 were lost, but the amount of salt marsh was still greater than in 2001. This trend seems to further highlight the influence of multiple factors affecting changes in marsh vegetation communities in South San Francisco Bay. The relative percentage of brackish marsh in the Main Study Area and the Reference Area (Figure 7) shows similar trends to the amount of annual rainfall (Figure 8), as well as to the interannual variations of mean sea level (Figure 9, data only available through 2003), both of which are tied to the El Niño/Southern Oscillation weather patterns.

Figure 9. Interannual variation of mean sea level for Alameda, California 1980-2003 (NOAA/NOS, http://tidesandcurrents.noaa.gov/sltrends).



Note: The plot shows the monthly mean sea level with the average seasonal cycle and the linear trend removed (dashed curve) and the 5-month average (solid curve). The data are taken at Alameda and the graph is indicative of the trends in San Francisco Bay. However, it should be noted that the tidal amplitude in the South Bay is greater than the values reported above for Alameda.

One factor that can influence marsh plant distribution is the flow of freshwater over the salt water lens and up onto the marsh surface. An increase in the mean sea level in a particular year can therefore increase the amount of freshwater reaching the marsh surface. The increase in mean sea level (Figure 9) combined with the high rainfall in 1998 (Figure 8) can account for some of the observed decreases in salt marsh vegetation that year (H.T. Harvey & Associates 1998).

Physical Effects

The direct impacts to marshes from the WPCP plant can only be determined from a study that includes both physical and biological variables that could be influenced by the freshwater flows. To better understand the causes of habitat conversion, monitoring of water levels, salinities and selected edaphic characteristics began in August 1999 (H.T. Harvey & Associates 2001b). Information from that study indicates that soil salinities are correlated with dominant plant species distribution and subsequent habitat types.

Interstitial soil salinities and soil bulk density were significantly different between habitat types (H. T. Harvey & Associates 2001b). Freshwater marshes had the lowest interstitial salinities and salt marshes the highest; brackish marsh habitats had intermediate interstitial salinities. Soil bulk densities were the highest in salt and brackish marsh habitats and were significantly lower in fresh marsh habitats. The reference area and the Upper Reach had mean interstitial salinities significantly lower than the remainder of the Main Study Area. The Transition and Lower Zones had significantly higher mean interstitial salinities than the Reference Area (H. T. Harvey & Associates 2001b). This indicates that similar freshwater flows influence the Reference Area and the Upper Zone of the Main Study Area. Furthermore, it can be hypothesized from this

study that decreases in freshwater influences will cause an increase in soil salinities leading to a conversion of brackish marsh to salt marsh habitat, as occurred in 2002.

Alkali bulrush distribution does not appear to be solely related to interstitial salinities. However, its distribution is likely related to a combination of environmental stress factors including interstitial salinities, interspecific competition and depth and duration of flooding over the marsh surface, all of which may be dramatically altered by increases in freshwater discharge. Alkali bulrush was found growing and thriving as the dominant plant species in locations where the interstitial salinities were as low as 1.1 ppt and as high as 51.8 ppt. Furthermore, alkali bulrush does occur as a dominant species in some areas of the colonization of new marsh in the high salinity zones of the Lower Reach.

The WPCP has had past influences on the plant species distribution in the South Bay Marshes. For example, the majority of Artesian Slough, a slough that dead ends at the discharge point for the WPCP, is freshwater marsh habitat. Without the WPCP discharge we would predict that Artesian Slough would consist of a mixture of brackish and salt marsh habitats. However, WPCP discharges have been relatively constant since 1989 (120 mgd), while salt marsh conversion has dramatically fluctuated. Therefore, it is likely that much of the interannual variation in habitats within the South Bay marshes is due to large-scale environmental factors (*e.g.*, changes in annual rainfall patterns). However, it is interesting to note that the habitats along the southern bank of Coyote Creek are brackish, whereas the habitats along the northern bank of Coyote Creek (and on into Mud Slough) are more saline (Figure A2). However, this is likely not solely related to the WPCP discharge, as other factors such as freshwater inputs from Coyote Creek, being on the inside of a bend, and the increased tidal prism from the Warm Springs restoration, also influence the observed habitat distribution.

Although the WPCP has had an effect upon portions of the system, discharges from Guadalupe River (Alviso Slough), Coyote Creek and the Sacramento/San Joaquin Delta also play a role in marsh conversion and formation. For example, the Reference Area has experienced a greater rate of salt marsh conversion than the Main Study Area. The Reference Area is hydrologically disconnected from the WPCP discharge (H. T. Harvey & Associates 2001b), yet it received flows from the Guadalupe River. Also, conversion of brackish marsh habitats to salt marsh habitats occurred in all reaches during the past year including Segments 15 and 21 immediately across from the mouth of Artesian Slough.

In the past 15 years, the Main Study Area has not been in a steady state with regards to the reduction in tidal prism and subsequent sedimentation within the channels. Therefore, it is difficult to discern what the steady state effects of the freshwater discharge would be on the marsh habitats. We do know that there has been only a minimal conversion of salt marsh to brackish marsh habitat (approximately 12 acres) in the Lower Reach segments, and therefore it can be assumed that the influence of the WPCP discharge does not extend beyond the Transition Zone of the Main Study Area. Furthermore, the trend of decreases in brackish marsh habitats and concurrent increases in salt marsh habitats since the last El Niño (1997 – 1998) and the interannual variability in marsh conversion rates, indicate that both rainfall and freshwater discharges, in conjunction with changing channel bathymetry in the South Bay, have a dramatic effect on the plant species distribution of the South Bay marshes.

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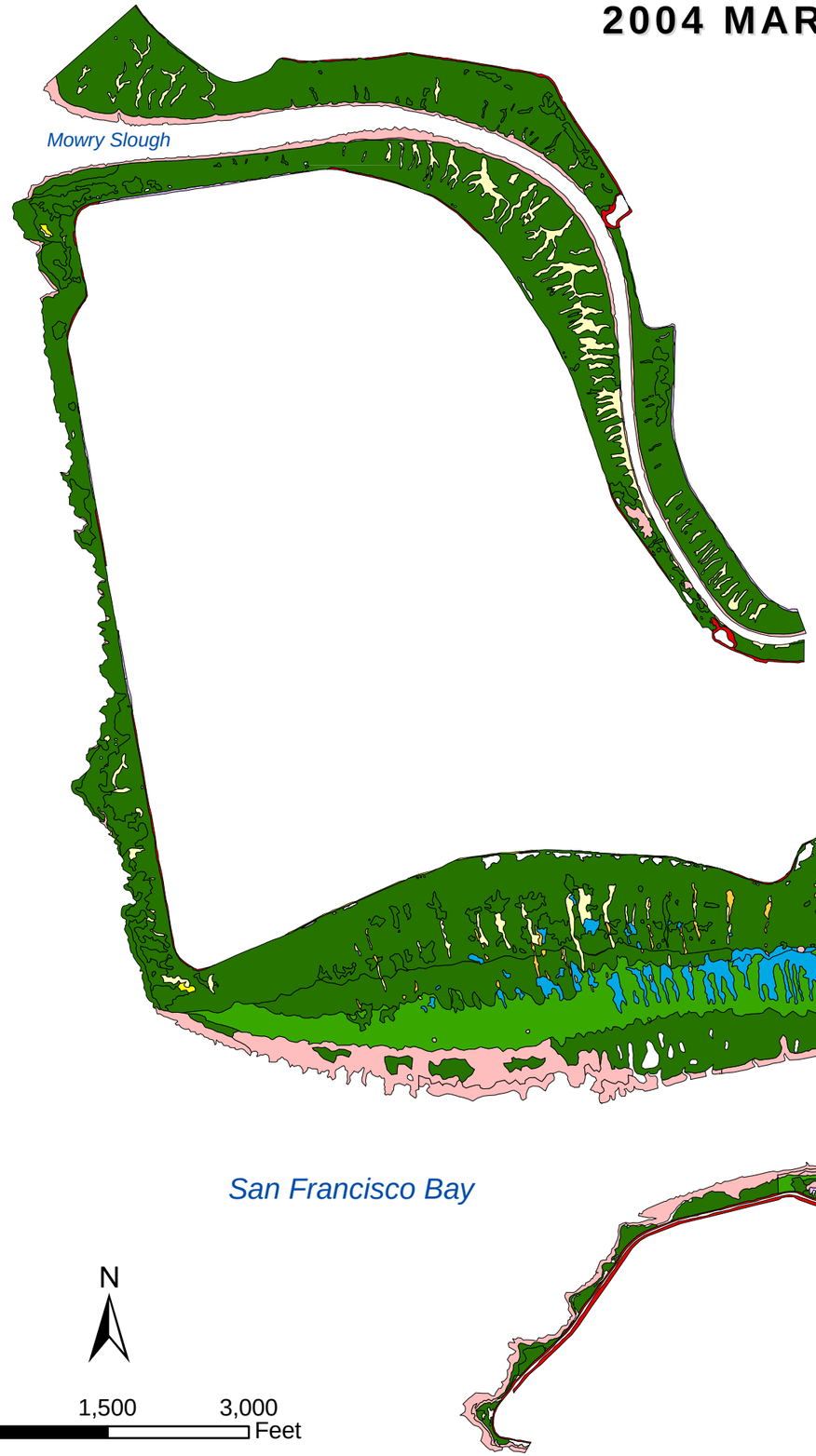
APPENDIX A.
2004 VEGETATION MAPS

2004 MARSH PLANT ASSOCIATIONS OF SOUTH SAN FRANCISCO BAY

LOWER REACH SEGMENTS DOMINANT SPECIES

SEGMENTS 1, 2, 3, 4, 8, 22 and 23



- Alkali Bulrush
- Alkali Heath
- Cordgrass
- Gumplant
- Jaumea
- Peppergrass
- Peripheral Halophytes
- Pickleweed
- Pickleweed-Cordgrass Mix
- Spearscale
- Water

H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

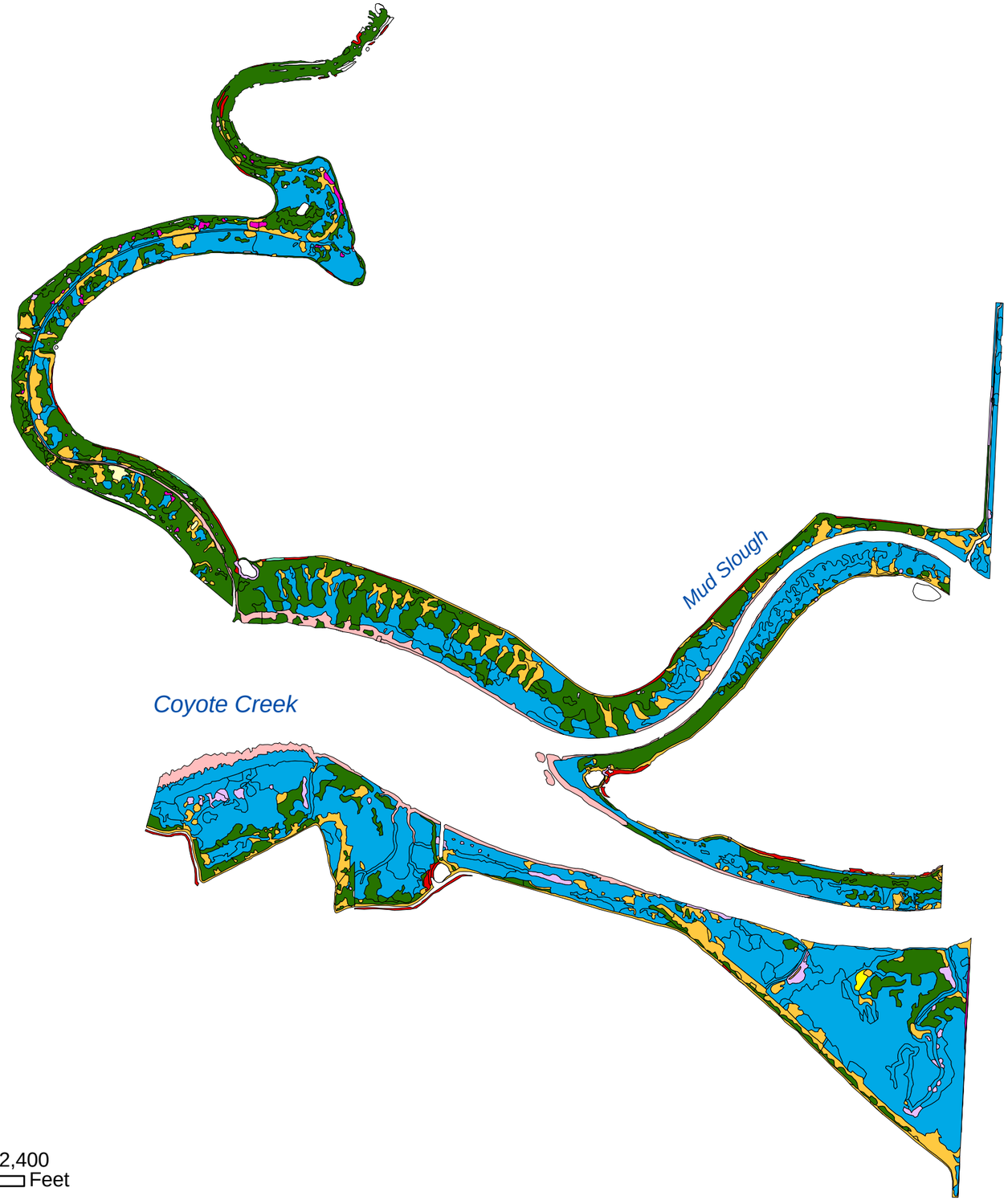
2004 South Bay Marsh Studies Dominant Plant Species By Reach

File No. 477-27	Date 1/14/05	Figure A-1

2004 MARSH PLANT ASSOCIATIONS OF SOUTH SAN FRANCISCO BAY

TRANSITION SEGMENTS DOMINANT SPECIES

SEGMENTS 5, 9, 10, 11, 14 and 20



- Alkali Bulrush
- Alkali Heath
- Cordgrass
- Gumplant
- Jaumea
- Peppergrass
- Peripheral Halophytes
- Pickleweed
- Russian Thistle
- Spearscale
- Water

N

0 1,200 2,400 Feet

H.T. HARVEY & ASSOCIATES
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2004 South Bay Marsh Studies Dominant Plant Species By Reach

File No. **477-27**	Date **1/14/05**	Figure **A-2**

2004 MARSH PLANT ASSOCIATIONS OF SOUTH SAN FRANCISCO BAY

UPPER REACH SEGMENTS DOMINANT SPECIES

SEGMENTS 12, 13, 15, 16, 17, 18, 19, 21, 24, 25 and 26

- Alkali Bulrush
- Alkali Heath
- California Bulrush
- Cattail
- Cordgrass
- Jaumea
- Peppergrass
- Peripheral Halophytes
- Pickleweed
- Pickleweed-Cordgrass Mix
- Smartweed
- Spearscale
- Water Primrose
- Water

H.T. HARVEY & ASSOCIATES
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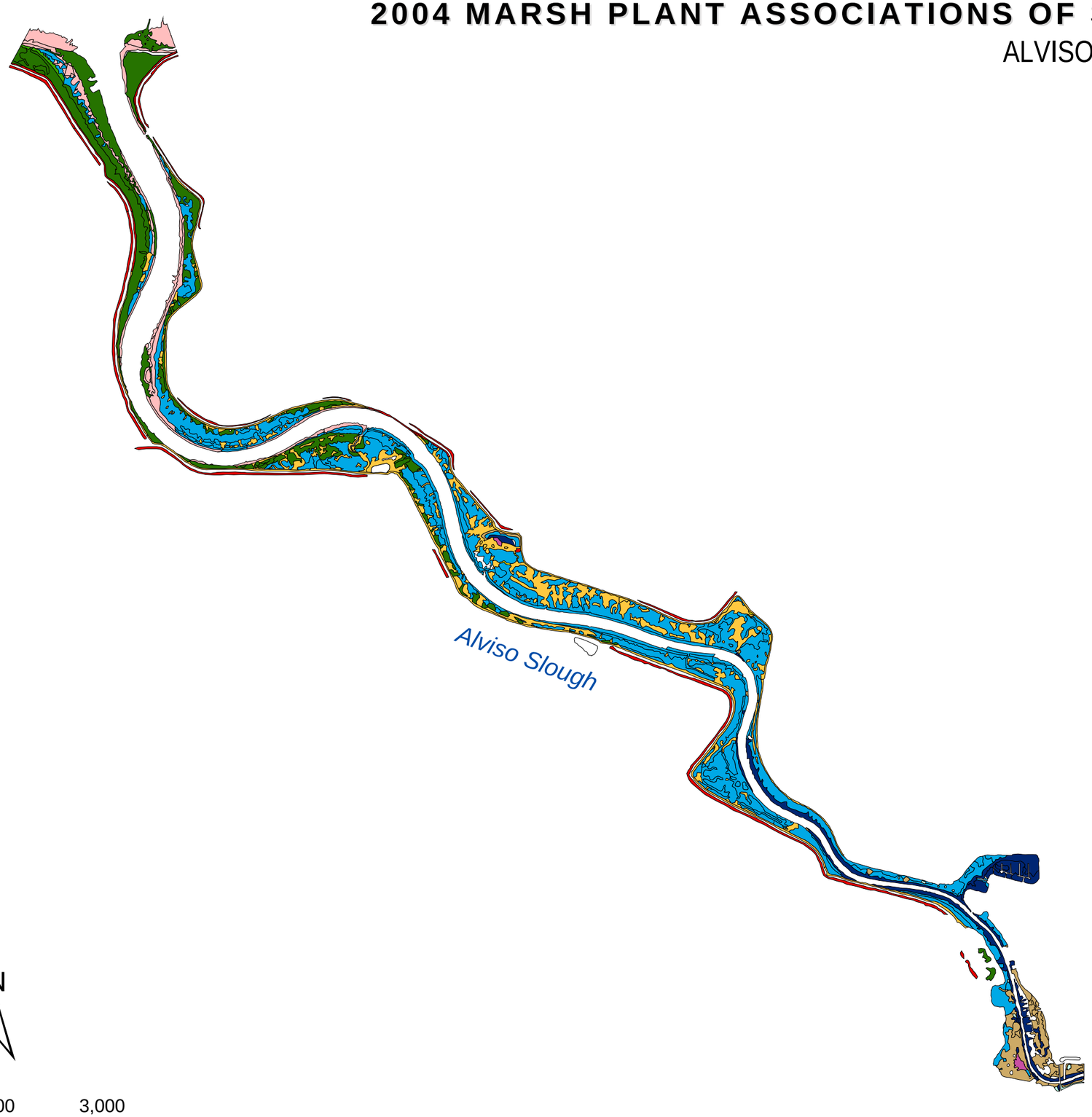
2004 South Bay Marsh Studies Dominant Plant Species By Reach

File No. **477-27**	Date **1/14/05**	Figure **A-3**

2004 MARSH PLANT ASSOCIATIONS OF SOUTH SAN FRANCISCO BAY

ALVISO SLOUGH SEGMENTS DOMINANT SPECIES

SEGMENTS 27, 28, 29 and 30



- Alkali Bulrush
- California Bulrush
- Cattail
- Cordgrass
- Coyote Brush
- Peppergrass
- Peripheral Halophytes
- Pickleweed
- Pickleweed-Cordgrass Mix
- Smartweed
- Spearscale
- Water

N

0 1,500 3,000 Feet

H.T. HARVEY & ASSOCIATES
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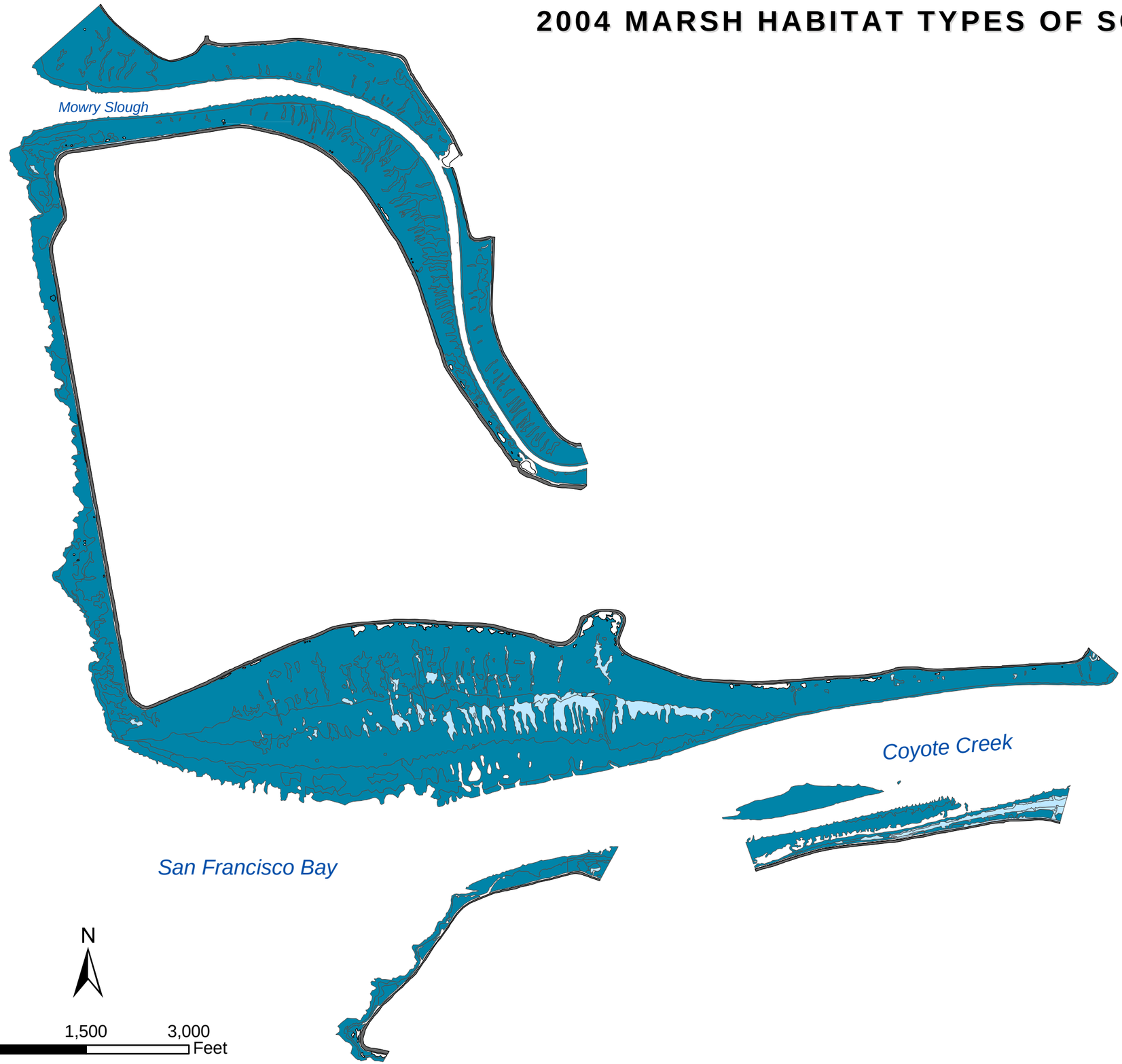
2004 South Bay Marsh Studies Dominant Plant Species By Reach

File No. **477-27**	Date **1/14/05**	Figure **A-4**

2004 MARSH HABITAT TYPES OF SOUTH SAN FRANCISCO BAY

LOWER REACH SEGMENTS HABITATS

SEGMENTS 1, 2, 3, 4, 8, 22 and 23



- Brackish
- Saline
- Levee
- Upland Species
- Water

H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

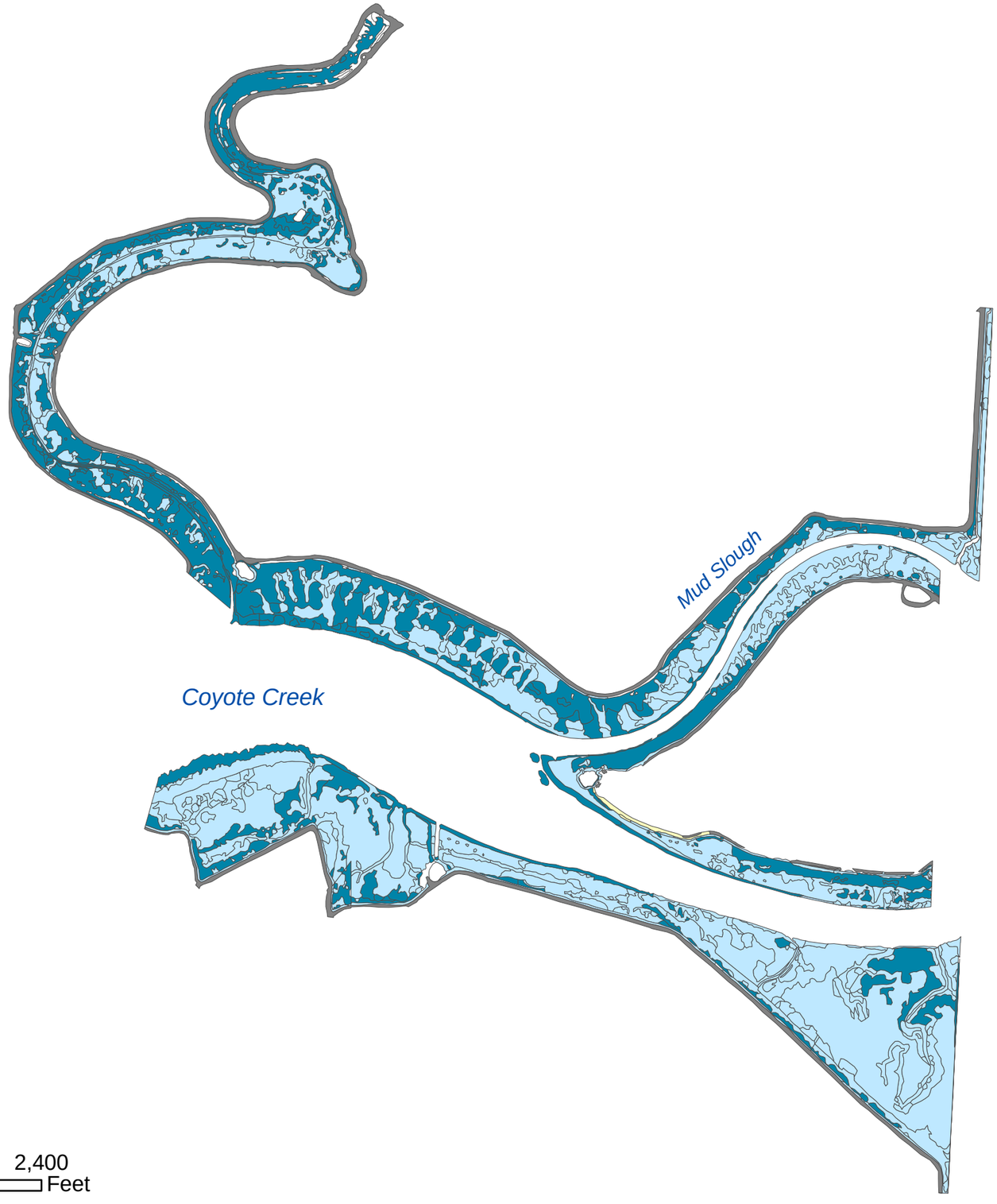
2004 South Bay Marsh Studies Marsh Habitat Types By Reach

File No. 477-27	Date 1/14/05	Figure A-5

2004 MARSH HABITAT TYPES OF SOUTH SAN FRANCISCO BAY

TRANSITION SEGMENTS DOMINANT SPECIES

SEGMENTS 5, 9, 10, 11, 14 and 20



Fresh
Brackish
Saline

Levee
Upland Species
Water

N

0 1,200 2,400 Feet

H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

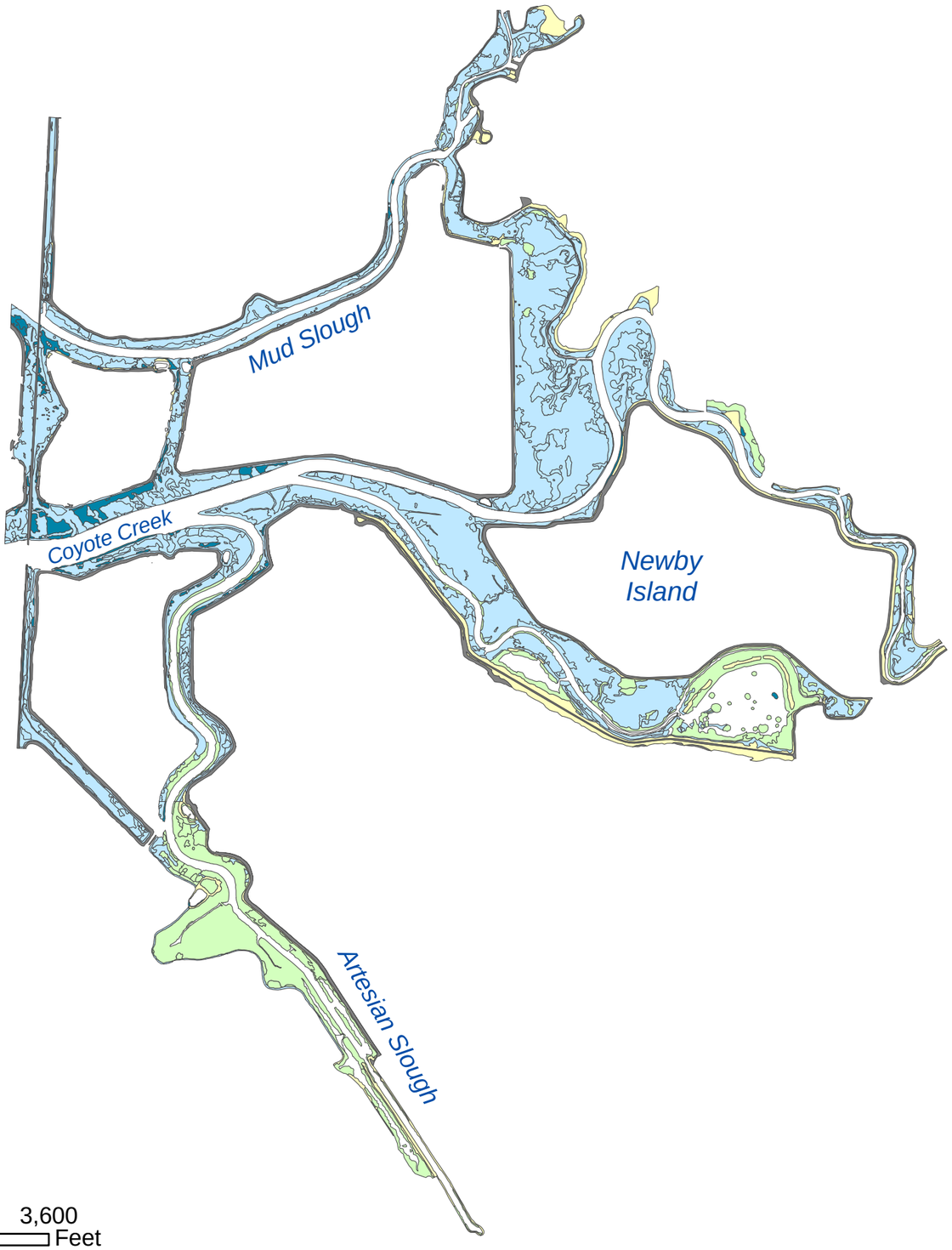
2004 South Bay Marsh Studies Marsh Habitat Types By Reach

File No. **477-27** | Date **1/14/05** | Figure **A-6**

2004 MARSH HABITAT TYPES OF SOUTH SAN FRANCISCO BAY

UPPER REACH SEGMENTS DOMINANT SPECIES

SEGMENTS 12, 13, 15, 16, 17, 18, 19, 21, 24, 25 and 26



- Fresh
- Brackish
- Saline
- Levee
- Upland Species
- Water

H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

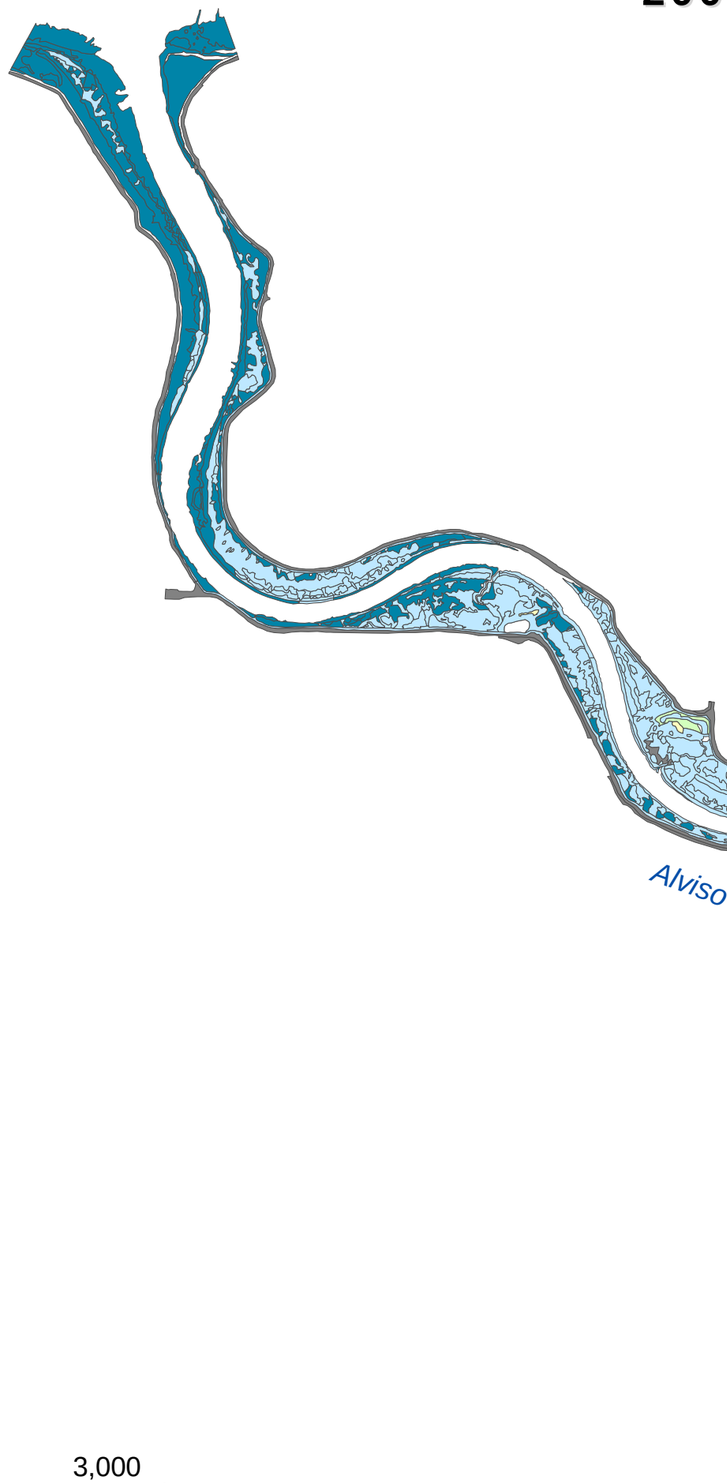
2004 South Bay Marsh Studies Marsh Habitat Types By Reach

File No. **477-27**	Date **1/14/05**	Figure **A-7**

2004 MARSH HABITAT TYPES OF SOUTH SAN FRANCISCO BAY

ALVISO SLOUGH SEGMENTS HABITATS

SEGMENTS 27, 28, 29 and 30



- Fresh
- Brackish
- Saline
- Levee
- Upland Species
- Water

N

0 1,500 3,000 Feet

H.T. HARVEY & ASSOCIATES
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2004 South Bay Marsh Studies Marsh Habitat Types By Reach

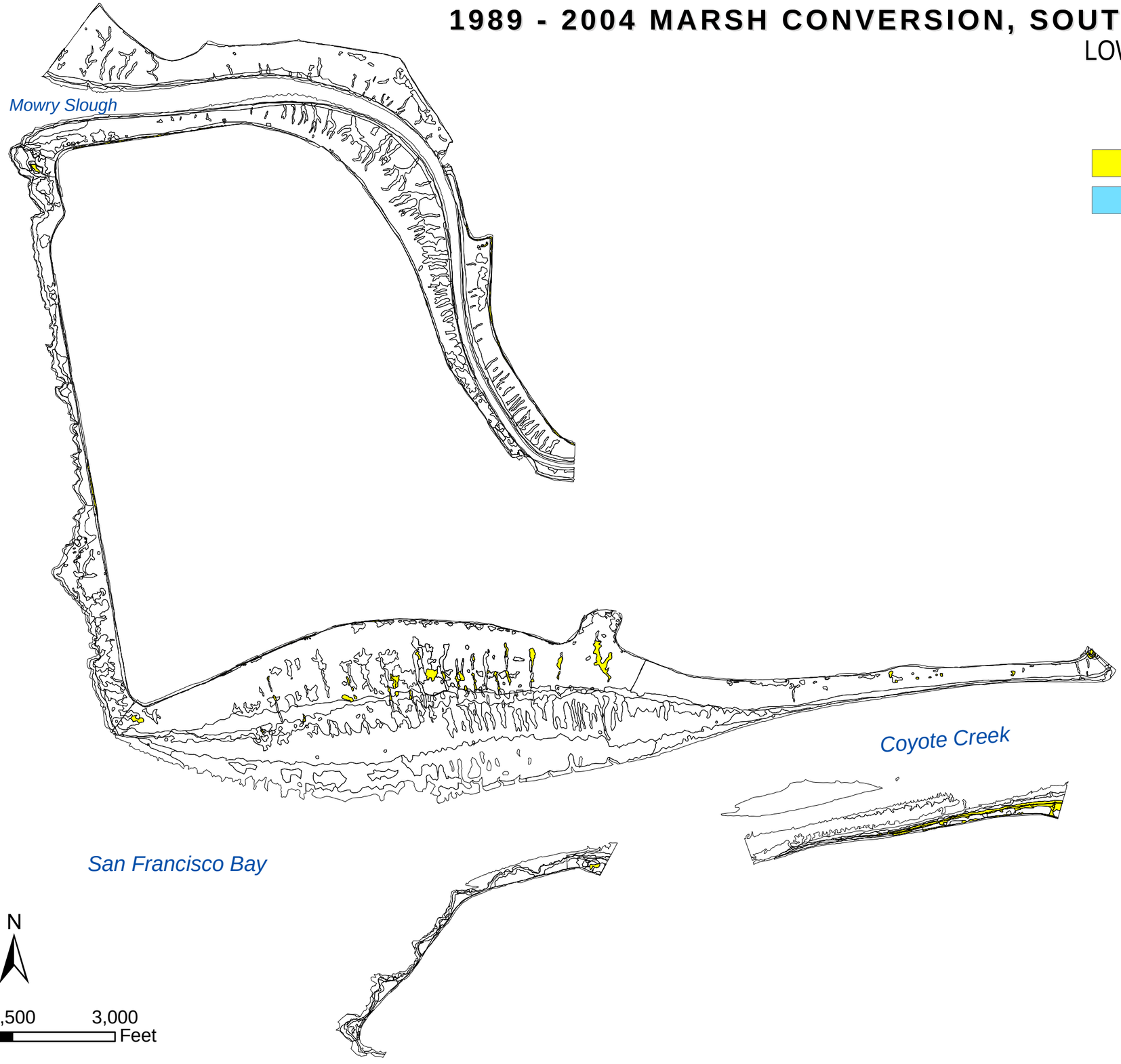
File No. **477-27** | Date **1/14/05** | Figure **A-8**

APPENDIX B.
1989/2004 SPATIAL ANALYSIS MAPS

1989 - 2004 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

LOWER REACH SEGMENTS HABITATS

SEGMENTS 1, 2, 3, 4, 8, 22 and 23



Salt Marsh Converted to Brackish Marsh

Brackish Marsh Converted to Salt Marsh

H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

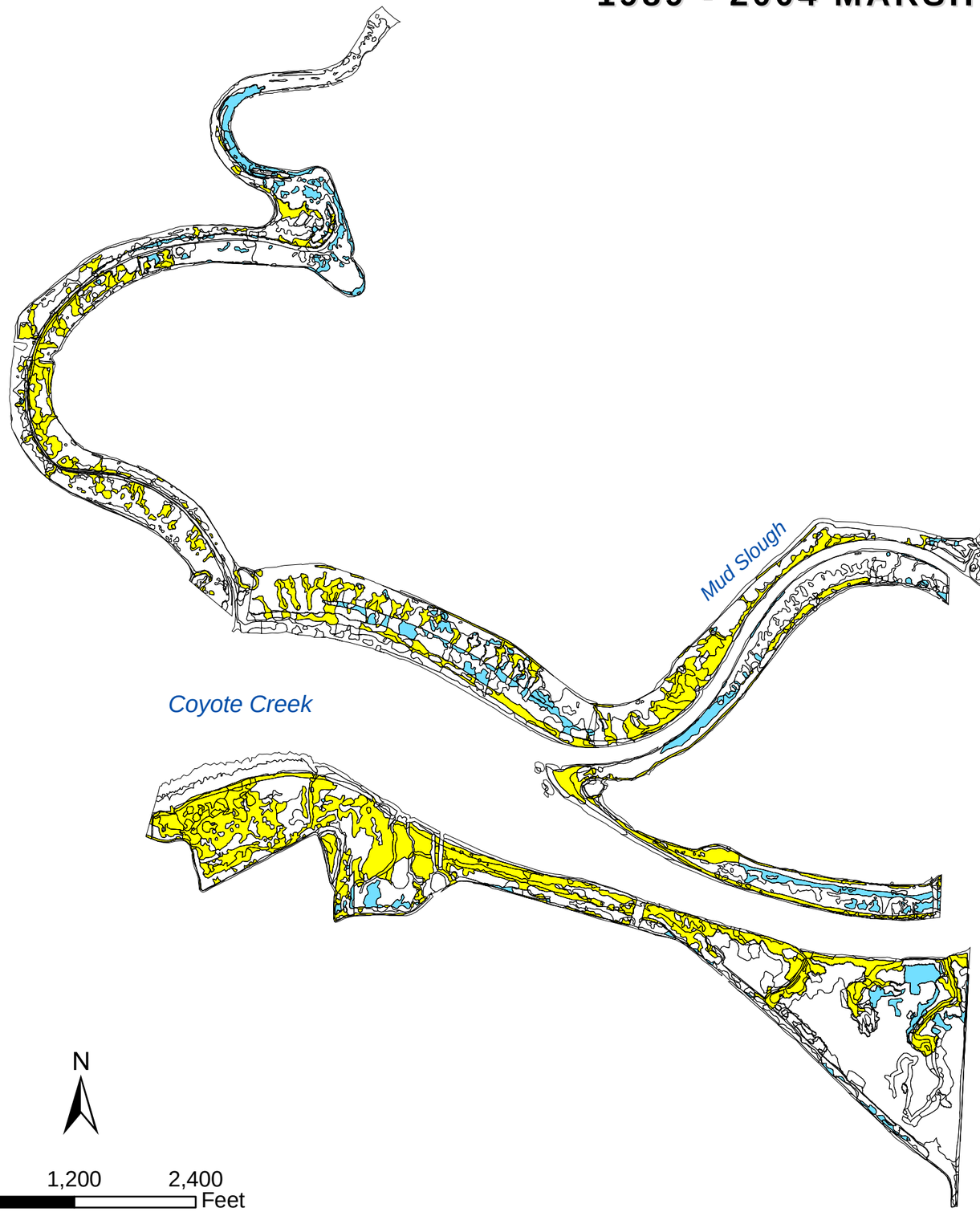
1989 - 2004 Marsh Conversion By Reach

File No. **477-27** | Date **1/14/05** | Figure **B-1**

1989 - 2004 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

TRANSITION SEGMENTS HABITATS SPECIES

SEGMENTS 5, 9, 10, 11, 14 and 20



Salt Marsh Converted to Brackish Marsh

Brackish Marsh Converted to Salt Marsh

H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

1989 - 2004 Marsh Conversion By Reach

File No. **477-27**	Date **1/14/05**	Figure **B-2**

1989 - 2004 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

UPPER REACH SEGMENTS DOMINANT HABITATS

SEGMENTS 12, 13, 15, 16, 17, 18, 19 and 21

- Salt Marsh Converted to Brackish Marsh
- Salt Marsh Converted to Fresh Marsh
- Brackish Marsh Converted to Salt Marsh
- Brackish Marsh Converted to Fresh Marsh

N

0 1,500 3,000 Feet

H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

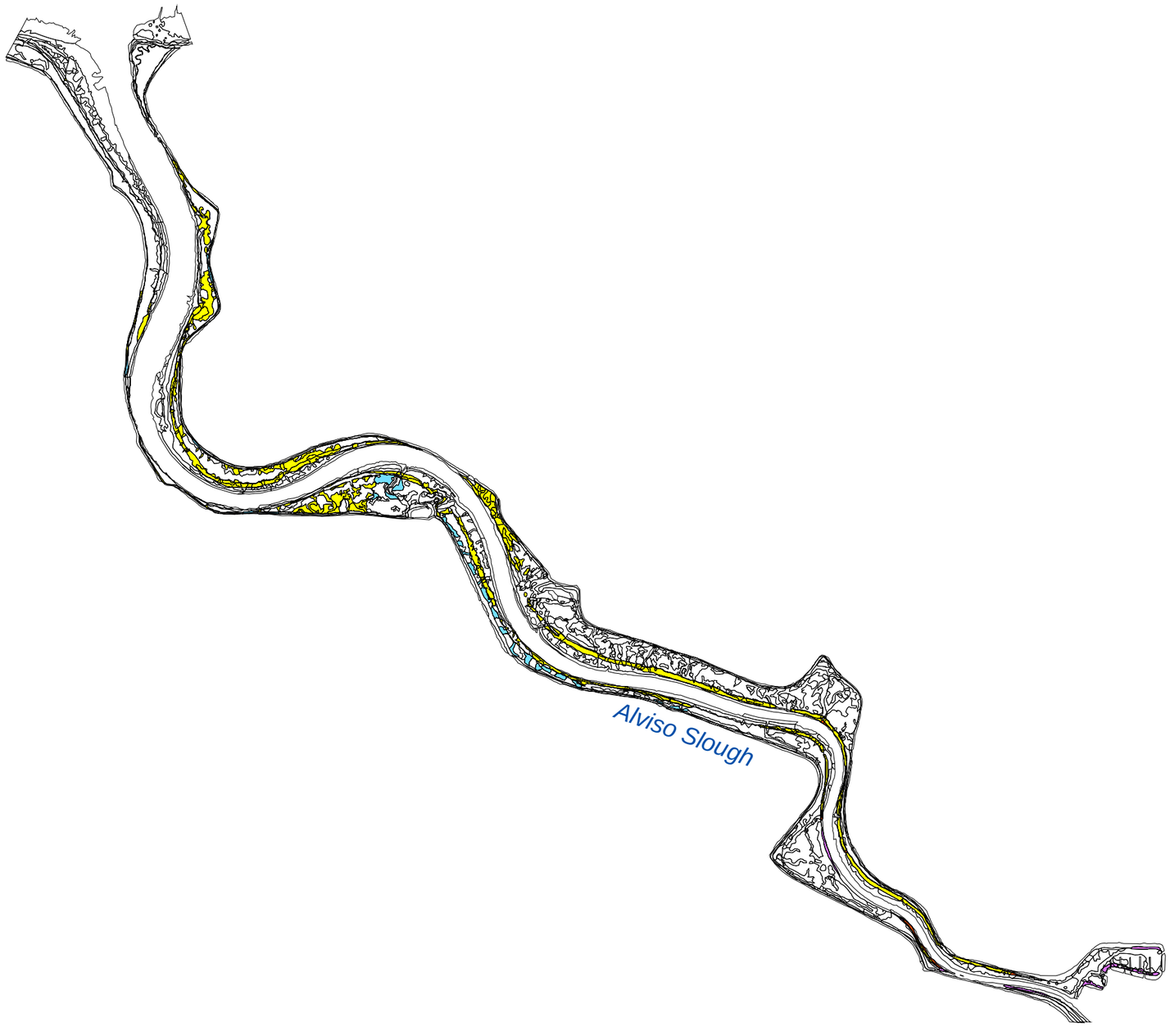
1989 - 2004 Marsh Conversion By Reach

File No. 477-27	Date 1/14/05	Figure B-3

1989 - 2004 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

ALVISO SLOUGH SEGMENTS HABITATS

SEGMENTS 28, 29 and 30



- Salt Marsh Converted to Brackish Marsh
- Brackish Marsh Converted to Salt Marsh
- Saline Marsh Converted to Fresh Marsh
- Brackish Marsh Converted to Fresh Marsh

N

0 1,500 3,000 Feet

H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

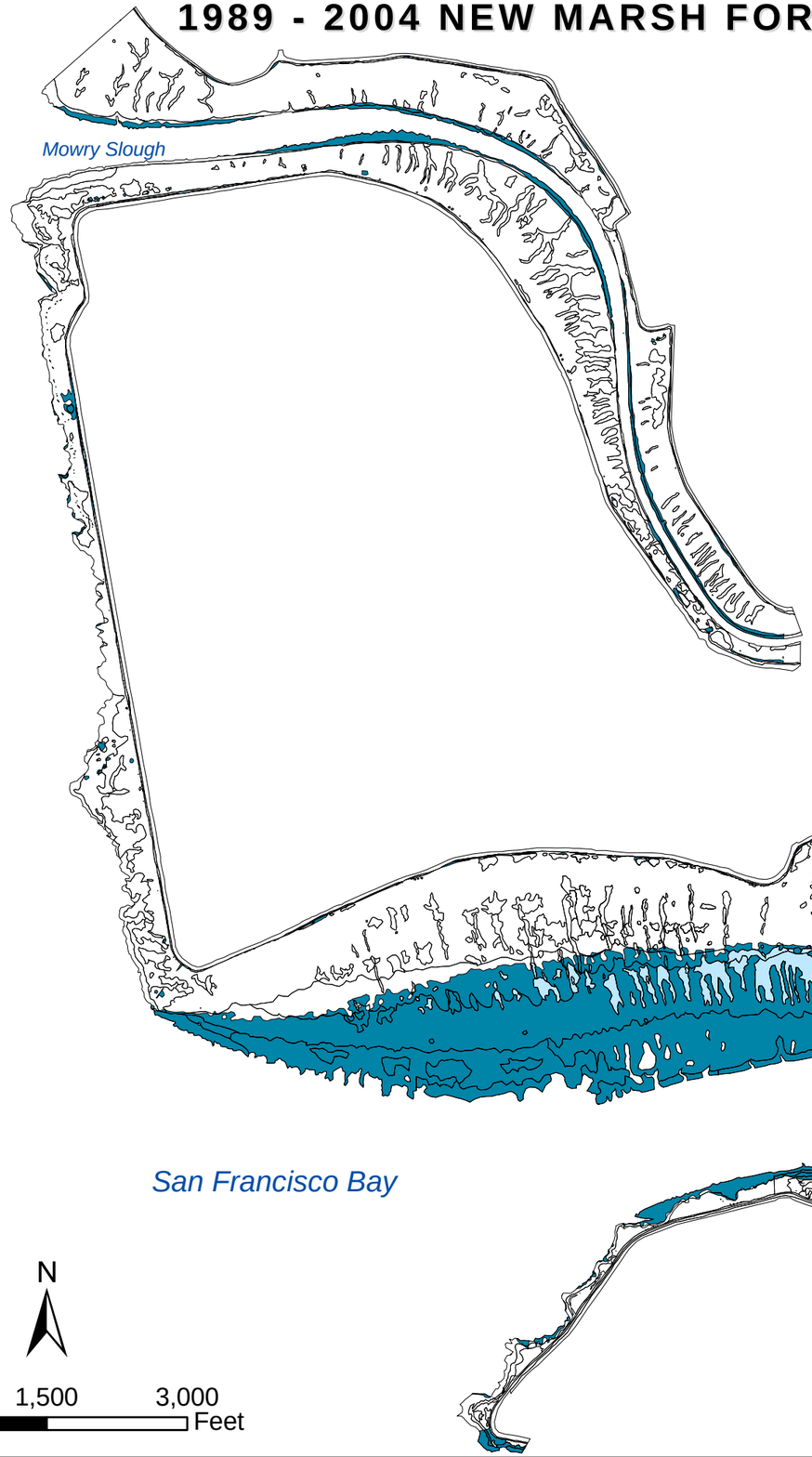
1989 - 2004 Marsh Conversion By Reach

File No. 477-27	Date 1/14/05	Figure B-4

1989 - 2004 NEW MARSH FORMATION BY HABITAT TYPES, SOUTH SAN FRANCISCO BAY

LOWER REACH SEGMENTS HABITATS

SEGMENTS 1, 2, 3, 4, 8, 22 and 23



New Brackish Marsh

New Saline Marsh

H.T. HARVEY & ASSOCIATES
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1989 - 2004 New Marsh by Habitat Type, by Reach

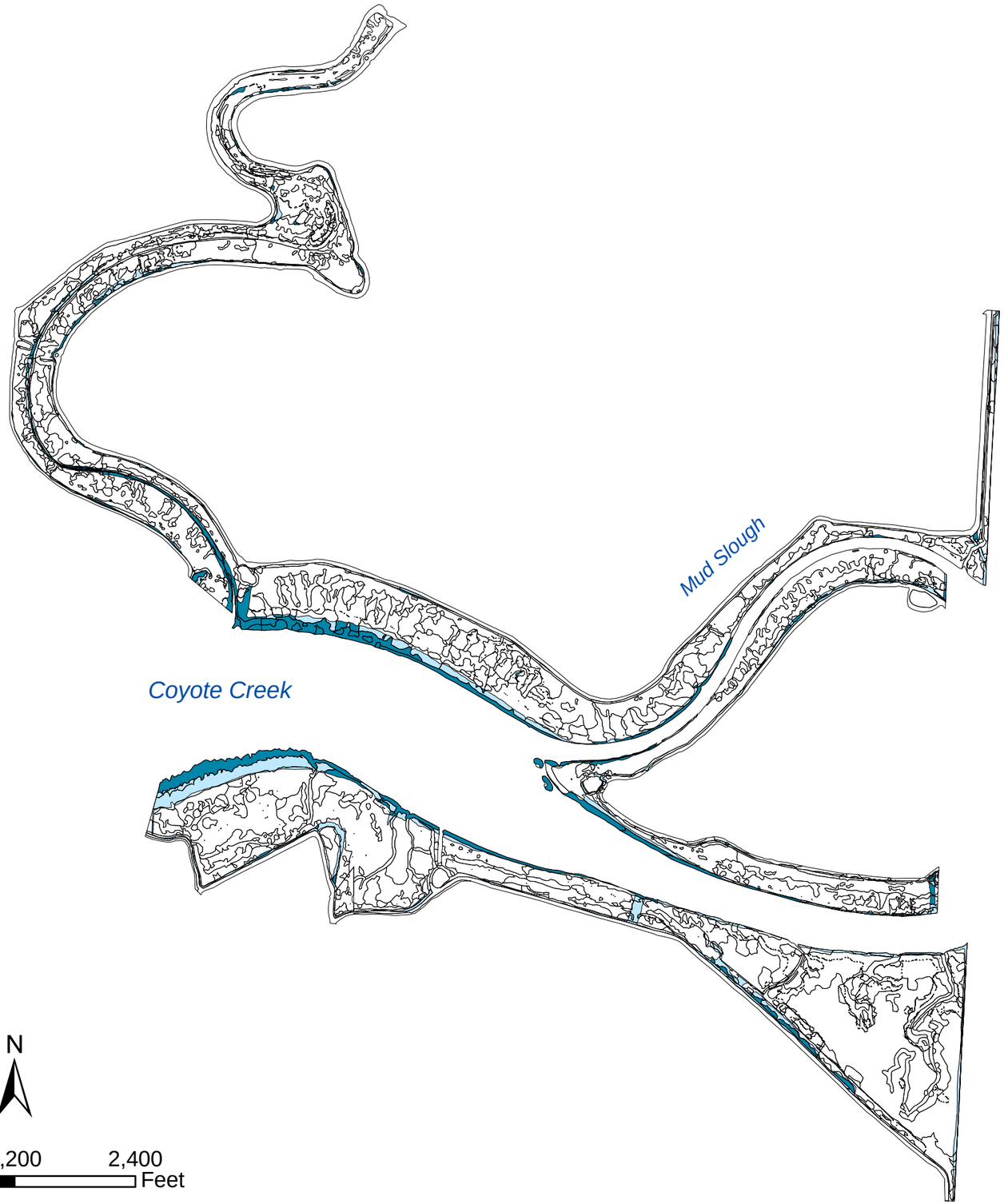
File No. **477-27** | Date **1/14/05** | Figure **B-5**

1989 - 2004 NEW MARSH FORMATION BY HABITAT TYPES, SOUTH SAN FRANCISCO BAY

TRANSITION SEGMENTS HABITATS SPECIES

SEGMENTS 5, 9, 10, 11, 14 and 20

New Fresh Marsh
New Brackish Marsh
New Salt Marsh



N

0 1,200 2,400 Feet

H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

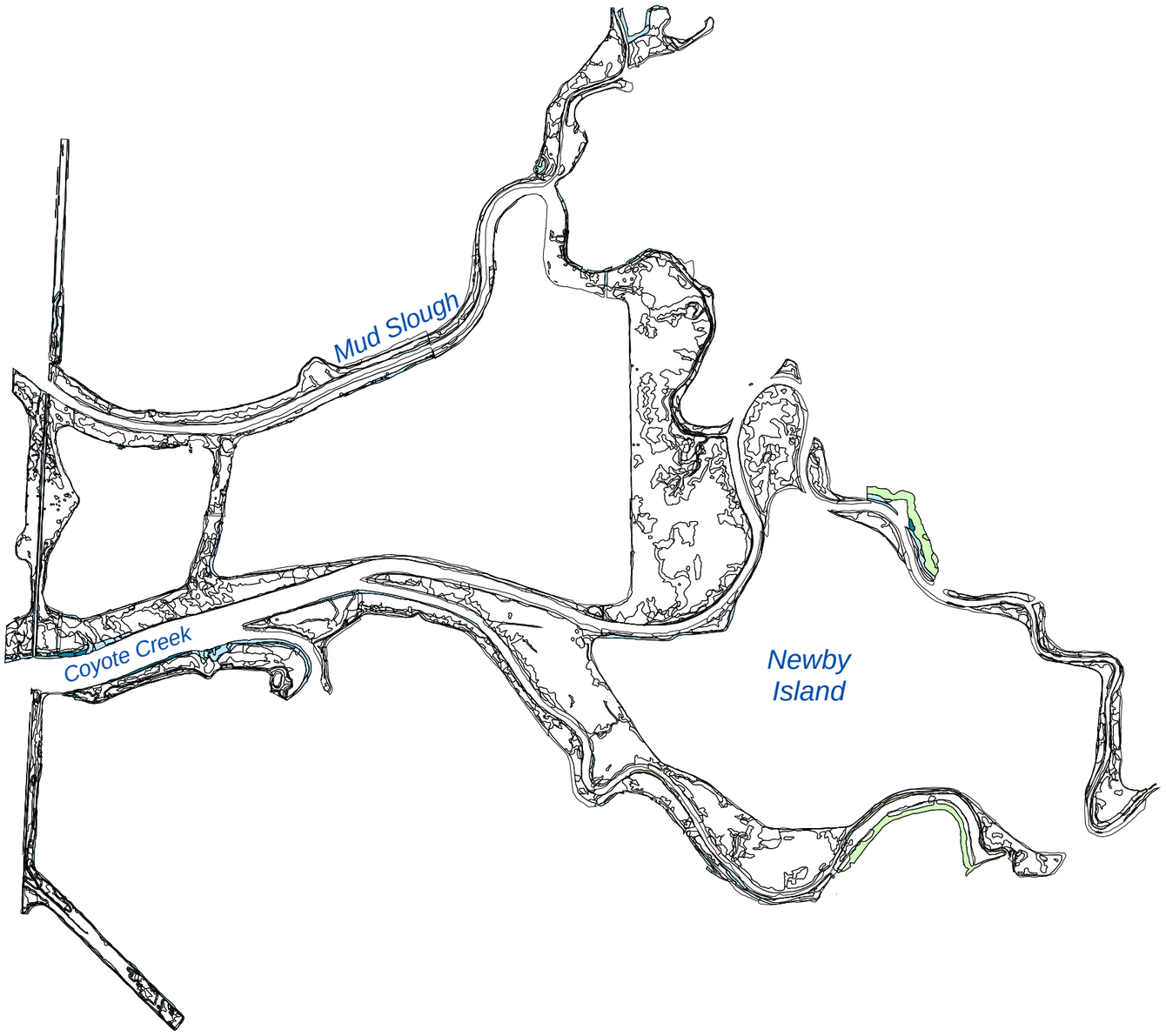
1989 - 2004 New Marsh by Habitat Type, by Reach

File No. **477-27** | Date **1/14/05** | Figure **B-6**

1989 - 2004 NEW MARSH FORMATION BY HABITAT TYPES, SOUTH SAN FRANCISCO BAY

UPPER REACH SEGMENTS HABITATS SPECIES

SEGMENTS 12, 13, 15, 16, 17, 18, 19 and 21



New Fresh Marsh
New Brackish Marsh
New Salt Marsh

N

0 1,500 3,000 Feet

H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

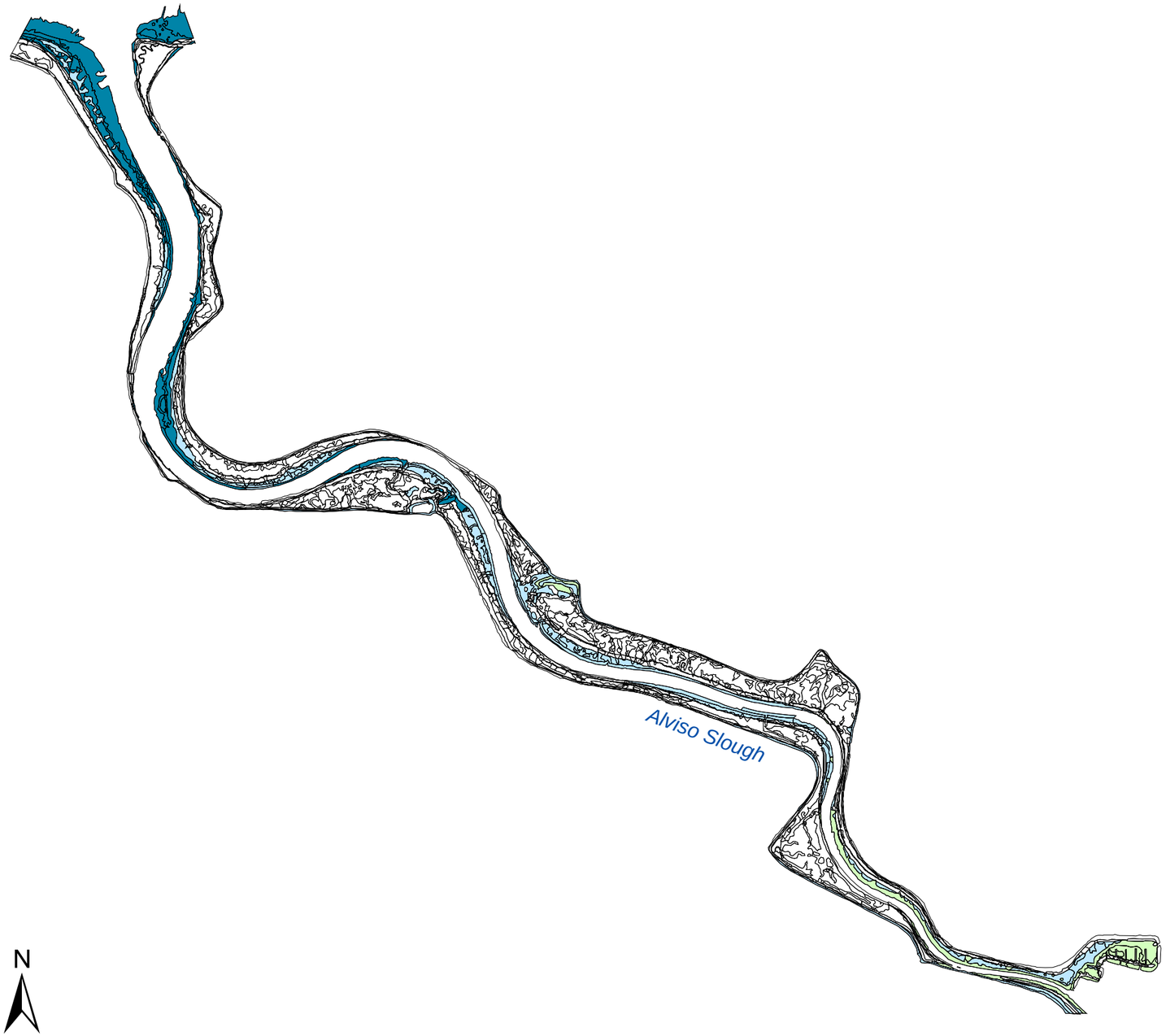
1989 - 2004 New Marsh by Habitat Type, by Reach

File No. 477-27	Date 1/14/05	Figure B-7

1989 - 2004 NEW MARSH FORMATION BY HABITAT TYPES, SOUTH SAN FRANCISCO BAY

ALVISO SLOUGH SEGMENTS HABITATS

SEGMENTS 28, 29 and 30



H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

1989 - 2004 New Marsh by Habitat Type, by Reach

File No. **477-27**	Date **1/14/05**	Figure **B-8**

APPENDIX C.
VEGETATION MATRICES

Table C1. Acreage Summary of Segment 1 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	13.3	19.2	27.2	18.6	12.2	12.6	16.3	18.7	24.2	23.1	22.9
Cordgrass	9.0	1.4	3.4	2.8	9.7	1.94	0.9	1.5	0.5	0.6	0.6
Pickleweed-Cordgrass Mix	14.1	0.0	0.0	1.3	0.8	0.7	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3
Gumplant	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.2
Peripheral Halophytes	1.0	1.5	1.7	0.0	1.4	1.43	1.2	4.4	0.3	0.5	0.5
Total Saline Dominant Species:	**37.4**	**22.1**	**32.3**	**22.7**	**24.3**	**16.8**	**18.5**	**24.8**	**25.2**	**24.4**	**24.5**
Brackish Marsh Vegetation											
Alkali Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peppergrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spearscale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Total Brackish Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**37.4**	**22.1**	**32.3**	**23.3**	**26.5**	**27.1**	**24.4**	**24.8**	**25.2**	**24.4**	**24.7**

Table C2. Acreage Summary of Segment 2 for 1989, 1994/1995, 1996- 2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	26.1	35.5	32.9	32.4	19.0	36.2	36.4	32.5	39.3	37.7	38.0
Cordgrass	13.7	2.3	2.6	3.8	10.5	3.1	1.5	3.1	0.4	0.6	0.5
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	1.8	0.0	0.0	0.7	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.4	0.3
Gumplant	0.0	0.0	0.0	0.2	0.2	1.4	1.0	1.6	1.3	1.2	1.4
Peripheral Halophytes	3.9	2.3	1.6	0.7	3.0	2.2	2.0	5.0	0.6	0.8	1.0
Total Saline Dominant Species:	**43.7**	**40.1**	**37.1**	**38.9**	**32.7**	**42.9**	**41.6**	**42.1**	**41.8**	**41.7**	**41.2**
Brackish Marsh Vegetation											
Alkali Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peppergrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spearscale	0.0	0.0	0.0	0.4	7.5	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**0.0**	**0.0**	**0.0**	**0.4**	**7.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**43.7**	**40.1**	**37.1**	**39.8**	**41.2**	**42.9**	**41.7**	**42.1**	**41.8**	**41.7**	**41.2**

Table C3. Acreage Summary of Segment 3 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	160.1	114.7	79.3	95.1	98.7	118.3	187.4	163.7	149.7	179.3	210.6
Cordgrass	0.6	3.4	2.9	86.6	104.6	15.9	46.3	70.6	42.1	57.8	37.0
Pickleweed-Cordgrass Mix	0.0	69.9	98.8	36.0	0.0	83.3	0.0	0.0	102.1	66.8	67.4
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0
Jaumea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Gumplant	0.0	0.0	2.7	6.9	2.2	7.4	6.6	7.6	4.6	4.8	6.0
Peripheral Halophytes	0.4	2.6	1.1	1.0	2.2	1.0	1.3	0.7	0.7	1.2	0.8
Total Saline Dominant Species:	**161.1**	**190.6**	**184.8**	**225.6**	**207.9**	**225.9**	**241.5**	**242.6**	**299.4**	**310.0**	**321.9**
Brackish Marsh Vegetation											
Alkali Bulrush	0.0	0.0	0.1	0.0	49.2	50.8	39.9	44.2	13.2	17.6	19.0
Peppergrass	0.0	1.1	1.2	1.6	1.8	1.8	1.5	2.6	1.8	2.4	3.7
Spearscale	0.0	0.0	0.0	0.2	2.4	0.0	0.0	0.0	0.0	0.0	0.9
Total Brackish Dominant Species:	**0.0**	**1.1**	**1.3**	**1.8**	**53.4**	**52.6**	**41.4**	**46.7**	**15.0**	**20.0**	**23.6**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**161.1**	**191.7**	**212.3**	**227.6**	**262.1**	**278.5**	**282.9**	**289.4**	**314.4**	**330.0**	**345.5**

Table C4. Acreage Summary of Segment 4 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	49.1	43.9	46.9	50.1	49.8	47.6	57.5	53.3	53.2	55.3	54.8
Cordgrass	6.2	6.2	4.1	5.6	12.9	17.1	9.9	6.5	12.6	8.8	11.0
Pickleweed-Cordgrass Mix	0.0	3.4	6.2	7.2	0.1	0.0	0.0	9.8	10.0	12.2	8.2
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.5	0.2	0.2
Gumplant	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2
Peripheral Halophytes	0.6	2.4	1.5	0.9	1.7	1.7	1.8	0.5	0.4	0.6	0.7
Total Saline Dominant Species:	**55.9**	**55.9**	**58.7**	**64.0**	**64.6**	**66.5**	**69.4**	**70.5**	**77.0**	**77.4**	**75.1**
Brackish Marsh Vegetation											
Alkali Bulrush	0.0	0.0	0.0	0.0	4.8	6.2	7.2	5.5	0.5	0.2	2.6
Peppergrass	0.4	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.0	0.2
Spearscale	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**0.4**	**0.1**	**0.1**	**0.1**	**5.0**	**6.4**	**7.3**	**5.6**	**0.6**	**0.2**	**2.8**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**56.3**	**56.0**	**58.8**	**64.0**	**70.0**	**72.9**	**76.7**	**76.1**	**77.6**	**77.6**	**77.9**

Table C5. Acreage Summary of Segment 5 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	60.4	62.3	30.5	36.6	34.4	41.6	44.5	43.4	47.4	45.4	49.9
Cordgrass	0.3	2.1	2.7	2.6	3.6	2.3	2.0	0.9	1.6	1.7	1.7
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	18.9	7.9	2.2	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.2	0.1	0.4	0.2	0.3	1.2	1.3	0.8
Jaumea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
Gumplant	0.0	0.0	0.0	0.1	0.0	0.3	0.2	0.9	0.8	0.9	0.7
Peripheral Halophytes	1.2	0.5	1.0	2.8	3.2	6.6	4.2	2.6	1.8	1.9	3.2
Total Saline Dominant Species:	**61.9**	**64.9**	**53.1**	**50.2**	**43.5**	**52.3**	**51.2**	**48.1**	**52.8**	**51.2**	**57.5**
Brackish Marsh Vegetation											
Alkali Bulrush	24.4	19.2	27.3	32.1	34.7	32.0	31.4	32.6	26.3	26.8	23.5
Peppergrass	0.8	1.4	2.4	4.0	3.4	7.5	7.5	8.1	9.4	10.6	10.3
Spearscale	0.0	0.0	0.0	3.7	13.6	0.1	0.6	0.2	0.1	0.5	0.2
Total Brackish Dominant Species:	**25.2**	**20.6**	**29.7**	**39.8**	**51.7**	**39.6**	**39.5**	**40.8**	**35.8**	**37.9**	**34.0**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**87.1**	**85.5**	**82.8**	**90.0**	**95.2**	**91.9**	**90.7**	**89.0**	**88.6**	**89.1**	**91.5**

Table C6. Acreage Summary of Segment 8 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	199.7	204.9	151.8	149.4	101.0	171.1	182.4	181.5	199.2	199.1	203.0
Cordgrass	23.1	11.7	10.2	22.5	98.0	32.5	17.8	16.7	14.9	15.8	20.2
Pickleweed-Cordgrass Mix	0.0	0.0	49.0	25.7	0.0	0.0	0.0	4.8	0.8	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.1	0.0	0.3	0.0	0.0	1.2	1.5	2.3
Gumplant	0.0	0.0	0.0	23.8	25.7	27.5	29.7	32.1	29.2	26.9	19.4
Saltgrass	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.7	0.0
Peripheral Halophytes	11.1	10.0	7.8	6.0	10.1	7.7	5.8	6.5	3.3	3.7	4.4
Total Saline Dominant Species:	**233.9**	**226.6**	**218.8**	**227.5**	**234.8**	**245.7**	**239.0**	**241.5**	**248.6**	**247.7**	**249.3**
Brackish Marsh Vegetation											
Alkali Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peppergrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spearscale	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**233.9**	**226.6**	**215.3**	**228.5**	**239.1**	**248.7**	**239.0**	**241.5**	**248.6**	**247.7**	**249.3**

Table C7. Acreage Summary of Segment 9 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	46.0	32.4	15.4	10.0	3.5	6.0	5.4	7.7	31.8	12.8	11.5
Cordgrass	4.4	8.9	3.9	6.6	7.3	4.7	2.6	3.4	5.1	6.5	6.2
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.1	0.0	0.2	0.4	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.4	0.2	1.8
Gumplant	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.5	0.2	0.0	0.0
Peripheral Halophytes	0.0	0.0	1.3	2.0	3.3	1.2	1.3	0.4	0.1	0.8	1.2
Total Saline Dominant Species:	**50.4**	**41.3**	**20.9**	**19.2**	**14.1**	**12.6**	**10.3**	**12.1**	**37.6**	**20.3**	**20.7**
Brackish Marsh Vegetation											
Alkali Bulrush	15.4	22.2	44.1	50.4	67.0	60.2	56.9	56.7	33.0	50.4	51.8
Peppergrass	0.6	1.3	1.2	1.7	1.4	4.3	4.8	5.7	6.2	5.4	7.7
Spearscale	0.0	0.0	0.0	1.5	1.9	3.0	2.1	0.5	0.1	0.0	0.0
Total Brackish Dominant Species:	**16.0**	**23.5**	**45.3**	**53.6**	**70.2**	**67.5**	**63.8**	**62.8**	**39.3**	**55.8**	**59.5**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**66.4**	**64.8**	**66.2**	**72.8**	**84.3**	**80.1**	**74.1**	**74.9**	**76.9**	**76.1**	**80.2**

Table C8. Acreage Summary of Segment 10 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	24.2	21.2	10.7	10.4	8.3	8.0	9.2	9.0	35.6	28.1	24.0
Cordgrass	6.4	11.0	8.4	8.3	5.0	3.6	1.5	2.0	1.4	1.5	8.1
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.1	0.7	1.3	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Peripheral Halophytes	0.7	0.1	0.6	0.6	1.6	0.2	0.4	0.1	0.2	0.0	0.4
Total Saline Dominant Species:	**31.3**	**32.3**	**19.7**	**19.3**	**14.9**	**12.0**	**11.8**	**12.4**	**37.2**	**29.7**	**32.6**
Brackish Marsh Vegetation											
Alkali Bulrush	10.2	5.8	19.7	24.3	37.1	30.7	30.4	32.0	9.2	17.0	17.2
Peppergrass	2.5	1.7	1.6	2.7	1.7	6.3	5.4	5.8	4.7	5.2	5.9
Spearscale	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**12.7**	**7.5**	**21.3**	**27.0**	**38.9**	**37.0**	**35.9**	**37.8**	**13.9**	**22.2**	**23.1**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**44.0**	**39.8**	**41.0**	**46.3**	**53.8**	**49.0**	**47.7**	**50.2**	**51.1**	**51.9**	**55.7**

Table C9. Acreage Summary of Segment 11 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	17.4	22.4	3.8	3.9	1.7	1.8	3.0	2.9	20.6	2.3	9.3
Cordgrass	0.0	1.6	1.1	1.1	1.6	2.3	0.6	1.1	1.6	1.0	0.1
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Jaumea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	1.9
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
Peripheral Halophytes	1.0	0.0	0.4	1.1	1.5	1.2	0.2	0.3	0.0	0.3	0.0
Total Saline Dominant Species:	**18.4**	**24.0**	**5.4**	**6.4**	**5.0**	**5.3**	**3.9**	**4.4**	**22.4**	**3.9**	**11.5**
Brackish Marsh Vegetation											
Alkali Bulrush	51.0	48.8	63.4	64.4	68.5	68.6	65.9	64.8	47.9	63.4	57.4
Peppergrass	6.2	5.6	6.2	6.4	5.5	8.2	10.4	10.7	9.9	10.3	11.2
Spearscale	0.0	0.0	0.0	1.2	1.1	0.4	0.2	0.0	0.0	2.0	0.4
Total Brackish Dominant Species:	**57.2**	**54.4**	**69.6**	**72.0**	**75.1**	**77.2**	**76.5**	**75.6**	**57.8**	**75.7**	**69.0**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**75.6**	**78.4**	**75.1**	**78.3**	**80.1**	**82.5**	**80.4**	**80.0**	**80.2**	**79.6**	**80.5**

Table C10. Acreage Summary of Segment 12 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	0.2	2.8	0.6	2.0	0.7	0.5	2.1	0.8	2.7	0.4	1.5
Cordgrass	0.0	2.2	1.1	1.1	0.7	1.4	0.2	0.0	0.8	1.3	1.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Saltgrass-Gumplant Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Peripheral Halophytes	0.0	0.0	1.7	1.1	10.2	2.2	2.4	0.0	1.7	0.8	1.0
Total Saline Dominant Species:	**0.2**	**5.0**	**3.8**	**4.3**	**11.7**	**4.1**	**4.8**	**0.8**	**5.4**	**2.6**	**3.5**
Brackish Marsh Vegetation											
Alkali Bulrush	25.7	21.2	25.4	24.1	19.0	24.2	26.4	22.0	21.0	20.3	21.8
Peppergrass	12.2	17.5	13.4	14.5	9.9	18.4	14.3	22.1	18.4	22.1	21.9
Spearscale	0.0	0.0	0.0	0.5	1.7	0.0	0.1	0.0	0.2	0.3	0.1
Total Brackish Dominant Species:	**37.9**	**38.7**	**38.8**	**39.0**	**30.6**	**42.6**	**40.8**	**44.1**	**39.6**	**42.7**	**43.8**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.1**	**0.2**	**0.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
Total Segment Acreage	**38.1**	**43.7**	**43.1**	**43.5**	**44.5**	**47.4**	**46.0**	**45.2**	**45.3**	**45.6**	**47.6**

Table C11. Acreage Summary of Segment 13 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	0.0	0.4	0.8	1.5	0.5	0.4	0.5	0.0	0.4	0.2	0.0
Cordgrass	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.3	0.1
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	0.4	0.0	11.9	7.0	4.0	3.1	1.8	0.0	0.4	1.5	0.1
Total Saline Dominant Species:	**0.4**	**0.8**	**12.7**	**8.7**	**4.5**	**3.5**	**2.4**	**0.1**	**1.0**	**2.0**	**0.3**
Brackish Marsh Vegetation											
Alkali Bulrush	95.3	79.9	84.8	73.3	63.0	76.1	83.8	78.7	80.5	76.9	68.2
Peppergrass	15.8	26.8	13.6	15.6	7.0	23.6	14.4	15.9	20.2	19.8	20.4
Spearscale	0.0	0.0	0.0	9.0	6.3	0.0	0.3	3.4	2.7	1.1	4.0
Total Brackish Dominant Species:	**111.1**	**106.7**	**98.4**	**97.9**	**76.2**	**99.7**	**98.5**	**98.0**	**103.4**	**97.8**	**92.6**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	1.3	4.3	26.7	7.0	5.7	4.4	13.7	16.6	23.5
Cattail	0.0	0.0	0.1	0.2	1.8	1.1	2.2	0.8	2.2	2.4	3.9
Total Freshwater Dominant Species:	**0.0**	**0.0**	**1.4**	**4.5**	**28.5**	**8.1**	**7.9**	**5.2**	**15.9**	**19.0**	**27.4**
Total Segment Acreage	**111.5**	**107.5**	**112.5**	**111.1**	**109.2**	**111.3**	**108.8**	**103.2**	**120.3**	**118.8**	**120.3**

Table C12. Acreage Summary of Segment 14 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	5.9	8.9	3.4	2.5	0.5	0.8	6.7	0.5	8.4	5.6	6.8
Cordgrass	3.2	2.0	1.5	2.1	2.0	2.4	1.4	2.1	1.6	1.9	1.6
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	0.7	0.0	0.0	0.6	0.9	1.4	1.0	0.7	1.3	0.5	0.5
Total Saline Dominant Species:	**9.8**	**10.9**	**4.9**	**5.2**	**3.4**	**4.6**	**9.1**	**3.4**	**11.3**	**8.0**	**8.9**
Brackish Marsh Vegetation											
Alkali Bulrush	10.6	9.1	14.6	16.7	19.3	18.5	13.8	18.4	11.0	14.2	12.5
Peppergrass	0.0	0.1	0.5	0.3	0.1	0.4	0.3	1.1	1.3	1.3	1.8
Spearscale	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**10.6**	**9.2**	**15.1**	**17.0**	**19.4**	**18.9**	**14.0**	**19.5**	**12.3**	**15.5**	**14.3**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**20.4**	**20.1**	**20.0**	**22.2**	**22.9**	**23.5**	**23.2**	**22.9**	**23.6**	**23.5**	**23.2**

Table C13. Acreage Summary of Segment 15 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	9.1	4.2	2.0	1.2	0.4	0.2	5.2	8.2	9.0	6.2	6.3
Cordgrass	0.0	0.7	0.4	0.7	0.2	0.8	0.1	0.3	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	0.0	0.0	0.2	0.5	0.8	1.4	0.1	0.2	0.9	0.6	1.3
Total Saline Dominant Species:	**9.1**	**4.9**	**2.6**	**2.3**	**1.3**	**2.4**	**5.3**	**8.8**	**9.9**	**6.8**	**7.7**
Brackish Marsh Vegetation											
Alkali Bulrush	20.2	16.7	18.7	17.9	22.5	21.0	15.6	11.5	10.8	13.3	13.1
Peppergrass	0.0	7.8	7.4	8.9	6.1	9.8	9.6	10.2	10.2	10.7	10.7
Spearscale	0.0	0.0	0.0	0.3	0.7	0.2	0.1	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**20.2**	**24.5**	**26.1**	**27.2**	**29.2**	**31.0**	**25.2**	**21.7**	**21.0**	**24.0**	**23.8**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**29.3**	**29.4**	**28.7**	**29.5**	**30.5**	**33.4**	**30.6**	**30.5**	**30.9**	**30.8**	**31.5**

Table C14. Acreage Summary of Segment 16 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1
Cordgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.2	0.3
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	0.0	0.0	2.1	1.1	0.0	0.0	0.0	0.4	0.1	0.4	0.0
Total Saline Dominant Species:	**0.0**	**0.1**	**2.1**	**1.3**	**0.0**	**0.0**	**0.0**	**0.5**	**0.3**	**0.6**	**0.4**
Brackish Marsh Vegetation											
Alkali Bulrush	37.2	29.4	35.3	18.2	33.6	28.2	26.9	23.4	26.7	25.7	23.0
Peppergrass	11.0	14.8	5.7	4.0	0.9	12.3	11.5	16.2	10.9	13.4	13.5
Spearscale	0.0	0.0	0.0	18.4	5.7	0.9	2.1	1.1	3.2	0.2	3.2
Total Brackish Dominant Species:	**48.2**	**44.2**	**41.0**	**40.6**	**40.2**	**41.4**	**40.4**	**40.7**	**40.8**	**39.3**	**39.7**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.3	0.7	0.7	3.4	3.7	3.4	4.4	4.8	4.7
Cattail	0.0	0.0	0.1	0.1	0.0	0.1	0.6	0.4	0.5	0.6	1.3
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.4**	**0.9**	**0.7**	**3.5**	**4.3**	**3.8**	**4.9**	**5.4**	**6.0**
Total Segment Acreage	**48.2**	**44.2**	**45.1**	**43.3**	**42.8**	**54.8**	**44.7**	**45.1**	**46.0**	**45.3**	**46.1**

Table C15. Acreage Summary of Segment 17 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	0.0	1.8	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cordgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	1.8	2.3	0.0	0.1	0.0	0.0	1.8	2.2	2.0
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Peripheral Halophytes	3.3	0.0	0.0	1.1	2.1	1.8	0.0	0.0	0.0	5.2	0.9
Total Saline Dominant Species:	**3.3**	**1.8**	**1.8**	**3.5**	**2.1**	**1.9**	**0.0**	**0.0**	**1.9**	**7.4**	**2.9**
Brackish Marsh Vegetation											
Alkali Bulrush	90.1	75.9	75.9	44.5	76.3	68.3	66.5	63.9	63.6	61.2	59.8
Peppergrass	8.8	18.9	18.9	21.1	11.7	28.4	29.4	29.0	22.9	29.7	30.8
Spearscale	0.0	0.0	0.0	26.6	11.3	0.0	1.8	0.3	7.6	0.5	3.5
Total Brackish Dominant Species:	**98.9**	**94.8**	**94.8**	**92.2**	**99.3**	**96.7**	**97.8**	**93.2**	**94.1**	**91.4**	**94.1**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.2	0.1
Cattail	0.0	0.0	0.0	0.5	0.7	0.2	1.2	0.9	1.0	2.2	1.6
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.5**	**0.8**	**0.2**	**1.3**	**0.9**	**1.1**	**2.4**	**1.7**
Total Segment Acreage	**102.2**	**96.6**	**96.6**	**96.2**	**102.2**	**98.8**	**99.2**	**94.1**	**97.1**	**101.2**	**98.7**

Table C16. Acreage Summary of Segment 18 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	1.0	2.1	0.8	1.6	0.6	0.7	1.3	0.7	0.6	0.2	0.5
Cordgrass	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.9	0.1	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.3	0.2	0.3	0.1	0.1	0.2	0.0	0.4	0.3	0.4
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	0.0	0.0	0.6	1.7	1.3	2.1	1.0	1.1	1.1	3.7	3.0
Total Saline Dominant Species:	**1.0**	**2.4**	**2.5**	**3.8**	**3.5**	**2.9**	**2.5**	**1.8**	**2.1**	**4.2**	**3.9**
Brackish Marsh Vegetation											
Alkali Bulrush	33.5	24.2	24.7	13.4	24.2	22.9	23.9	21.1	20.9	20.3	20.7
Peppergrass	3.3	8.2	7.2	4.4	2.3	8.3	6.2	10.4	8.2	9.2	10.7
Spearscale	0.0	0.0	0.0	12.1	3.7	1.3	1.5	0.2	3.2	1.3	0.3
Total Brackish Dominant Species:	**36.8**	**32.4**	**31.9**	**29.8**	**30.3**	**32.5**	**31.7**	**31.6**	**32.3**	**30.8**	**31.7**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.1	0.1	0.0	0.3	0.2	0.3	0.4	0.3
Cattail	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.3	0.0	0.4	0.1
Giant Reed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.2**	**0.3**	**0.1**	**0.4**	**0.5**	**0.3**	**0.8**	**0.4**
Total Segment Acreage	**37.8**	**34.8**	**34.5**	**33.8**	**34.1**	**35.5**	**34.5**	**33.9**	**34.7**	**35.8**	**36.0**

Table C17. Acreage Summary of Segment 19 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	7.0	11.3	2.6	2.1	30.9	1.0	2.7	10.4	7.2	1.6	1.6
Cordgrass	0.0	2.0	1.8	0.7	0.1	0.5	0.0	0.0	0.1	0.2	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.6	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.4	0.2	0.3	0.0	0.1	0.2	0.0	0.4	0.3	0.4
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	0.0	0.5	1.5	2.8	3.6	3.8	3.1	2.7	2.3	1.5	1.5
Total Saline Dominant Species:	**7.0**	**14.2**	**6.7**	**6.0**	**34.8**	**5.6**	**6.0**	**13.1**	**10.0**	**3.6**	**3.5**
Brackish Marsh Vegetation											
Alkali Bulrush	29.9	22.1	31.4	24.7	0.8	29.8	27.4	17.7	23.4	29.0	29.1
Peppergrass	0.5	1.1	1.7	1.2	0.3	2.0	2.3	2.2	2.0	2.2	3.4
Spearscale	0.0	0.0	0.0	4.2	0.5	0.1	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**30.4**	**23.2**	**33.1**	**30.1**	**1.7**	**31.9**	**29.7**	**19.9**	**25.4**	**31.2**	**32.5**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.2	0.0	0.6	0.6	0.0	0.0	0.0	0.1
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.2**	**0.0**	**0.6**	**0.6**	**0.0**	**0.0**	**0.0**	**0.1**
Total Segment Acreage	**37.4**	**37.4**	**39.8**	**36.2**	**36.5**	**38.1**	**36.3**	**33.0**	**35.4**	**34.8**	**36.1**

Table C18. Acreage Summary of Segment 20 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	30.8	31.2	18.6	18.2	14.6	14.4	13.6	18.0	29.8	20.5	18.8
Cordgrass	2.4	6.0	5.0	4.7	2.7	2.6	1.7	1.6	2.5	3.0	3.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.1	0.2	0.0	0.3	0.1	0.0	0.0	0.4
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	0.0	0.0	1.6	1.4	3.3	1.9	1.3	1.3	1.6	1.5	1.3
Total Saline Dominant Species:	**33.2**	**37.2**	**25.2**	**24.5**	**20.9**	**18.9**	**16.9**	**21.6**	**33.9**	**25.0**	**23.5**
Brackish Marsh Vegetation											
Alkali Bulrush	26.5	17.0	28.9	33.1	36.4	37.9	36.8	31.4	22.0	30.4	30.0
Peppergrass	1.9	3.3	2.5	3.3	3.3	6.7	7.2	6.6	5.6	6.0	7.6
Spearscale	0.0	0.0	0.0	0.1	2.1	0.1	0.1	0.1	0.0	0.0	0.2
Total Brackish Dominant Species:	**28.4**	**20.3**	**31.4**	**36.5**	**41.8**	**44.7**	**44.0**	**38.2**	**27.6**	**36.4**	**37.8**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**61.6**	**57.5**	**56.6**	**61.0**	**62.7**	**63.6**	**61.0**	**59.7**	**61.5**	**61.4**	**61.3**

Table C19. Acreage Summary of Segment 21 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	2.7	7.0	2.9	2.2	1.1	1.0	3.6	4.6	5.4	5.1	4.1
Cordgrass	0.5	0.4	0.3	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.1
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	0.0	3.6	0.4	0.3	1.2	0.9	1.9	1.4	1.1	1.6	1.0
Total Saline Dominant Species:	**3.2**	**11.0**	**3.6**	**2.9**	**2.7**	**2.1**	**5.6**	**6.1**	**6.6**	**6.9**	**5.2**
Brackish Marsh Vegetation											
Alkali Bulrush	19.8	15.1	18.6	17.6	20.6	20.5	18.4	14.9	15.4	15.8	16.2
Peppergrass	2.9	3.7	4.1	5.3	3.4	6.2	5.1	0.1	5.9	5.5	6.5
Spearscale	0.0	0.0	0.0	0.8	1.0	0.2	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**22.7**	**18.8**	**22.7**	**23.7**	**24.9**	**26.9**	**23.5**	**15.0**	**21.3**	**21.3**	**22.7**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**25.9**	**29.8**	**26.7**	**26.7**	**27.6**	**29.0**	**29.1**	**21.1**	**27.9**	**28.2**	**27.9**

Table C20. Acreage Summary of Segment 22 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	7.5	6.1	7.3	6.1	5.2	5.0	5.5	4.9	4.9	5.1	5.1
Cordgrass	2.7	3.9	2.8	3.8	3.5	4.7	2.3	4.1	4.1	8.3	32.8
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	0.4	0.0	0.5	1.0	1.2	0.9	0.9	0.0	0.0	1.2	3.1
Total Saline Dominant Species:	**10.6**	**10.0**	**10.6**	**10.9**	**9.9**	**10.7**	**8.7**	**9.0**	**9.0**	**14.6**	**41.1**
Brackish Marsh Vegetation											
Alkali Bulrush	0.0	0.0	0.2	1.0	2.9	2.7	4.6	2.3	2.3	3.8	6.3
Peppergrass	0.0	0.2	0.4	0.0	0.0	0.6	0.7	3.6	3.6	0.2	1.2
Spearscale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**0.0**	**0.2**	**0.6**	**1.0**	**2.9**	**3.3**	**5.4**	**6.0**	**5.9**	**4.0**	**7.5**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**10.6**	**10.2**	**11.2**	**11.9**	**12.8**	**14.0**	**14.1**	**14.9**	**14.9**	**18.6**	**48.6**

Table C21. Acreage Summary of Segment 23 for 1989, 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year										
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	8.8	14.1	14.1	11.1	10.2	10.2	10.9	10.5	8.8	13.1	10.3
Cordgrass	7.9	3.7	3.6	4.8	6.2	5.9	6.2	7.4	7.9	8.4	10.5
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.1	0.0	1.3	0.2	0.0	0.0	0.0	0.9
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.2	0.0	0.0	0.2	0.3	0.0	0.0	0.3	0.2
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Saltgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.2	0.0
Peripheral Halophytes	1.9	0.0	0.8	1.4	1.7	1.5	1.7	2.6	1.9	1.2	4.4
Total Saline Dominant Species:	**18.6**	**17.8**	**18.7**	**17.4**	**18.1**	**19.1**	**20.0**	**20.5**	**18.6**	**23.2**	**26.3**
Brackish Marsh Vegetation											
Alkali Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0
Peppergrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Spearscale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**4.0**	**0.0**
Freshwater Marsh Vegetation											
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**18.6**	**17.8**	**18.8**	**17.4**	**18.1**	**19.1**	**20.1**	**20.5**	**18.6**	**27.2**	**26.3**

Table C22. Acreage Summary of Segment 24* for 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year									
Saline Marsh Vegetation	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	0.8	0.2	0.6	0.6	0.2	1.3	0.6	0.8	0.0	0.7
Cordgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	1.5	2.2	0.7	0.8	0.5	1.0	0.0	0.0	0.0	0.1
Total Saline Dominant Species:	**2.3**	**2.4**	**1.3**	**1.4**	**0.7**	**2.3**	**0.6**	**0.8**	**0.1**	**0.8**
Brackish Marsh Vegetation										
Alkali Bulrush	1.5	2.0	1.8	2.2	2.4	2.7	2.0	2.1	2.7	1.9
Peppergrass	7.0	6.0	5.7	7.1	7.1	4.6	7.5	6.6	6.6	7.7
Spearscale	0.0	0.0	0.0	0.5	0.1	0.1	0.0	0.1	0.0	0.0
Total Brackish Dominant Species:	**8.5**	**8.0**	**7.5**	**9.7**	**9.6**	**7.4**	**9.5**	**8.8**	**9.3**	**9.6**
Freshwater Marsh Vegetation										
California Bulrush	1.4	1.6	1.9	2.0	2.6	2.8	2.2	2.9	3.1	2.7
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**1.4**	**1.6**	**1.9**	**2.0**	**2.6**	**2.8**	**2.2**	**2.9**	**3.1**	**2.7**
Total Segment Acreage	**12.2**	**12.0**	**10.7**	**13.1**	**12.9**	**12.4**	**12.3**	**12.5**	**12.5**	**13.1**

*** Segment 24 not mapped in 1989**

Table C23. Acreage Summary of Segment 25* for 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year									
Saline Marsh Vegetation	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1
Cordgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	5.3	4.0	2.6	0.0	1.0	0.0	0.0	0.1	0.1	1.3
Total Saline Dominant Species:	**5.3**	**4.0**	**2.6**	**0.0**	**1.0**	**0.1**	**0.0**	**0.1**	**0.2**	**1.5**
Brackish Marsh Vegetation										
Alkali Bulrush	2.9	4.3	3.4	3.3	5.8	6.5	4.9	5.7	3.6	4.7
Peppergrass	10.4	7.7	6.5	48.6	7.6	7.1	8.8	7.6	7.2	5.8
Spearscale	0.0	0.0	0.3	0.5	0.1	0.1	0.0	0.3	0.0	0.0
Total Brackish Dominant Species:	**13.3**	**12.0**	**10.3**	**52.3**	**13.5**	**13.7**	**13.7**	**13.6**	**10.8**	**10.5**
Freshwater Marsh Vegetation										
California Bulrush	29.8	30.3	31.3	0.1	38.6	36.2	35.9	34.2	34.0	33.9
Cattail	0.2	0.8	1.5	0.2	2.0	1.3	2.1	2.2	4.6	4.4
Knotweed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**30.0**	**31.1**	**32.8**	**0.3**	**40.6**	**37.5**	**38.0**	**36.4**	**38.6**	**38.3**
Total Segment Acreage	**48.6**	**47.1**	**45.7**	**52.7**	**55.1**	**51.3**	**51.7**	**50.1**	**49.6**	**50.3**

***Segment 25 not mapped in 1989**

Table C24. Acreage Summary of Segment 26* for 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year									
Saline Marsh Vegetation	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cordgrass	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	1.3	1.3	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Saline Dominant Species:	**1.3**	**1.3**	**0.8**	**0.1**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**
Brackish Marsh Vegetation										
Alkali Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peppergrass	2.5	2.6	0.6	0.1	2.9	3.3	0.5	0.3	0.0	0.9
Spearscale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**2.5**	**2.6**	**0.6**	**0.2**	**3.0**	**3.3**	**0.5**	**0.3**	**0.0**	**0.9**
Freshwater Marsh Vegetation										
California Bulrush	17.8	18.7	17.5	18.8	18.0	18.4	18.4	18.8	19.1	17.5
Cattail	0.1	0.2	0.4	0.3	0.1	1.0	0.6	0.9	0.4	1.3
Knotweed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**17.9**	**18.9**	**17.9**	**19.1**	**18.1**	**19.4**	**19.0**	**19.7**	**19.5**	**18.8**
Total Segment Acreage	**21.7**	**22.8**	**19.2**	**19.4**	**21.1**	**22.8**	**19.5**	**20.0**	**19.5**	**19.7**

***Segment 26 not mapped in 1989**

Table C25. Acreage Summary of Segment 27* for 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year								
Saline Marsh Vegetation	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	0.0	0.9	0.0	0.0	0.9	1.0	0.8	0.5	0.6
Cordgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	1.0	2.1	2.3	0.0	0.3	0.0	0.0	0.0	0.3
Total Saline Dominant Species:	**1.0**	**3.0**	**2.3**	**0.0**	**1.2**	**1.0**	**0.8**	**0.5**	**0.9**
Brackish Marsh Vegetation									
Alkali Bulrush	11.4	9.1	8.9	7.4	7.7	7.4	7.9	5.4	4.9
Peppergrass	0.6	1.7	0.1	1.2	1.9	1.2	1.9	0.0	0.0
Spearscale**	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.2	0.0
Total Brackish Dominant Species:	**12.0**	**10.8**	**9.1**	**8.6**	**9.6**	**8.6**	**9.9**	**5.6**	**4.9**
Freshwater Marsh Vegetation									
California Bulrush	3.3	4.4	6.7	4.7	5.8	6.2	5.5	5.8	5.3
Cattail	7.6	7.8	8.4	10.8	9.8	9.5	8.7	9.3	10.6
Total Freshwater Dominant Species:	**10.9**	**12.2**	**15.2**	**15.5**	**15.6**	**15.8**	**14.2**	**15.1**	**15.9**
Total Segment Acreage	**23.8**	**26.0**	**26.6**	**36.5**	**26.5**	**25.4**	**24.9**	**21.2**	**21.7**

***Segment 27 not mapped in 1989 and 1994/1995**
**Not a Dominant Species Category in 1996

Table C26. Acreage Summary of Segment 28* for 1994/1995, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year									
Saline Marsh Vegetation	1989	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	0.0	0.5	0.2	0.1	0.1	0.0	0.1	0.0	0.1	0.2
Cordgrass	8.6	1.6	1.8	0.8	0.0	0.0	1.1	0.0	0.0	0.0
Peripheral Halophytes	0.0	0.3	1.4	4.0	3.4	1.6	0.6	0.0	0.0	5.3
Total Saline Dominant Species:	**8.6**	**2.4**	**3.4**	**4.8**	**3.5**	**1.6**	**1.8**	**0.0**	**0.1**	**5.5**
Brackish Marsh Vegetation										
Alkali Bulrush	47.7	53.7	49.8	61.9	57.0	55.8	59.2	56.2	52.3	55.9
Peppergrass	8.3	9.9	15.8	2.2	10.2	13.6	9.0	16.9	17.7	17.5
Spearscale**	0.0	0.0	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.1
Total Brackish Dominant Species:	**56.0**	**63.5**	**65.7**	**64.3**	**67.2**	**69.5**	**68.3**	**73.1**	**70.0**	**73.5**
Freshwater Marsh Vegetation										
California Bulrush	0.3	10.5	9.1	15.5	15.6	15.1	9.4	11.0	14.6	12.5
Cattail	0.0	0.3	0.4	0.5	0.6	0.5	1.4	0.9	0.7	0.3
Total Freshwater Dominant Species:	**0.3**	**10.8**	**9.5**	**16.0**	**16.2**	**15.6**	**10.8**	**11.9**	**15.3**	**12.8**
Total Segment Acreage	**64.9**	**76.7**	**78.6**	**85.1**	**86.9**	**86.8**	**80.9**	**85.0**	**85.4**	**91.8**

***Segment 28 not mapped in 1994/1995**
**Not a Dominant Species Category in 1996

Table C27. Acreage Summary of Segment 29* for 1989, 1996 - 2004.
DOMINANT SPECIES CATEGORY

	Year									
Saline Marsh Vegetation	1989	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	20.1	14.8	12.1	9.0	9.3	6.6	8.0	14.6	6.3	15.0
Cordgrass	14.3	5.6	6.8	4.6	2.3	1.7	5.7	7.7	10.2	6.5
Peripheral Halophytes	0.0	2.2	4.3	5.8	5.6	4.4	0.0	4.3	4.8	5.2
Total Saline Dominant Species:	**34.4**	**22.5**	**23.2**	**19.4**	**17.2**	**12.7**	**13.6**	**26.6**	**21.3**	**26.7**
Brackish Marsh Vegetation										
Alkali Bulrush	24.6	48.4	47.2	58.7	65.5	62.2	61.6	50.5	55.8	46.6
Peppergrass	10.8	10.0	9.5	3.9	11.0	13.3	13.2	15.5	17.0	25.6
Spearscale**	0.0	0.0	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Total Brackish Dominant Species:	**35.4**	**58.3**	**57.0**	**62.6**	**76.6**	**75.5**	**74.8**	**66.0**	**72.8**	**72.3**
Freshwater Marsh Vegetation										
California Bulrush	0.0	0.0	0.0	0.0	0.3	0.4	0.0	0.0	0.0	0.5
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.5
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.4**	**0.0**	**0.1**	**0.1**	**1.0**
Total Segment Acreage	**69.8**	**80.8**	**80.2**	**82.0**	**94.1**	**88.6**	**88.5**	**92.7**	**94.2**	**100.0**

***Segment 29 not mapped in 1994/1995**
**Not a Dominant Species Category in 1996

Table C28. Acreage Summary of Segment 30* for 1989, 1996-2004.
DOMINANT SPECIES CATEGORY

	Year									
Saline Marsh Vegetation	1989	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pickleweed	23.5	26.5	23.1	19.7	21.0	24.7	26.4	32.1	32.8	34.3
Cordgrass	15.5	8.0	9.8	10.7	13.0	3.3	12.3	13.5	13.0	14.2
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.6
Alkali Heath	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.1	0.0	0.0
Saltgrass	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0
Peripheral Halophytes	3.1	1.5	2.6	2.9	3.7	2.5	0.3	1.2	2.4	5.5
Total Saline Dominant Species:	**42.1**	**36.0**	**35.5**	**33.3**	**37.7**	**32.9**	**39.1**	**46.9**	**48.2**	**54.6**
Brackish Marsh Vegetation										
Alkali Bulrush	0.0	1.5	1.7	6.5	5.5	11.6	4.3	2.5	5.9	6.4
Peppergrass	1.3	2.0	0.0	0.0	0.0	1.1	3.3	2.1	0.6	2.2
Spearscale**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**1.3**	**3.4**	**1.7**	**6.5**	**5.5**	**12.7**	**7.6**	**4.6**	**6.5**	**8.6**
Freshwater Marsh Vegetation										
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**43.4**	**39.4**	**37.2**	**39.9**	**43.2**	**45.7**	**46.7**	**51.5**	**54.7**	**63.2**

***Segment 30 not mapped in 1994/1995**
**Not a Dominant Species Category in 1996

APPENDIX D.
PLANT LIST

Appendix D. Plants Observed in the South Bay Marsh Project Site		
FAMILY NAME	**SCIENTIFIC NAME**	**COMMON NAME**
Aceraceae	*Acer negundo* ssp. *californica*	California box elder
Aizoceae	*Mesembryanthemum nodiflorum*	slender-leaved iceplant
	Tetragonia tetragonioides	New Zealand spinach
Apiaceae	*Foeniculum vulgare*	sweet fennel
	Conium maculatum	poison hemlock
Asteraceae	*Baccharis pilularis*	coyote brush
	Carduus pycnocephalus	Italian thistle
	Centaurea solstitialis	yellow star-thistle
	Conyza canadensis	horsetail
	Grindelia sp.	gumplant
	Picris echioides	bristly ox-tongue
Brassicaceae	*Brassica nigra*	black mustard
	Hirschfeldia incana	small-pod mustard
	Lepidium latifolium	perennial peppergrass
Chenopodiaceae	*Atriplex semibaccata*	Australian saltbush
	Atriplex triangularis	spearscale
	Bassia hyssopifolia	five-hook bassia
	Salicornia virginica	common pickleweed
	Salicornia europeae	annual pickleweed
	Salsola soda	Russian thistle
Cuscutaceae	*Cuscuta salina* var. *major*	salt marsh dodder
Cyperaceae	*Scirpus acutus*	tule
	Scirpus californicus	California bulrush
	Scirpus maritimus	alkali bulrush
Frankeniaceae	*Frankenia salina*	alkali heath
Juglandaceae	*Juglans californica*	California black walnut
Poaceae	*Arundo donax*	giant reed
	Bromus diandrus	ripgut grass
	Bromus hordeaceus	soft chess
	Distichlis spicata	saltgrass
	Hordeum sp.	barley
	Spartina foliosa and *S. alterniflora*	cordgrass
	Phragmites australis	common reed
Polygonaceae	*Polygonum punctatum*	knotweed
Salicaceae	*Populus fremontii*	Fremont's cottonwood
Solanaceae	*Solanum americanum*	deadly nightshade
	Nicotiana glauca	tree-tobacco
Typhaceae	*Typha* sp.	cattail
The species are arranged alphabetically by family name for all vascular plants encountered during the plant survey. Plants are also listed alphabetically within each family. In some cases it was not possible to accurately identify a particular plant to the species level due to the absence of specific anatomic structures required for identification.		