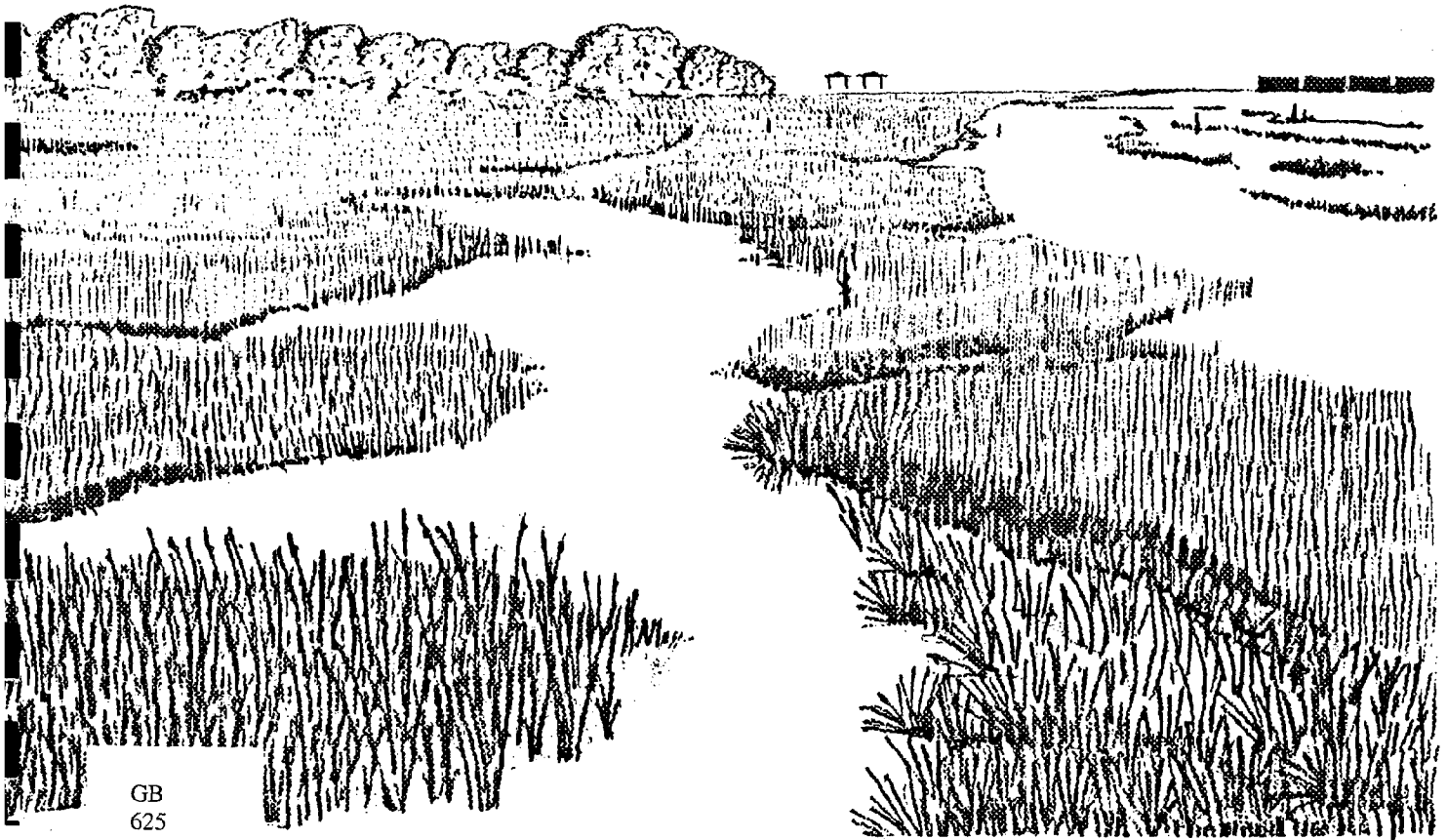


Rec'd Task 5.10
2-1-88 (FY86)

CITY OF EUREKA
and
CALIFORNIA COASTAL CONSERVANCY

GB625.C2 P35 1987

**PALCO MARSH
ENHANCEMENT PLAN**



GB
625
.C2
P35
1987

**SUN ENTERPRISES PLANNER/ENVIRONMENTAL CONSULTANTS
IRG & COMPANY SURVEYORS/ENGINEERS**

PROJECT INFORMATION

Project Name: Palco Marsh Wetland Enhancement Plan

Project Sponser: City of Eureka
Eureka, CA 95501
(707) 443-7331 ext. 309

Landowner: City of Eureka

Assessor's Parcel Numbers: 7-031-01
7-013-03
7-051-01
7-041-01 (Portion)
7-051-03 (Portion)
7-061-01
7-071-10

Project Size: 86 Acres

Zoning: Natural Resource (City of Eureka LCP Adopted July, 1984)

Project Location: Sections 28 & 33, T5N, R1W, H.M.

City of Eureka City Council Approval September 29, 1987

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MAP 1 Enhancement Plan

Back Cover

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The following maps are available for review at the City of Eureka and are at a scale of 1 inch equals 100 feet.

- 1 Enhancement Plan
- 2 Topographic Map
- 3 Vegetation Map

1.0 SUMMARY

1.1 Introduction

The Palco Marsh has been a focus of concern for enhancement activities by a number of agencies; the Army Corps of Engineers designated the site as an "Area of Importance" to the functioning of the Humboldt Bay ecosystem; the California Coastal Commission included the Palco Marsh on its list of priority public acquisition sites; and the City of Eureka designated this site in its Local Coastal Plan for acquisition and enhancement activity, and requested funding from the Coastal Conservancy for acquisition and eventual enhancement improvements.

The Coastal Conservancy agreed to provide funding to acquire, plan and restore the Palco Marsh site with three primary objectives:

1. Enhance tidal action in the Palco Marsh.
2. Remove fill in drying shed area and restore to marsh habitat.
3. Assemble land in the project area to improve future management.

The development of the following Enhancement Plan takes into account agency goals, site condition, and subsequent discussions with the City of Eureka, the Coastal Conservancy and other interested agencies.

Section 2.0 describes the project site location and its relationship to other projects. Section 3.0 includes a site inventory and identification of Marsh enhancement opportunities and constraints. Section 4.0 contains the principal findings, opportunities, constraints and goals developed from this information.

Information compiled in this report was gathered from September, 1986 through February, 1987. Technical information has been included, where appropriate, but for brevity's sake, is referenced as separate studies available from the City of Eureka. Development of goals and objectives proceeded from the Coastal Conservancy's initial goals and were influenced by opportunities and constraints inherent to site conditions. These goals were further defined through discussions with the City of Eureka, the Coastal Conservancy and the California Department of Fish and Game.

1.2 Description and Location

The Palco Marsh project site is located on the eastern shoreline of Humboldt Bay at the western edge of the City of Eureka. It is surrounded by urban development of three sides: 1) Del Norte and Hawthorne Streets and adjacent commercial/industrial uses to the north; 2) Broadway Avenue with commercial uses to the east; and 3) the newly constructed Bayshore Mall to the south. West of the Palco Marsh project site are Humboldt Bay mudflats, central channel and the Samoa Peninsula. The Crown Simpson pulp mill is located directly across the Bay channel on the Samoa Peninsula, 1/2 mile west of the subject property.

The project is bisected by the Northwestern Pacific Railroad right-of-way, which traverses north-south across the project site. The east half of the site consists of approximately 45 acres which includes a six acre developed area and a 39 acre marsh complex, consisting of approximately 17 acres of salt marsh, nine acres of brackish marsh, eight acres of freshwater marsh, and five acres of riparian habitat. The western half of the project site, 41 acres, consists of tidal flats, a shoreline strip of salt marsh and a four acre upland peninsula located just south of the end of Del Norte Street.

1.3 Site Analysis

Marsh topography, soils and off-site hydrologic conditions have not changed much from historical conditions. Vegetation is more sensitive to changing environmental conditions, and thus reacts more quickly to changes. Because of this, opportunities are available to improve the vegetation and consequently wildlife habitat values. There are certain factors causing the marshes to be under stress and affecting the marsh vegetation density.

These include poor tidal circulation and retention of storm runoff which causes hypersalinity and dissolved oxygen depletion. The unhealthy condition of the salt marsh is evident by the lack of diversity of the vegetation. Under an improved tidal regime, salt marsh areas could be returned to a higher functioning value. Information gathered at the drying shed area indicates that, depending on the amount of fill removed and the availability of future water sources, this area could support wetland vegetation.

The major problem with the Palco Marsh with regard to wildlife use is the lack of tidal circulation in the salt marsh and the lack of significant amounts of open water habitat in the brackish and freshwater marshes. This results in reduced food production for all species of water-related birds and in a lack of water surface for landing and take-off for certain waterfowl species (e.g. ruddy ducks, greater scaups, coots, and grebes). The outcome is both reduced numbers and diversity of wildlife.

Improving the circulation of tidewater throughout the salt marsh will improve its value to wildlife. The lack of circulation in this area causes low food availability for wildlife. Organisms

normally associated with salt marsh (and good circulation) are present in limited areas within the Palco Marsh. These include invertebrates which are critical for foraging by shorebirds, snowy egrets, etc. An increase in tidal flows would allow the redevelopment of this invertebrate fauna; subsequently the diversity and numbers of wildlife in the area should increase.

If a deep water pond (six to nine foot depth) was developed in the freshwater/brackish marsh area, there would be an appreciable increase in both diversity and numbers of wildlife using the area. The important submerged aquatic plants necessary for the development of a food base in the pond are present in the residual pond left in the freshwater marsh. This would allow waterfowl, grebes, coots and mergansers to land, forage and have the safety of deeper water for escape from potential predators. Herons and egrets would have a foraging area on the edges of the pond and would roost near this new feeding area.

Since mixed commercial/industrial land uses surround the project site, adequate buffers are needed to protect/enhance the integrity of the marsh environments. The site, at present, has uncontrolled access and is used in ways contrary to wildlife values. As the project site is restored for wildlife, increased interest and subsequent use by the public is anticipated. Providing controlled access for compatible public uses will be necessary to maintain wildlife values for the site.

1.4 Enhancement Plan

The improvements necessary to accomplish the project goals include both improving conditions in the existing marshes as well as creating wetlands in non-marsh areas. Control of water within the marsh will be accomplished by the placement of larger diameter culverts at a lower elevation and channel excavation within the marsh. Water levels in the marsh will be adjustable by weir structures on either end of the culvert. This will increase tidal circulation, and run-off drainage out of the marsh. Clearing a one and a half acre area of cattails and excavating a deep open water area will provide a more diverse and much needed addition to the surrounding marsh habitats.

The RR Marsh will be graded with channels connecting into the Palco Marsh drainage. Portions of the paved area, as well as the railroad spur, will be graded to wetland elevations.

The remaining paved area will be enhanced as a "Phase 2" for this project at a time when adjacent water sources become available and/or as part of wetland mitigation for development of an adjacent coastal dependent industrial parcel (Parcel 4).

Riparian vegetation will be utilized to screen and buffer adjacent land uses, road edges, and parking areas. Public access

will be encouraged on the site in ways compatible with wildlife needs. Access to the site will include two main entrance locations, connected to each other by a pedestrian trail. Viewing areas, benches and a picnic site are included in the improvements. Access barriers will be provided in necessary locations and signs will provide both educational information and site use regulations. Riparian vegetation will be utilized to screen and provide a buffer from adjacent land uses.

Project maintenance will be minimum and consist of inspecting and maintaining water circulation improvements and public access areas. Completion of the construction phase is only the beginning phase of this project. Monitoring hydraulic, vegetation and wildlife changes, as a result of this project, is an important aspect to the project, both in research value and for fine-tuning the marsh to ensure a "successful" enhancement project. Completion of base data will be necessary prior to construction.

2.0 PROJECT DESCRIPTION

2.1 INTRODUCTION

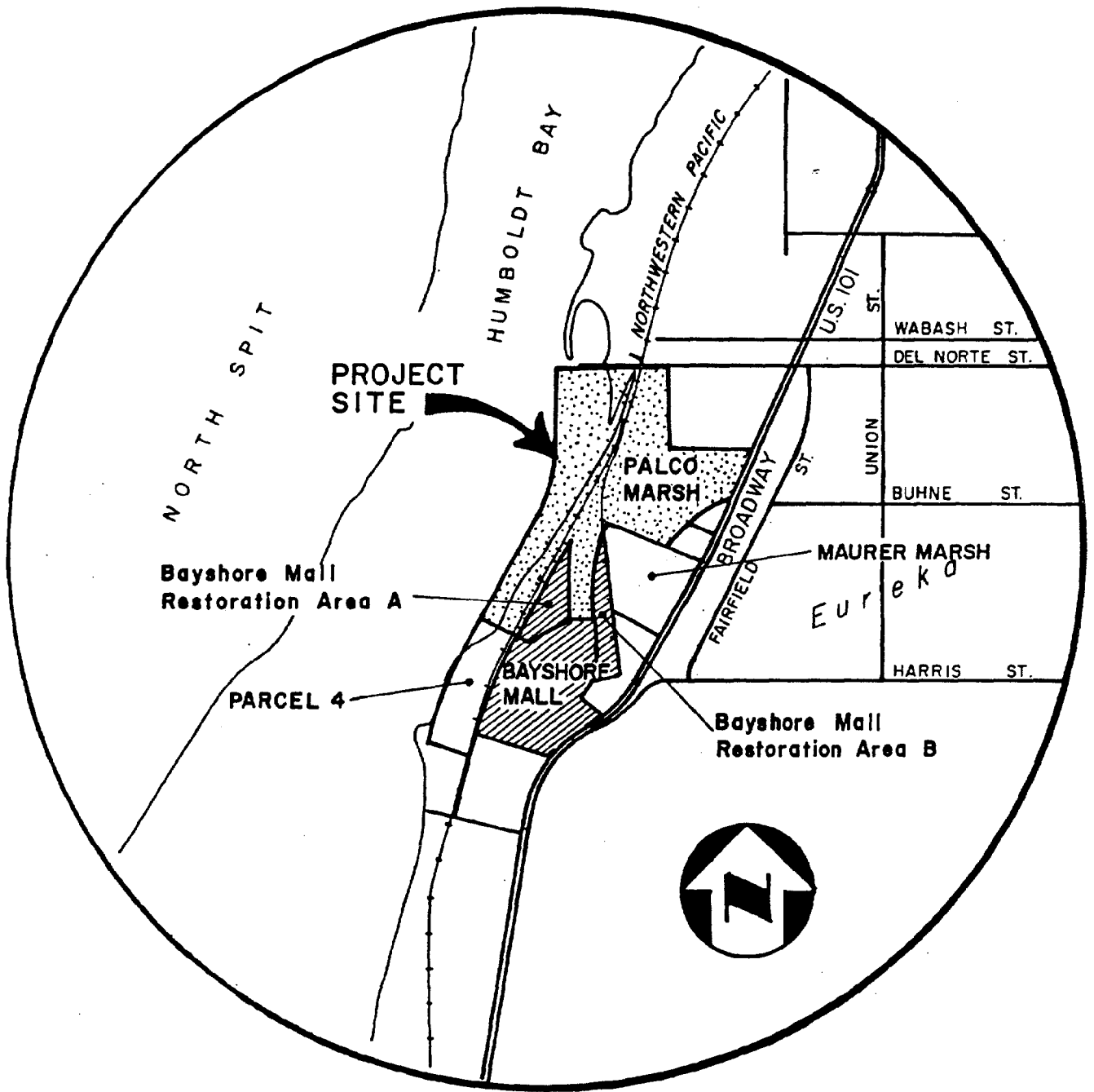
Humboldt Bay has experienced a loss of approximately 90% of its wetlands. Out of a total of 6,500 acres in existence in the 1800's only 600 acres of salt marsh and 40 acres of freshwater marsh remained as of 1980. Recent restoration efforts, funded for the most part by the State of California, have increased these figures to approximately 700 acres of salt marsh and 100 acres of freshwater marsh.

Several agencies have been involved in direct efforts to restore wetland areas or enhance degraded wetlands around Humboldt Bay. These include the California Coastal Conservancy, California Department of Fish and Game, and the U.S. Fish and Wildlife Service. Other agencies, such as the California Coastal Commission, California Department of Fish and Game, Army Corp of Engineers, and locally, the Humboldt Bay Harbor, Recreation and Conservation District as well as local municipalities regulate development affecting wetland or marine resources.

The project area has been an area of concern to a number of agencies. In 1980, the Army Corps of Engineers completed an exhaustive inventory of Humboldt Bay wetlands and designated areas into categories based on their resource values (Humboldt Bay Wetlands Review and Baylands Analysis, Shapiro, 1980). The Palco Marsh project area was designated in this report as an "Area of Importance" because of its importance to the functioning of the Humboldt Bay ecosystem. The California Coastal Act mandates wetland protection and enhancement where feasible. As a result, the Coastal Commission included Palco Marsh on its list of priority public acquisition sites and supported the City's application for funds to acquire and enhance the site.

The City of Eureka's Local Coastal Program identifies specific areas for wetland restoration projects within City limits. The objectives of the program include enhancing the biological productivity of the wetlands, minimizing or eliminating conflicts between wetlands and adjacent urban uses and providing stable boundaries and buffers between upland habitat areas. The Palco Marsh project site is specifically mentioned for wetland restoration.

The California Coastal Conservancy had been interested in purchasing the marsh complex for a number of years. Discussions with representatives from Pacific Lumber Company (the landowner) led to an agreement to preserve the integrity of the marsh. This included Pacific Lumber Company (PALCO) divesting their entire land holdings in the project area.



PROJECT SITE LOCATION

Figure 1

In 1986 the Coastal Conservancy provided the City of Eureka with the funding to purchase the Palco Marsh project site. Following acquisition, the City of Eureka dedicated an open space easement over the Palco Marsh project site to the Conservancy or a management entity approved by the Executive Officer of the Conservancy.

In addition to providing funding for acquisition of the Palco Marsh project site, the Coastal Conservancy will be involved in funding a project that enhances this area. Enhancement, as outlined by the Coastal Conservancy, would include improving tidal action to the 39 acre marsh complex, removing fill on a six acre parcel, and assembling parcels of land to improve the resource management of the project area. To this end, the Conservancy provided funding to the City of Eureka to develop an Enhancement Plan. Omsberg & Company and Rising Sun Enterprises were contracted to complete a site analysis and develop the Enhancement Plan for the area. A project team was compiled to assist in this endeavor consisting of Dr Robert Willis and Dr Mac McKee as project hydrologists, Gail Newton and Associates as project botanists and Dr Kitchen as wildlife specialist.

This Enhancement Plan involved a process beginning with identification of preliminary project goals by the Coastal Conservancy. Based on this initial direction, a site analysis was conducted to identify opportunities for enhancement planning. Information compiled in this report was gathered from September, 1986 through February, 1987. Further definition of goals and objectives were influenced by opportunities and constraints inherent to site conditions. Discussions with the City of Eureka and the Coastal Conservancy led to a definition of goals and objectives which are listed in Section 4.2 of the Enhancement Plan.

This Enhancement Plan, after the City's approval, will be submitted and reviewed by both permitting and reviewing agencies (California Coastal Conservancy, Humboldt Bay Harbor District, California Coastal Commission, Army Corps of Engineers, California Department of Fish and Game). The review and permitting sequence offers several opportunities for public review and hearings.

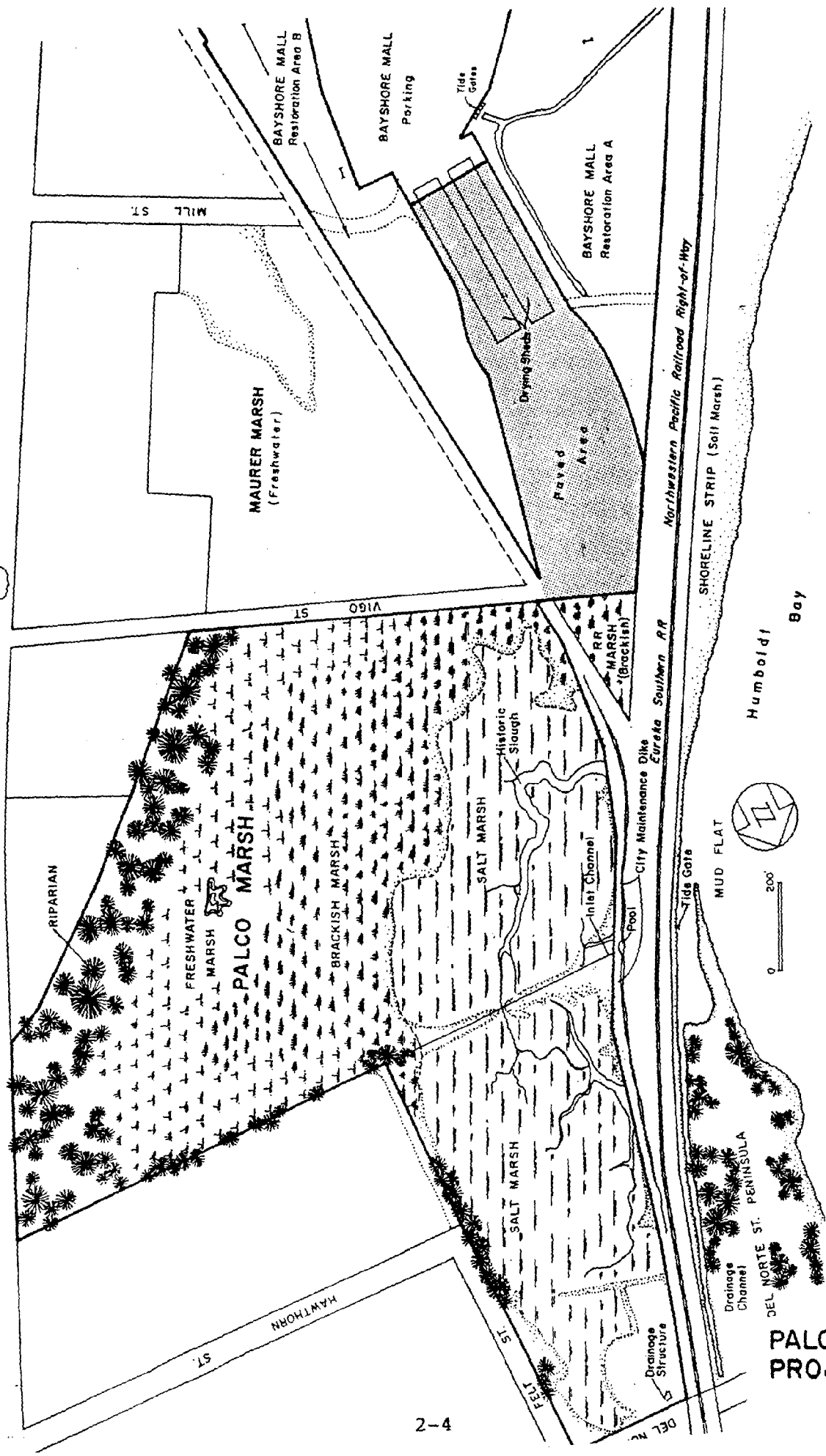
The City is currently establishing a non-profit organization that would manage the Palco Marsh project, as well as other enhancement projects planned in the City of Eureka. If the City is unable to establish a nonprofit organization to perform this function, then the Department of Fish and Game has expressed an interest in managing the project area.

2.2 Site Definition

The Palco Marsh project site is located on the eastern shoreline of Humboldt Bay at the western edge of the City of Eureka. It is surrounded by urban development on three sides: 1) Del Norte and Hawthorne Streets and adjacent commercial/industrial uses to the

101

BROADWAY



**PALCO MARSH
PROJECT AREA**

north; 2) Broadway Avenue with commercial uses to the east; and 3) the newly constructed Bayshore Mall to the south. West of the Palco Marsh project site are Humboldt Bay mudflats, central channel and the Samoa Peninsula. The Crown Simpson pulp mill is located directly across the Bay channel on the Samoa Peninsula, 1/2 mile west of the Palco Marsh site.

The project is bisected by the Northwestern Pacific Railroad right-of-way, which traverses north-south across the project site. The east half of the project site consists of approximately 45 acres which includes a six acre developed area and a 39 acre marsh complex consisting of approximately 17 acres of salt marsh, nine acres of brackish marsh, eight acres of freshwater marsh, and five acres of riparian habitat. The western half of the project site, 41 acres, consists of tidal flats, shoreline strip of salt marsh and a four acre upland peninsula located just south of the end of Del Norte Street. See Figure 2 for location and nomenclature used throughout the report.

2.3 Related Projects and Properties

Several other projects, not a part of the Palco Marsh project site, are related to the project and addressed in other portions of this report. These include: 1) "Parcel 4", a 15 acre parcel zoned for Coastal Dependent Industrial Use which was acquired at the same time as the Palco Marsh project site; 2) Maurer Marsh, a 10 acre freshwater marsh between Vigo and Mill Streets, is currently in private ownership. The City of Eureka with the Coastal Conservancy is currently negotiating title to this wetland portion of the parcel 3) a railroad spur and a 1/2 acre triangular shaped "RR Marsh", which is currently owned by the Northwestern Pacific Railroad but is being acquired by the City of Eureka; and 4) "Wetland Restoration Areas A and B", adjacent to the paved drying shed area and belonging to General Growth Inc., are wetland mitigation areas constructed as part of the Bayshore Mall project.

3.0 SITE CONDITIONS

3.1 Topography and Geology

The City of Eureka is situated on the edge of a gently sloping, broadly rolling terrace that rises from 20 to 250 feet above the central part of Humboldt Bay and surrounding tidal flats. Portions of the City, including the project site, extend onto the lowland areas that form the Bay margin (City of Eureka, Human Safety Technical Background Study, 1977). According to mapping of the California Department of Mines and Geology (1962), the project site is underlain by recent alluvium. The upland terrace area, east of Broadway, is underlain by the Pleistocene non-marine sedimentary deposits of the Hookton Formation, made up of loosely-aggregated gravel, sands and clay.

The project site, located on partially reclaimed tidelands and estuarine deposits, is within a mile of the existing mouth of the Elk River. The tendency of north coast estuary areas to undergo changes in configuration with fluctuating current, runoff and sediment deposition characteristics, suggests that sediments on the site were influenced by such estuarine movements. Materials underlying the project site could be expected to be bay sediments, river alluvium and sand dune materials.

Topographic information was compiled for the project site from various existing sources of information. Additional elevations were obtained during the site analysis phase of the project. All elevations throughout the report will be to City of Eureka's datum. Mean lower low water equivalents will be given in parenthesis where noted.

The topography of the site gently slopes upward from 1.7 feet (2.1 MLLW) at the tide gate structure to 10+ feet at Broadway. The salt-brackish marsh complex is located between 5.1 feet (5.5 MLLW) and 6.1 feet (6.5 MLLW) elevation. The freshwater marsh area is generally at 6.3 feet (6.7 MLLW) elevation. The filled and paved upland area containing the drying sheds is generally between 8.0 feet and 10.6 feet elevation.

Indications for Enhancement Planning

The location and influence of Humboldt Bay and the Elk River has varied throughout the site's history causing site conditions to be conducive to re-establishment of wetland habitats. The majority of the site remains unfilled; portions are still influenced by tidal input or from upland drainages. The relatively low gradient of the Marsh, sensitive to small changes in water surface elevations, dictates that careful planning will be necessary to maintain or enhance the site for a particular type of wetland. Elevations present on-site are conducive to an increased yet still muted tidal prism. Grading in some areas will be necessary to provide channels to distribute tidal input or provide adequate drainage.

3.2 Soils

Lowland areas around the Bay have been subject to extensive disturbance since the settlement of the area in the 1850's, making the nature of native materials underlying the filled and paved areas of the site difficult to determine from surface evidence. The 1854 U.S. Coast Survey of Humboldt Bay (Bache, 1854) indicates that the site at that time encompassed higher areas of sandy grasslands and lower marsh areas subject to tidal inundation. Though unmapped, a correlation can be made with soils found near the mouth of the Elk River. Soils in the Elk River area are composed of two mapping units: Sand Dunes (SD) and Bayside Silty Clay Loam (Ba6). The "Sand Dunes" classification consists of wind-deposited, fine-grained sands. The Bayside soils have high clay content and are derived from reclaimed tidal marshes at elevations near sea level (McLaughlin and Harradine, 1965).

On-site soils data was analyzed by CalTrans during explorations in connection with the proposed Eureka freeway in 1965 and 1971. CalTrans' investigations include a series of bore holes on a north-south trending line through the site. These bore holes, ranging in depth from 16 to 55 feet, penetrated extensive layers of saturated sands, clays, organic and marine layers, tending to confirm what is thought to be the original conditions on the site (sand dune, river mouth and bay deposits). Very wet soils (free water present) conditions were encountered at or near ground surface for the majority of the holes located on the site.

Surface soils in the Palco Marsh wetland area were analyzed for texture, salinity and pH (see Table 1). These samples exhibited a range of texture varying from clay to organic soils. Signs of anaerobic decomposition and hypersaline conditions were found in the clays associated with the unvegetated salt marsh areas, indicating poorly flushed tidal areas; thick organic layers were found in the fresh/brackish marsh area.

Aerial photographs dating back to 1931 and historic maps were examined to identify areas where fill in the paved drying shed area may exist. It appears that higher upland areas were leveled to fill lower tidal areas. Several exploratory holes, dug in 1986 with a backhoe, indicated that the paved area consists of an average of four inches of paving. Sandy grassland soils, as well as imported river run gravel, served as the source of fill. Bayside silty clay loam was encountered two to three feet below the surface in some locations. Groundwater was present approximately five feet below the surface, which is consistent with adjacent wetland elevations (5.0 foot elevation).

TABLE 1
SOIL pH/SALINITIES

Soil	Elevation	pH	Salinity (ppt)
Bay - cordgrass	n/a	6.6	15
Bay - pickleweed	n/a	6.4	25
Marsh - pickleweed	6.0	6.4	15
N. Marsh - mudflat	5.3	6.7	60
N. Marsh - mudflat	5.3	6.9	50
Saltgrass - rear inlet	5.3	6.5	30
Northend - pickleweed	5.5	5.8	25
Southend - pickleweed	6.1	6.8	25
Historic slough	5.0	6.5	65
Brackish marsh	5.7	5.0	5
Freshwater marsh	4.6	4.7	0

Indications for Enhancement Planning

Soils in the existing wetland areas exhibit characteristics that would normally be expected, given the present hydrologic influences and vegetative cover. Surface soils in the salt marsh area could be improved with an increase in tidal flushing, thereby reducing salinities and providing suitable conditions for natural revegetation by existing salt marsh species. Removal of the paving, and a minimal amount of fill in the area surrounding the drying sheds, would provide habitat for willows and alders, if planted. Other upland species would also expect to colonize in the area. Removal of all the fill, as well as 2-3 feet of native soil would be necessary to subject the area to enough tidal action to establish salt marsh habitat. Freshwater ponds could also be established in this area provided an adequate source of water is available.

3.3 Hydrology

The Palco Marsh project site is physically separated from Humboldt Bay hydraulics by the existing Northwestern Pacific Railroad right-of-way and the City of Eureka's maintenance dike. The principal hydrologic inputs to the Palco Marsh include tidal influx, urban runoff from areas east of the site, direct precipitation and ground water discharge.

3.31 Tidal Influence/Surface Runoff

A tidegate, located on the bay-side of the railroad right-of-way, has historically limited tidal influence into the Marsh. The existence of established salt marsh vegetation in the Marsh indicates that the tidegate has not been kept in proper working order. At present, sediment and debris are keeping the tidegate partially open. A 24 inch culvert extends from the tidegate to the inland side of the railroad tracks. From this point, tide waters empty into a 10 x 20 foot "pool" (see Figure 3). The Palco Marsh drains into this pool and receives tidewaters, via two 12-inch PVC pipes located on the City of Eureka's maintenance dike. Tides in excess of 4.0 feet enter the pool area and fill the lateral ditches. Only tides in excess of 5.4 feet enter the Palco Marsh, and only for a brief period of time.

During summer months, tidal influence on Palco Marsh is limited. Water surface elevation changes of 0.2 feet were measured during a tidal range that varied eight feet. This represents an extremely muted tidal cycle. This combined with evapotranspiration results in hypersaline conditions, soil shrinkage/subsidence and algal mats. During winter months, tidal influence is similarly limited but influence of surface runoff, as a result of precipitation, causes more dramatic changes in water elevations. Observations indicate that a one inch rainfall caused water levels in the marsh to increase as much as six inches and took several days to drain out. (see Figure 5).

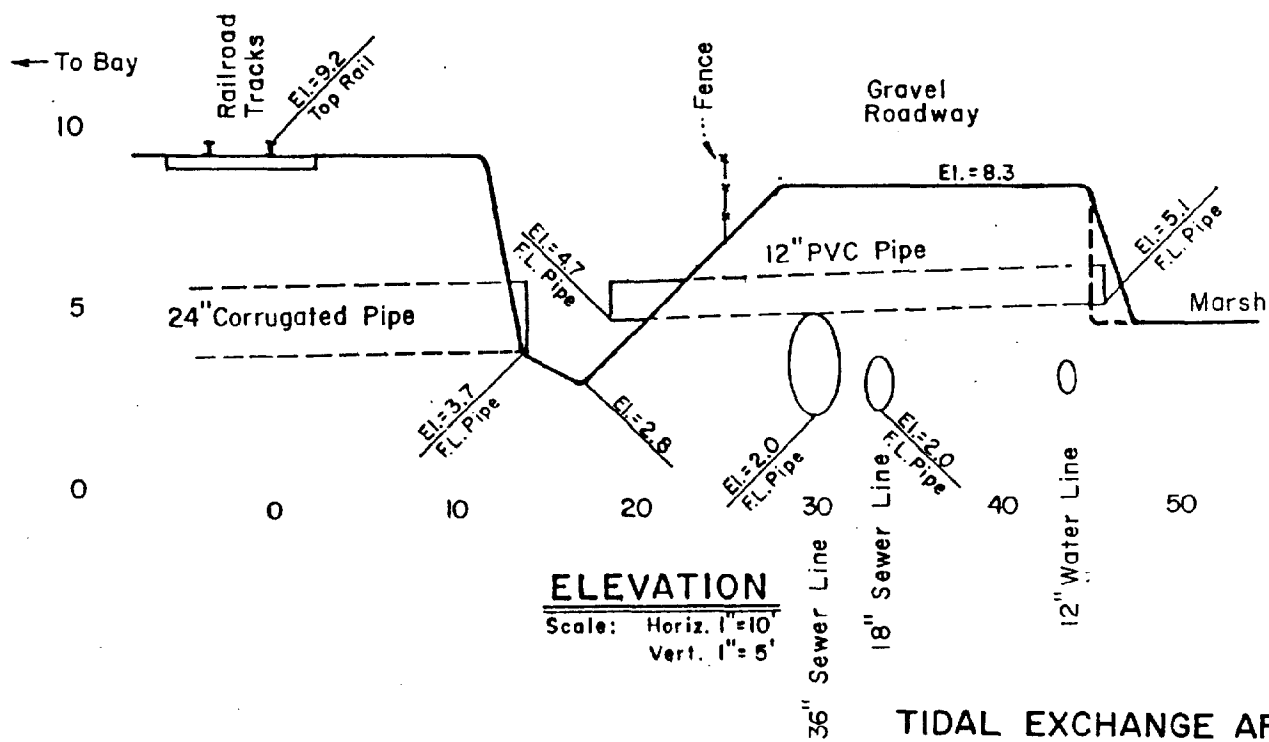
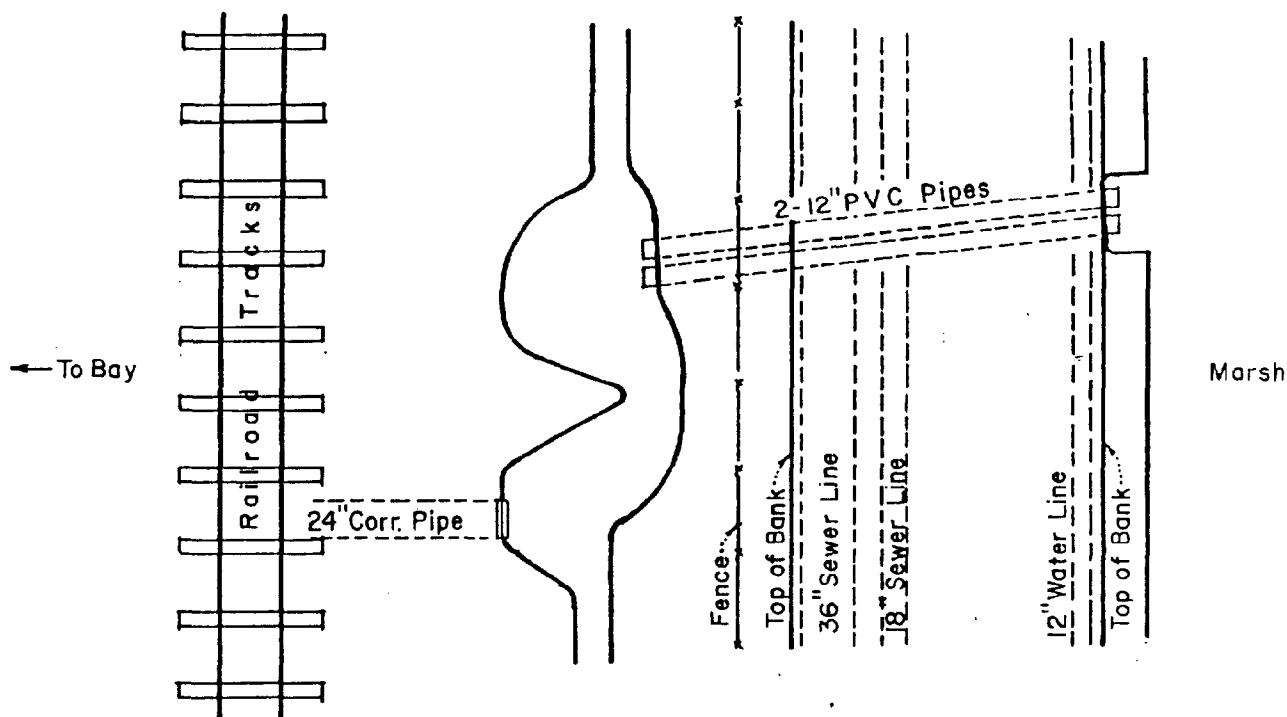


Figure 3

The area of the Palco Marsh is approximately thirty-nine acres. Hydrologic systems in the vicinity of the Palco Marsh include 13 watershed areas (see Figure 4). Of these thirteen areas, only input from Drainage Areas 2 through 9 (a total of 197.5 acres) drain into the Palco Marsh. Of the total 197.5 acres, drainage from approximately 150 of the acres flow into the Maurer Marsh (Drainage Area 7) and subsequently into Palco Marsh.

Drainage Areas 10 through 13, though adjacent to the project, drain into Humboldt Bay without entering the Palco Marsh. Drainage area acreage, elevations and relevant drainage structures are listed in Table 2 for each of the watershed areas depicted in Figure 4.

Groundwater data for the project site are limited. CalTrans test borings near South Broadway have indicated shallow (unconfined) groundwater resources in the east portion of Palco Marsh at approximately 5.0 feet elevation. Backhoe pits, dug in the drying shed vicinity also indicated similar groundwater levels. Springs also occur at the base of the bluff east of Broadway, adjacent to the Palco Marsh. The marsh vegetation in the eastern portion of Palco Marsh consists primarily of freshwater species supported from these high groundwater sources. The magnitude and temporal variation in the groundwater discharge occurring at the project site remains unknown.

3.32 Flooding

The existence and severity of flood hazards in the City of Eureka were investigated by the Federal Emergency Management Agency (FEMA). The study covered all significant flooding sources affecting Eureka. As the Management Agency concluded:

"Eureka is protected by the Samoa Peninsula from flooding by the open ocean; however, areas of Eureka adjacent to Humboldt Bay are subject to tidal flooding. The highest estimated tidal elevation recorded at Eureka occurred on February 4, 1958. The estimated storm surge height was approximately ... 10 feet above mean lower low water. (MLLW)"

This elevation was determined in the FEMA study to represent the 100-year storm tide elevation. Flood-prone areas, as mapped by FEMA, lie immediately west of the Northwestern Pacific Railroad right-of-way. Within the project site, only the Del Norte Street pier and adjacent peninsula, and the shoreline strip of salt marsh are mapped as being in the 100-year flood zone.

Although the Palco Marsh does not appear to be directly affected by storm surges, a mathematical model was developed to determine the probable variations in marsh water levels resulting from extreme hydrologic and tidal events. A combination of a 10 foot storm tide and a 100-year precipitation event (3.0 inches of rain) resulted in a water level in the marsh of 7.5 feet. This would indicate the highest water surface elevations expected in

TABLE 2

PALCO MARSH DRAINAGE AREAS

Drainage Area	Area of Drainage (acres)	Flow into	Via	Elevation*	Notes
1	38.74	pool	2-12" culverts	5.1	Palco Marsh Area
pool	-	Bay	24" culvert	3.7	Flow to Bay
2	3.7	1	18" culvert	6.4	Pocket Marsh #7
3	6.6	1	1-18" culvert 2-8 " culverts	6.2	runoff drainage from City Garbage
4	3.4	1	surface runoff	-	Harbor Lanes Bowling Alley
5	10.4	1	30" culvert	±10.0	enters marsh adjacent to bowling lanes
6	4.4	1	surface runoff	-	urbanized area north of Vigo
7	19.0	1	20" culvert	3.6	Maurer Marsh (10.5 acres) + urbanized area
8	150.0	7	36" culvert	11.2	Henderson Street drainage
9	6.0	Pool	surface runoff	-	asphalt/drying shed area
10	7.0	Bay	25" culvert	6.7	Bayshore Restoration Area A
11	7.2	9	adjustable weir	±7.0	Bayshore Restoration Area B
12	26.4	11	2-18' culverts	11.4	drainage from Harris St. south
13	15.2	9, 11	direct surface runoff	-	north parking area of Bayshore Mall (partial)

* City of Eureka Datum

the marsh from this single storm event.

On February 18, 1986, (after a sequence of high rainfall, combined with a sequence of high tides reaching up to 6.5 MLLW), water levels in the marsh were above what was produced by the mathematical model. These elevations, from observation, were estimated to be approximately one foot below the street surface at Hawthorne and Felt Streets, making the water surface elevation approximately nine feet. A simulated storm event, representing conditions prior to February 18, 1986, was placed into the hydraulic model; results approximated field observations. Approximately six inches of rain fell in a seven day period. Although none of the individual storms were of a significant nature, the cumulative effect on the Palco Marsh was significant. High tides, as well as constricted outflow, severely limited discharge of fresh water from the marsh. Fluctuation in water levels occurring in the marsh, caused by tidal influence and storm events are depicted in Figure 5.

3.33 Water Quality

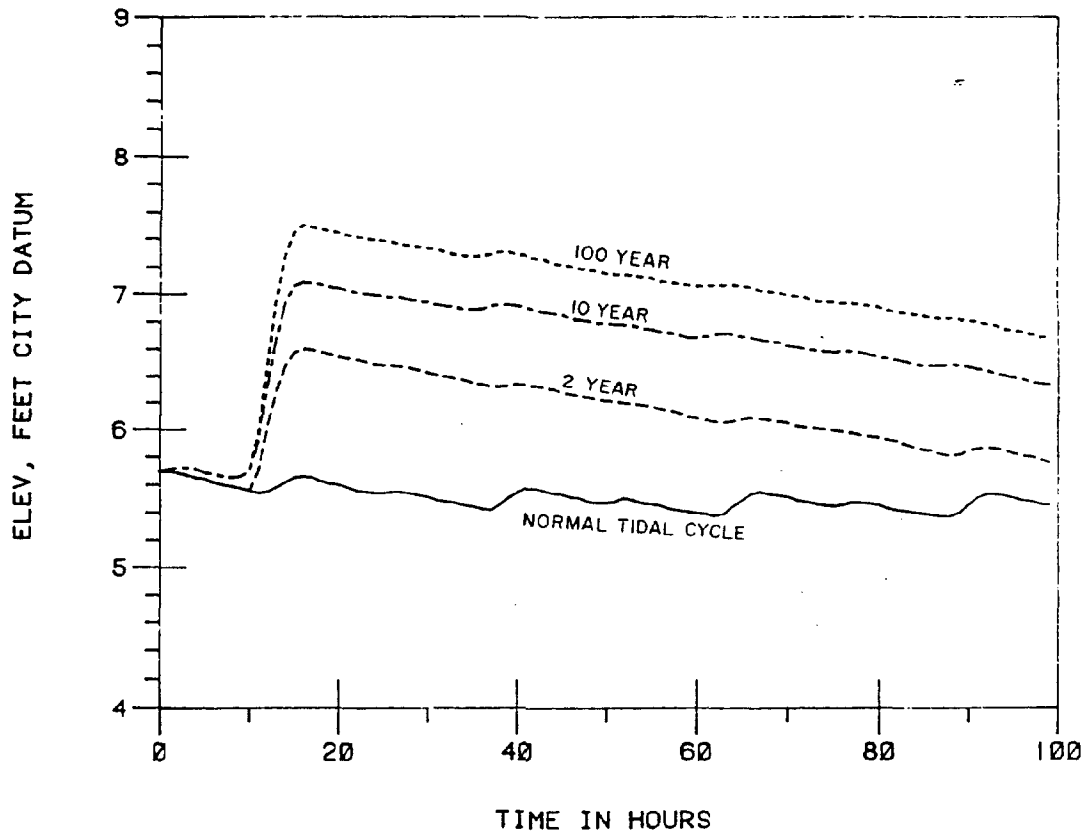
Water quality data have been compiled which attest to the extreme variability in water quality factors in Humboldt Bay. Nutrient levels, salinity, temperature, and dissolved oxygen levels vary with periods of ocean upwelling, tidal changes, seasonal temperatures and storm runoff. The Humboldt Bay Wetlands Review and Analysis (Shapiro, 1980) discusses these general relationships and their significance in more detail.

Land use factors which affect water quality in Humboldt Bay and associated tidal marshlands include discharge from the Arcata and Eureka sewage treatment plants, agricultural, silvicultural and urban runoff. Restrictions on the harvest of shellfish from the Bay result from bacterial contamination from agricultural, sewage collection and treatment facility sources. Suspended sediment deposition and turbidity in the Bay results primarily from influx of turbid ocean water into the Bay, as well as erosion and sediment transport from upland watersheds.

The Palco Marsh is primarily influenced by both surface runoff from urban areas and tidal influx. Runoff from urban areas may contain toxic chemicals and sediment contributed by residential and commercial areas. On-site wetland areas are influenced by bay salinity to varying degrees as indicated by the distribution of marsh vegetation described in Section 3.4. Although salinities generally decline with distance from bay discharge outlets, localized areas subject to limited inundation, poor drainage and flushing, combined with seasonal evapotranspiration, tend to have higher salinities than bay waters.

Six basic water quality parameters were measured during this study: temperature, pH, dissolved oxygen (DO), salinity, biological oxygen demand (BOD) and suspended materials. These water quality parameters are summarized in Table 3.

PRESENT CONDITIONS IN MARSH
WITH VARIOUS PRECIPITATION EVENTS



WATER LEVELS IN MARSH
PRESENT CONDITIONS

Figure 5

TABLE 3
WATER QUALITY

Sample #	Location	Temp. °C	pH	DO	Salinity ppt	Suspended Material mg/l	BOD mg/l
1	Bay	15.5	5.7	5.6	90	.007	31.6
2	Inlet	16.0	5.9	4.0	55	.008	30.0
3	500' E. of Inlet	17.5	6.0	2.7	40	.104	50.7
4	500' E. 100' N. of Inlet	17.0	6.2	6.5	60	.003	40.5
5	Middle of N. Marsh	18.5	6.1	2.4	110	.015	40.0
6	Fresh Water Marsh	15.0	5.8	4.0	1	.028	44.8
7	Middle of S. Marsh	18.0	6.3	5.5	2.5	.003	29.5
8	Maurer Marsh Drainage	18.0	4.0	3.7	2.5	.001	30.0

The results indicate some of the important processes occurring in the marsh. As would be expected, water temperatures increased relative to distance from the bay inlet. An exception to this was the sample taken within the freshwater marsh area. Lower temperatures would indicate the presence of surface groundwater flow. High temperatures and salinity toward the north end of the Palco Marsh indicate hypersaline conditions due to poor circulation and excessive evapotranspiration. Areas subject to poor circulation had a high BOD value indicating a lack of oxygen. High suspended solids values were found in vegetated areas where organic decomposition was occurring.

Indications for Enhancement Planning

One of the factors that limit enhancement opportunities is the high elevation (4.1 MLLW) of the culvert underneath the railroad tracks which brings tidal waters from the bay to the marsh. Though it would be possible to install a new culvert at a lower elevation under the railroad tracks, this alternative is not feasible for two reasons. First an 800 foot channel would have to be dredged from the main bay channel to the culvert. Second, since the Palco Marsh is, for the most part well above 4.0 MLLW, major grading and drainage reconfiguration would be necessary to take advantage of the extra tidal variation. This would require excessive costs and environmental degradation beyond what was intended in the original project goals.

Increasing tidal circulation into the marsh can be accomplished by removing existing constraints, including removing the tidegate and modifying the area where marsh runoff and tidal influx interchange. Results from the mathematical model indicated that either enlarging and/or lowering the elevation of the exchange pipes under the maintenance dike, removing the tidegate, or modifying channel configuration, would not, in themselves, significantly change the conditions in the marsh. A combination of all the above would be necessary to effect such a change.

Surface runoff from the surrounding watershed areas dramatically changes the hydraulics of the Palco Marsh during the rainy season. The majority of surface runoff entering the Palco Marsh is contributed by runoff from 150 acres that enters via the Maurer Marsh. During storm conditions, not only does water back up into Maurer Marsh due to higher water elevations in the Palco Marsh, but outflow is restricted from vegetation surrounding the connecting culvert under Vigo Street.

Flooding problems in the Palco Marsh are a result of constrictions on freshwater discharge from the marsh, rather than tidal influx. Increasing the rate of run-off leaving the Marsh, without appreciably increasing the volume of tide waters entering the marsh, would reduce flooding problems. Modeling results indicate that increasing the capacity of the exchange area (Figure 3) will improve tidal exchange and drainage without significantly increasing the intake volume of tide waters during flood conditions. This is due mainly to the short period of tidal peaks, restricted inflow through the culvert under the tracks and the relatively high elevations of the marsh.

3.4 Vegetation

3.41 Overview

Wetlands around Humboldt Bay can be categorized into salt marsh, brackish marsh, freshwater marsh, riparian and swamp habitats. These classifications occur around the Bay in varying degrees of distinction and health.

In general, the vegetation of the site is typical of marshlands around Humboldt Bay (Koplin, et. al. 1984; Newton 1984, 1985a, 1985b; Seeman 1985, 1986). The salt marshes west of the railroad tracks are healthy and diverse. The salt marshes east of the railroad tracks are degraded and low in plant diversity. Extensive riparian woodlands with diverse understories and freshwater marshes are located on higher elevations toward the east side of the marsh complex. Between the riparian woodlands and the salt marshes, a large zone of freshwater brackish marshes occurs. The assortment of brackish marsh vegetation is unique in that most types of brackish marsh located around Humboldt Bay can be found within this one marsh complex. This is due in part to the gradual elevation increase and the inland extent of the wetland. As a result, the gradient changes from salt to brackish to freshwater marsh.

The vegetation of the Palco Marsh complex was sampled late in the flowering season, between September 29 and October 15, 1986. Due to the timing of this study, species composition, quantitative variations, and strata height are biased toward the late blooming species and/or those species that are distinguishable at that time of year. A compiled species list can be found in Appendix B. This species list is representative of the season of this study.

The vegetation patterns of the site were mapped in detail, especially the vegetation of the salt marshes located east of the railroad tracks. Location and extent of the rare species Humboldt Bay gumplant was mapped along with the location of invasive exotic species. Figures 6 and 7 depict the location of rare species and invasive species, located on the site, respectively.

The Vegetation Descriptions (Section 3.42) describes the general factors influencing the current vegetation of the Palco Marsh. Each specific vegetation type is described in detail in Appendix B; codes used correspond to the 1" = 100' vegetation map which accompanies this study.

The site contains a large population of the rare plant species Humboldt Bay gumplant. Any activity necessary to increase the diversity of the salt marshes will not adversely affect this population of the rare gumplant. These plants, for the most part, occur at high elevations along the west side of the railroad right-of-way. Only one specimen was found in the Marsh complex.

There are four other species of concern that were found on the site. The berms surrounding the marshes contain three invasive exotic species, scotch broom, french broom, and pampas grass. In addition, an invasive plant, the common reed, native to California but uncommon around Humboldt Bay, is also found on the site.

3.42 Vegetative Descriptions

The vegetation of the site is briefly described in the following discussion. The complete description of each vegetation type (or plant assemblage), based on species composition, quantitative variations, and structure, has been placed in Appendix B.

3.421 Salt Marsh -- SM

The salt marshes on the site are located both in a shoreline strip west of the railroad tracks and in Palco Marsh, east of the tracks. The salt marshes west of the tracks contain the usual diversity of vascular plants typical of salt marshes around Humboldt Bay. In this narrow strip of marsh, the three dominant salt marsh species, pickleweed (Salicornia virginica), cordgrass (Spartina densiflora), and salt grass (Distichlis spicata) occur together in varying amounts. Occasional throughout these marshes are sea lavender (Limonium californicum var. californicum), jaumea (Jaumea carnosa), and arrow grass (Triglochin spp.). The rare Humboldt Bay gumplant (Grindelia stricta ssp. blakei) is found along the upper edges of this marsh and the salt marsh snail (Ovatella myosotis) is common in this location.

The salt marshes and extensive mud flats east of the tracks are degraded and lack much of the diversity common in healthy salt marshes on Humboldt Bay. With the exception of the three main salt marsh species -- pickleweed, cordgrass, and salt grass -- none of the other salt marsh species occur in this area. The only location that contains a gumplant and a modest population of jaumea is a small portion of pickleweed marsh adjacent to the inlet channel.

Orache (Atriplex patula) and brass buttons (Cotula coronopifolia) are common in many of the areas east of the tracks, becoming dominant in small areas away from the inlet channel. These species are typically found in areas that are disturbed or severely stressed, likely from oxygen starvation and hypersalinity due to evaporation during the summer months.

Several areas east of the tracks are dying back at an accelerated rate. Aerial photos show that the majority of the die-back has occurred since 1981, with significant differences between 1983 and 1986. Tufts of salt grass from which the substrate has been eroded still persist in this area.

Since the health of the existing salt marsh east of the tracks is one of the main concerns of the enhancement project, the vegetation was mapped in detail. Other marshes on Humboldt Bay located at similar elevations are usually dominated by pickleweed and jaumea. More detailed vegetation descriptions and codes relate to the vegetation map of the site are listed in Appendix B.

3.422 Brackish Marshes -- BM

Brackish marshes form at the interface between the salt marshes and the freshwater marshes, therefore exhibiting a wide range of salinities that change seasonally. The species composition slowly changes as one moves from the areas near the salt marshes to the areas near the willow swamps or riparian woodlands. Three species of plants which are common throughout these brackish marshes are salt rush (Juncus lesueurii var. lesueurii, pacific silverweed (Potentilla egedii ssp. grandis), and water parsley (Oenanthe sarmentosa).

In general, the brackish marshes found on the site are typical of other such marshes around Humboldt Bay. Two types of marshes located on the site that are uncommon around Humboldt Bay are the pacific rush (Juncus effusus var. pacificus) and the common reed (Phragmites communis var. berlandieri) stands. The pacific rush marsh represents a unique resource; the common reed marsh could represent a threat to Humboldt Bay marshes. Though none of the brackish marshes, or species therein, are rare, the uniqueness of this site lies in the quantity and diversity of the marshes represented. Within the project site, most of the common types of brackish marshes can be found.

The brackish marshes on the site are separated by species composition and structure. The brackish marshes vary from very short areas dominated by grass species to the tall stands of slough sedge (Carex obnupta).

3.423 Freshwater Marshes -- FM

The marshes included in this section range from the upper edge of the brackish marshes to the riparian habitats (or willow swamps). The freshwater marshes include two tall, emergent dominated marshes and one emergent/floating-leaved marsh. These marshes are typical of Humboldt Bay. Some have previously been described by Monroe (1973), Newton (in Koplin, et. al. 1984), and Newton (1984, 1985a, 1985b).

These freshwater marshes are extensive within the site and intergrade heavily with adjacent riparian areas. Similar freshwater marshes can be found around Humboldt Bay but are usually in grazed pastureland areas.

3.424 Riparian Woodlands (or Willow Swamps) -- R

The riparian woodlands are present in abundance around the east edges of the site. Two riparian vegetation types are delineated based on the herbaceous layer; one contains typical freshwater marsh species in the understory while the other contains dense blackberry hedges and various grass species in the understory.

3.43 Rare Species

The three rare salt marsh species, which commonly occur around Humboldt Bay, are Point Reyes' bird's beak (Cordylanthus maritimus ssp. palustris), Humboldt Bay owl's clover (Orthocarpus castillejoides var. humboldtensis), and Humboldt Bay gumplant (Grindelia stricta ssp. blakei). Of these species, only the gumplant was found during the surveys conducted between September 29 and October 15. The bird's beak and the owl's clover are both annual species and are not possible to locate at this time of year.

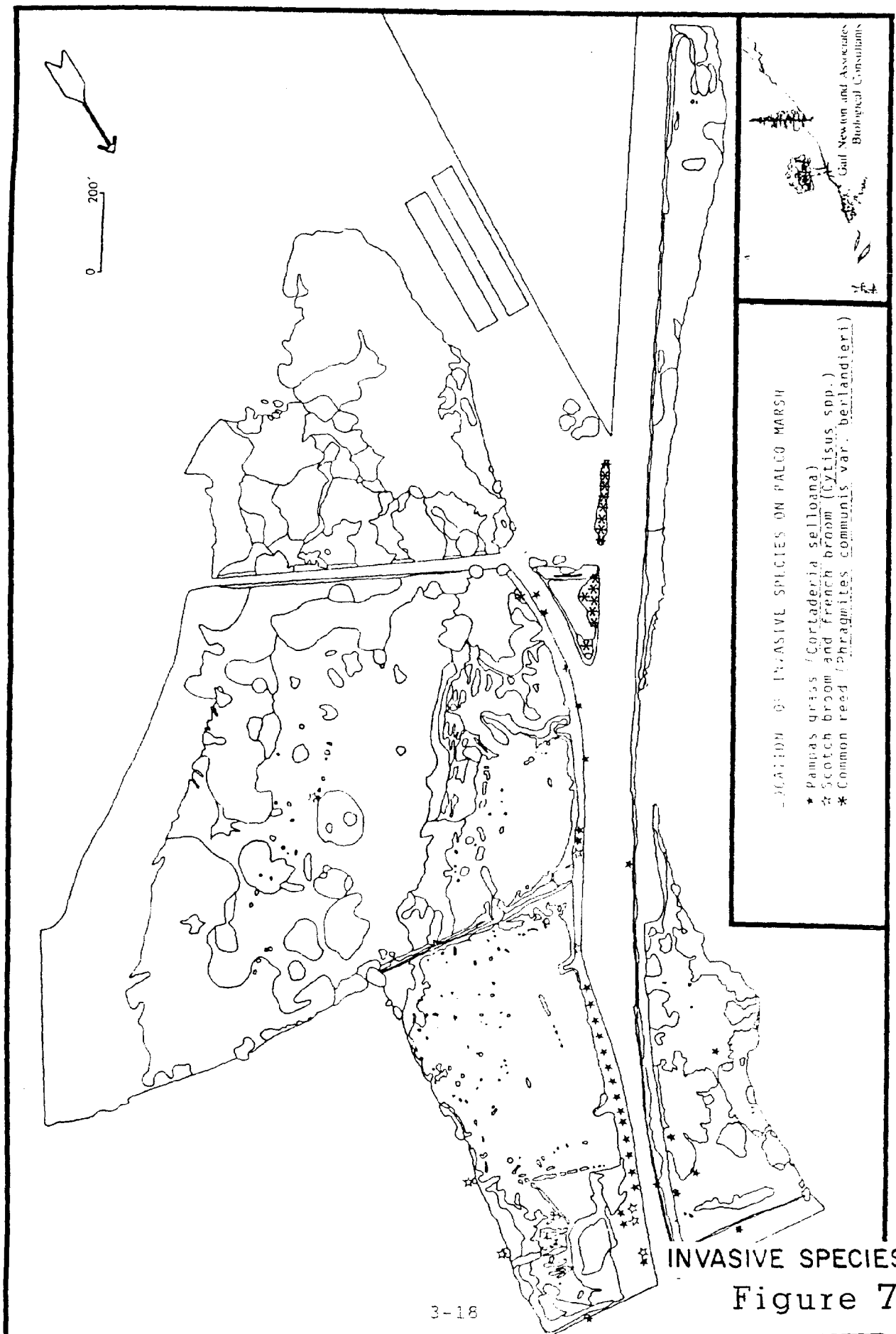
The population of the gumplant is located almost solely along the west side of the railroad berm and the adjoining areas. (See Figure 6). Only one individual of gumplant was located in the marsh east of the railroad tracks. The total population on the site is 4,061 individuals. The current degraded condition of the salt marsh east of the railroad tracks probably could not support either the owl's clover or the bird's beak. However, marginal habitat for both species is located in the salt marsh west of the railroad tracks. Enhancement activities should create habitat acceptable for these two species within the Marsh, if they are present near the site.

3.44 Invasive Exotics

The list of exotic species located on the site is extensive (including plants such as the cordgrass, himalaya berry, and brass buttons). Therefore, this discussion of exotics will be limited to the highly invasive species worthy of eradication and for which eradication is possible. Eradication of species such as himalaya berry would prove costly and futile. The main exotic species of concern located on the site are two species of broom (Cytisus spp.) and pampas grass (Cortaderia selloana).

The locations of these species are indicated on Figure 7. The majority of the pampas grass is distributed along the railroad right-of-way and nearby berms. The species of broom are more generally distributed throughout the site, but overall are less abundant. Eradication of these species from Palco Marsh should also include eradication from adjoining areas, particularly the railroad right-of-way.

One other species of concern located on the site is common reed (Phragmites communis var. belandieri). This species is cosmo-



politan in distribution (Mason 1957); however, its occurrence around Humboldt Bay is very limited. On the east coast and throughout the interior of California, common reed occurs in monotypic stands covering large acreages. The structure of those marshes decreases overall diversity and decreases wildlife habitat values. For this reason common reed should be treated as an invasive exotic in the Humboldt Bay area and should be eradicated before it spreads throughout the Bay's marshlands.

3.45 Influencing Factors

Three main factors influence the vegetation of a wetland: the duration of inundation, the chemistry of the water, and the site history. More specifically, the duration of inundation refers to both inundation by tidal action and inundation by direct or indirect precipitation. The most important aspect of the chemistry is the relative amount of soluble ions in the water. The third factor is the history of the site, particularly the disturbance history. The 1854 map of the site shows tidal marshes on the western edge of the site with small sandy areas included. The eastern portion of the site at that time is shown as vegetated dunes or grasslands with the very eastern edge containing some brush. In 1931 the site east of the railroad tracks was under agricultural use. The primary slough patterns within the pasturelands follow the same route today as they did in 1931. The riparian area near Highway 101 was much less extensive than present day.

It appears that by 1939, the eastern portion of the present day brackish marshes was no longer being as heavily plowed, as evidenced by the tufts of vegetation. By 1954 the taller vegetation had spread throughout the eastern portion of the marsh and the freshwater pond (of which a small remnant remains today) had started to develop. By 1962 the pond was fully developed, and the salt marshes were present. By 1972, the marshes appeared well established, and the riparian area was slowly expanding.

One of the more significant events in the vegetation history of Palco Marsh occurred during 1981, during the construction of the sewer line. The salt marshes located adjacent to Del Norte Street and north of the inlet channel began dying back at a rapid rate. The difference between the extent of the marsh vegetation between 1983 and 1986 is dramatic, some areas having diminished by 50% or more. Evidence of the erosion is present in the vegetation on the site; isolated tufts of salt grass can be found on the mudflats.

With all three factors; water, chemistry and history varying independently throughout a site, an association of plants is not an adequate indicator of the environmental conditions that prevail, since each species has different tolerances and can grow under different conditions. Absolute lines between salt marsh, brackish marsh, and freshwater marsh cannot be designated.

Indications for Enhancement Planning

Site conditions, as discussed in the preceding sections, have not dramatically changed in regards to topography, soils or off-site hydrology. Vegetation is more sensitive to changing environmental conditions, and thus reacts more quickly to changes. Because of this, opportunities are available to improve the vegetation and consequently wildlife habitat values. There are certain factors causing the marshes to be under stress and affecting the marsh vegetation density. These include poor tidal circulation and retention of storm run-off, which causes hypersalinity and dissolved oxygen depletion. The unhealthy condition of the salt marsh is evident by the lack of diversity of the vegetation. Under an improved tidal regime, salt marsh areas could be returned to a higher functioning value. Information gathered at the drying shed area indicates that, depending on the amount of fill removed and the availability of future water sources, this area could support wetland vegetation.

The rare species of plants thrive better in healthy salt marshes. Anything done to improve the circulation in the salt marsh would enhance the area for rare plant establishment. Longterm protection and stabilization of the marsh environment would also encourage expansion of rare species habitat. (Newton,86)

Freshwater marsh areas are slowly succeeding towards replacement by other vegetation development. Large expanses of cattail have filled in open water areas and the riparian edge is advancing westward towards the freshwater marsh habitat. Deep, open water pools that once support emergent species of plants, are now limited to the one small open water area.

The four exotic species of plants mentioned earlier are prolific propagators and difficult to control. For the most part Pampas grass is limited to the upland areas outside and along the upper edge of the Marsh. Reduction and eventual eradication of this species will require both removing specimens from adjacent property, particularly the railroad right-of-way, and adherence to a regular yearly eradication program. The two species of broom will require select removal. It is best to do this early into the flowering period when it is highly visible and before seed production begins.

The common reed presents a different problem in that this species of plant is located in the brackish marsh areas and propagates both from seed and rhizomes. Efforts to remove plants which cause them to break apart and disperse by the tide or wind will only aggravate the problem and could cause spreading to other parts of the Marsh. As of yet, no known attempts to remove this plant species have been made on Humboldt Bay.

Presently, areas containing common reed are accessible by backhoe and or hand removal.

3.5 Wildlife

3.51 Overview

Humboldt Bay is second only to San Francisco Bay area in wildlife species diversity and abundance in California. The Bay and associated wetland habitats form an important link in the chain of coastal wetlands extending from the Arctic Circle to South America. The Bay itself provides a variety of estuarine environments which are supplemented and enhanced by the presence of a variety of upland, riparian and freshwater marsh habitats.

Both salt and freshwater marshes have a high nutrient production rate, which significantly contributes to the food base of aquatic organisms. Because of the decline of wetland areas throughout the State, wildlife species adapted for utilizing wetland areas are increasingly dependent on the limited areas still remaining. The value of both salt and freshwater marshes are significantly increased when the two habitats are contiguous.

Wildlife use of the Marsh was analyzed during November, 1986. In addition, census information developed during the Bayshore Mall EIR (EDAW, 1984) and other research projects (Gerstenberg, 1972) was reviewed.

The Palco Marsh can be divided into three separate areas with regard to wildlife use: 1) salt/brackish marsh; 2) freshwater marsh; and 3) riparian areas. None of these areas are receiving the amount of use by wildlife that would be expected given the proximity of the Palco Marsh to Humboldt Bay, the known diversity of wildlife in the area, and the lack of these habitats, in general, in the greater Humboldt Bay Region. At present the area with the richest wildlife fauna is the salt/brackish marsh.

3.52 Salt/Brackish Marsh Area

The salt marsh area presently has the most open water of all three types of marsh and, therefore, receives the heaviest use by birds; including a variety of shorebirds, herons, egrets, gulls and waterfowl (see Table 4). In 1985, black-necked stilts bred in the area and the young were successfully raised. In the Falls of 1983-1986, migrating ruffs were observed to use this area for feeding and resting. These two species, while generally abundant in other areas, are rare in coastal areas such as Humboldt Bay and represent unique sightings.

Throughout the year the principal use of the salt marsh by birds is for feeding and resting. While use of the salt marsh is greater than the other marsh areas, it is still below what would be expected both in terms of numbers of species and numbers of individuals. For example, this area historically had an abundance of green-winged teal that could be observed feeding in the area. Presently this species is seldom present and, when it is, it is represented by only one to four individuals rather than

TABLE 4
AVIAN SPECIES LIST

SPECIES	TOTAL	AVERAGE	FEED	% ACTIVITY	
				REST	FLIGHT
SALT/BRACKISH WILDLIFE					
Large Gulls	139	27.8	4	69	27
Bonapartes Gulls	17	3.4	--	--	100
Killdeer	18	3.6	10	85	5
Greater Yellowlegs	40	8.0	80	15	5
Small Sandpipers	72	14.4	72	10	18
Dowitchers	105	21.0	66	22	12
Great Blue Heron	15	3.0	9	73	18
Snowy Egret	21	4.2	74	11	14
Black-Crowned					
Night Heron	61	12.2	--	100	--
Common Egret	14	2.8	53	38	19
Shoveler	34	6.8	63	26	11
Green-Winged Teal	243	48.6	--	100	--
Black Shoulder Kite	5	1.0	--	--	100
Cooper's Hawk	3	.6	--	--	100
Black Phoebe	9	1.8	15	85	--
Marsh Wren	33	6.6	45	35	20
Song Sparrow	7	1.4	35	65	--
Raven	5	1.0	--	5	95
TOTAL - Salt/Brackish	685	137.0			
FRESHWATER MARSH					
Redtailed Hawk, Imm	5	1.6	--	100	
Kestrel-Male	2	.6	30	50	20
Marsh Wren	66	22.0	45	35	20
Snipe	3	1.0	--	100	--
Common Egret	35	7.0	--	100	--
Great Blue Herron	3	.6	--	100	--
TOTAL - Freshwater	114	25.3			
RIPARIAN					
Song Sparrow	22	4.4	52	10	48
Fox Sparrow	29	5.8	18	11	71
Chestnut-Backed					
Chickadee	64	12.8	43	8	49
Black Phoebe	10	2.0	73*	27	73*
Yellow-Rumped Warbler	40	8.0	19	14	67
Junco	52	10.4	--	--	100
Towndsen's Warbler	7	1.4	26	14	60
Red-Shouldered Hawk	3	.6	--	88	12
Cooper's Hawk	2	.4	--	--	100
TOTAL - Riparian	229	25.4			

From 5-day Survey (November 04 - November 18, 1986)

TABLE 5

MAMMALS (EXPECTED)

NAME	HABITAT
Western harvest mouse	throughout
California mouse	throughout
California vole	throughout
Norway rat	throughout
Black rat	throughout
House mouse	edges
Marsh shrew	marsh, field
Shrew mole	field edge
Brush rabbit	marsh edge
Gray fox	edges
Common dog	throughout
Raccoon	edges
Long-tailed weasel	edges
Stripped skunk	woods
California myotis	woods
Red bat	woods
Big brown bat	woods
Black-tailed deer	edges

the dozens seen in the past. This suggests that changes have occurred that have reduced the available food for green-winged teal. Snowy egrets feed in the area regularly, but common egrets and great blue herons rarely do more than rest. Usually, these last two species would forage heavily in a habitat such as this if the proper food items were present.

Humboldt Bay is known to be an important link in Spring and Fall migrations of shorebirds; past studies indicate that the Palco Marsh site was extensively used by shorebirds. Long-billed dowitchers, greater yellowlegs and willets are currently the most common large shorebirds observed feeding in the open water areas of the salt marsh. Though an assortment of smaller sandpipers were using the open mudflat areas, their numbers were much less than normally would be expected to be feeding in the area. Also missing were large numbers of marbled godwits and phalaropes which would normally be present. This recent decrease in use by shorebirds can be considered significant.

Even though no direct sampling of the food base was conducted during this study, observations indicate a lack of necessary food items. Mudflat invertebrate fauna, normally present in a salt marsh area, is lacking in the Palco Marsh. Marine infauna were only found near the inlet channel and the salt marsh snail, normally common in salt marsh areas, was absent from the Palco Marsh site. Aquatic insect larvae was most likely the main food item being utilized.

Gulls of various species are quite common on this salt marsh and spend a great deal of time resting in the shallow water areas. Their abundance is due largely to the adjacent City Garbage Company of Eureka transfer station. However, Bonaparte's gulls use the area and feed in the marsh itself and Sabine's gulls have been observed in the area during migration. In particular, the Sabine's gull has been seen there during severe storms at sea and has appeared to seek refuge in the area. Use of the area by the more common gull species (California gull, ring-billed gull, herring gull and Western gull) will remain heavy as long as the transfer facility is in the area.

The group of birds most conspicuously absent is the waterfowl. The only species observed regularly in the salt marsh were a few green-winged teal, shovelers and pintails. There are about a dozen species of ducks alone (eg. mallard, gadwall, etc.) that one would expect to see in the salt marshes around Humboldt Bay. The reasons they are not present are not completely clear, but a lack of suitable foods, poor water circulation, and lack of any deep water (six to nine foot depth) are the most likely explanations.

The brackish marsh is immediately adjacent to the salt marsh and has little open water at any time. This habitat is used almost exclusively by both species of egrets, great-blue herons and black-crowned night herons for roosting. Brackish marshes with more open water are heavily used in other parts of Humboldt Bay

for foraging by these ardeids, by numerous species of shore birds and large numbers of waterfowl. The lack of open water reduces the available food and, therefore, the value of this area for wildlife.

3.53 Freshwater/Riparian Marsh

The freshwater/riparian marsh area has virtually no open water and almost no use by wetland-related species of birds (Table 4). The primary wetland species present in the area is the marsh wren. It's use of the area is year-round, with a significant breeding population present in the summer. Some of the larger waders (common egret and great-blue heron) use this area for roosting and will forage on the rodents in the habitat. In addition, redtailed hawks, cooper's hawks, kestrels and black-shouldered kites make limited use of this area's rodents. Based on observed captures, it would appear that the most common species of rodent is the California vole.

3.54 Use of Palco Marsh by Mammalian Species

No trapping studies were conducted in any of the three marsh areas to determine population levels of rodents or other mammals. Larger mammals' use of the area was primarily observed to occur along the Bay's edge, as well as in the freshwater marsh area. This area receives heavy use by gray foxes, raccoons and domestic cats. Signs of occasional use by deer were also observed. Mammals expected to be found in this area are listed in Table 5.

Indication for Enhancement Planning

The Palco Marsh has a great potential for wildlife use that is currently not being observed in the area. The general location next to the bay and adjacent wetlands, as well as the size and variation of the marshes all contribute to the uniqueness of the Palco Marsh. Since many of the wetland areas surrounding the Bay are limited in their lateral extent they tend towards narrow habitat ranges and often monotypic types of wetlands. Even though the general distribution of marshes in Palco Marsh, from salt marsh in the west to riparian habitat in the east, occurs in a short distance, a unique balance exists. For the various species of wildlife utilizing the area, the site offers resting and feeding areas, nesting and freshwater sources, refuge from storms and, presently, mudflats exposed even at high tides.

It would be difficult to justify expansion of one type of habitat in favor of another. Freshwater marshes are limited around Humboldt Bay, and as seen at Arcata's freshwater marshes and oxidation pond, are well used throughout the year. Though a case could be made to expand the freshwater marsh area, adjacent freshwater marsh areas (Maurer, Bayshore Mall Restoration Area 2) offer ample opportunities for future increased use. The best use of

the site seems to be in maintaining a balance of the diverse range of habitats present. Therefore, the best opportunities to enhance the site lie in correcting the problems within the Marsh to provide higher quality habitat.

The major problem with the Palco Marsh with regard to wildlife use is the lack of water circulation in the salt marsh and the lack of significant amounts of open water habitat in the brackish and freshwater marshes. This results in reduced food production for all species of water-related birds and in a lack of water surface for landing and take-off for certain waterfowl species (eg. ruddy ducks; greater scaup, coots, and grebes). The outcome is both reduced numbers and diversity of wildlife at the Palco Marsh.

Improving the circulation of tidewater throughout the saltmarsh will improve its value to wildlife. The lack of circulation in this area causes low food availability for wildlife. Organisms normally associated with salt marsh-related mudflats (and good circulation) are absent in the Palco Marsh. These include invertebrates which are critical for foraging by shorebirds, snowy egrets, etc. An increase in tidal flows would allow the redevelopment of this invertebrate fauna; subsequently the diversity and numbers of wildlife in the area should increase.

If a deep water pond (six to nine foot depth) was developed in the freshwater/brackish marsh area, there would be an appreciable increase in both diversity and numbers of wildlife using the area. The important submerged aquatic plants necessary for the development of a food base in the pond are present in the residual pond left in the freshwater marsh. This would allow waterfowl, grebes, etc. to land, forage and have the safety of deeper water for escape from potential predators. Herons and egrets would have a foraging area on the edges of the pond and would roost near this new feeding area. If more ponds were developed, a breeding waterfowl population might occur in the area. Otters commonly use the Bay adjacent to the Palco Marsh. If significant areas of open water were developed in the various types of marsh then it would be reasonable to expect otters to make occasional use of the area. Other species of mammals would be unaffected by alterations of the three habitat types present in the Palco Marsh.

3.6 Mosquito Vectors

Though mosquito problems are generally not significant around Humboldt Bay, sporadic outbursts, generally associated with tidal pools, do occur. The most significant problem area on the Bay is at the Palco Marsh site, where its location, upwind from a large population center, amplifies the situation (Strickland, pers. com.)

The County Public Health Department has been monitoring and treating the Palco Marsh area for the past six years (from May to

September) to assure the minimization of mosquito production. (Prior to this time the City of Eureka managed this task.) The primary problem species in this area is the mosquito, Aedes dorsalis, a vicious biter of humans with the capacity of migrating up to 20 miles from its breeding habitat (Strickland, pers. com.). This is a brackish flood water mosquito which lays its eggs on dry land subject to infrequent tidal inundation. The best habitat would be shallow depressions that are filled at a high high tide and left standing for ten days. This species of mosquito hatches from May to September and is a prolific breeder.

The area which contains the type of habitat favored by this mosquito is located in the southwest corner of the Palco Marsh, just north of Vigo Street. Tidewaters enter the marsh and move towards the south end of the marsh, flooding the area via several ditches. Freshwater run-off from the Maurer Marsh, after crossing under Vigo Street, drains towards the west and subsequently into the southwest corner. This combination causes the necessary breeding conditions.

Source reduction is the most successful mosquito abatement method. Either eliminating tidal influence into this area or improving tidal action (where standing brackish flood water would not occur) would be the best control for this species. The Marsh has been successfully treated regularly for the past two years using a bacterial larvacide "BT Formulation" (Bacillus thuringiensis var. israelensis). This is non-toxic to other aquatic organisms, being specific for the destruction of mosquito larvae. Other methods such as lateral ditching have been used or are available but have not been found to be cost-effective.

One suggestion made by the County Health Department was to provide nest boxes that would attract violet-green swallows or other insectivorous birds. If this proves to be a feasible alternative, local service groups could be contacted to further assist in this endeavor.

3.7 Land Use/Access

3.71 Site History

Lowland areas around Humboldt Bay have been subject to extensive disturbance since the settlement of the area in the 1850's. The 1854 U.S. Coastal and Geodesic Survey of Humboldt Bay (Bache, 1854) indicates that the site at that time encompassed areas of sandy grasslands and lower marsh areas subject to tidal inundation. At that time, existing settlements included Bucksport to the south, and Fort Humboldt to the east (EDAW, 1984).

By 1870, some of the wetlands between "A" Street in Eureka and Bucksport had been diked and reclaimed for agricultural pasture. The dikes were improved and used in 1901 for the Northwestern Pacific Railroad (EDAW, 1984); these diked areas included the Palco marshes. The Palco marshes originally consisted of tidal sloughs and salt marsh, but the placement of fill for the railroad right-of-way subsequently caused retention of runoff and the subsequent development of fresh/brackish marsh complexes.

After diking, the Palco marsh area was used for pasture. Remnants of fenceposts and lines are still evident in recent aerial photos and site reconnaissance. This area was part of the larger Russ Ranch, which was located on top of the bluff east of Broadway Avenue. During this time, the Dolbeer & Carson Lumber Company was offloading logs from railcars into the Bay from a wharf built for that purpose; remnants of this wharf can still be seen in the Bay just west of the Palco marsh. Logs dumped at this location were floated up to the mill near the Carson Mansion site.

In the 1870's, the South Park Race Track was built in an area near Broadway and Wabash. This site was used for both horses and, later, automobiles. The area at the extreme northern end of the Palco marsh was used for pasturing horses that raced at the track. A boxcar, remnants of which can be seen today, was moved on to the site to store hay. (Poyfaire, pers. comm.)

The Holmes-Eureka Mill was established in 1903 on "ten acres of sand dunes" located south of the project site. The original plant employed 40 workers. By the 1920's, Holmes-Eureka was a "highly mechanized modern plant, covering 50 acres, employing over 500 men, and engaging in the "world-wide export" of Humboldt County redwood lumber. The plant was primarily located between the Bay and the railroad right-of-way at the Parcel 4 location and along the shoreline. Areas east of the railroad were used for log and lumber storage (Sanborn Insurance Maps of Eureka, 1920; Steenfott Collection).

From 1930 to 1950, the Eureka Lumber and Crossarm Company built cross arms for telephone poles and other uses on the site northwest of Mill Street. The existing drying sheds in this area were built in 1958 and 1959. The Pacific Lumber Company bought the

site in 1959 and used it more or less continuously until 1983, for the drying and storage of lumber. During this period, the site was substantially graded, creating a series of basins and berms throughout portions of the property (LSA, 1986).

The Palco Marshes, though, remained unfilled. Comparison of recent aerial photographs with historic maps show that the western portion of the marsh retained its topographic characteristics (present over one hundred years ago), as evidenced by the cut-off slough and associated drainages. (See Figure 8). Since at least the beginning of this century, with the diking for agricultural use and placement of the railroad right-of-way, the Palco Marsh has been influenced by retention of some upland runoff and limited saltwater intrusion from the Bay.

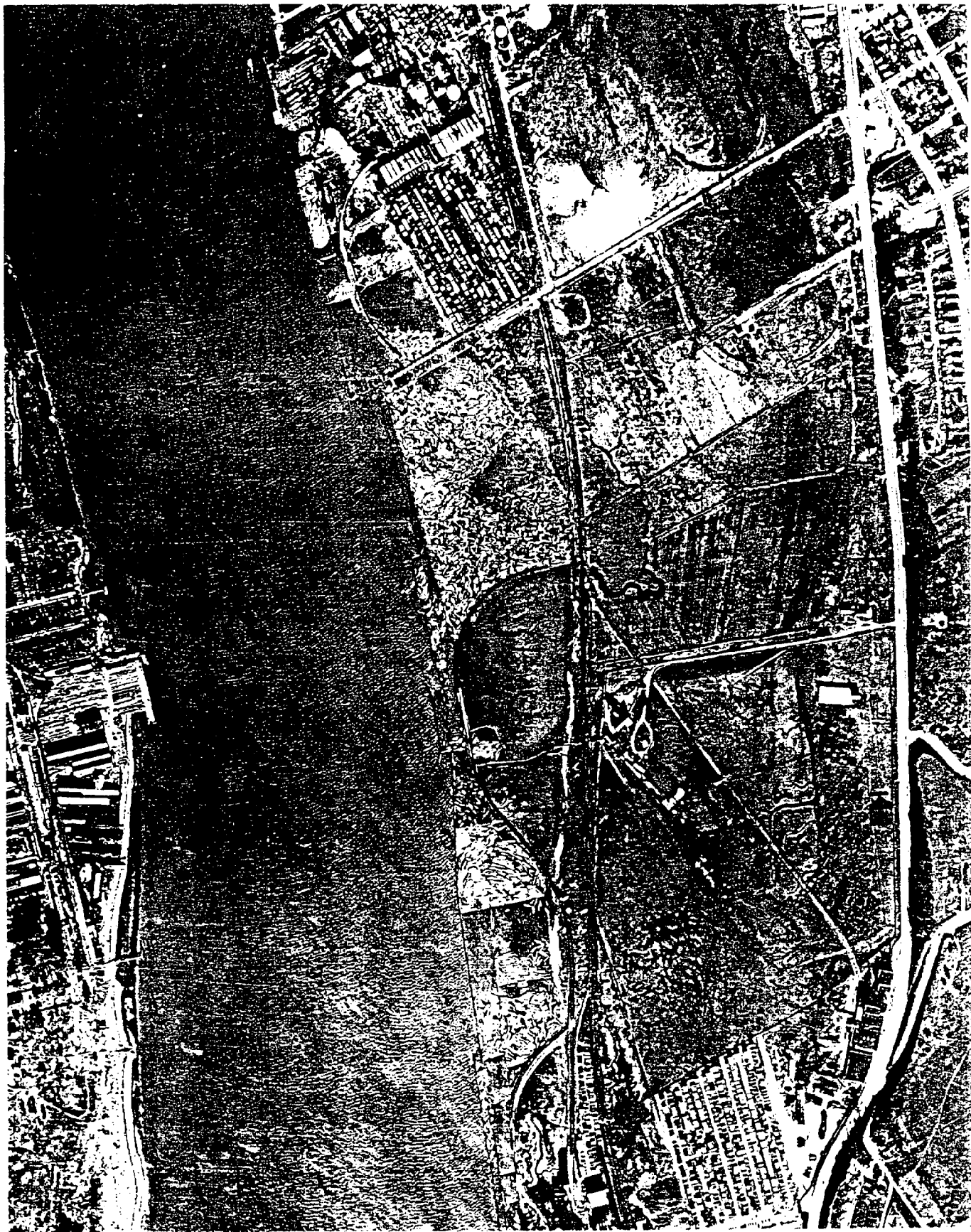
In the early fifties, Hawthorne Street, off Broadway, ended approximately where the current City Garbage Company of Eureka office is now located. A house was located there, and the owner raised and sold chickens. Mr. Tom Hall, involved in construction and demolition of bridges and buildings, improved the road (filled the marsh) to where Hawthorne Street turns into Felt Street. Here, a circular road was constructed for storage of old trusses and timbers from Hall's construction business. This area was bermed and buffered from the marsh as part of conditions for City Garbage Company's Coastal Development Permit in 1978. (Poyfaire, pers. comm.) Drainage from City Garbage is filtered through sand prior to entering the marsh. (Linda Locklin; Coastal Commission, pers. comm.)

In the 1940's, a twelve inch water main was installed just east of the railroad tracks. This new line, enclosed in a raised berm, runs along the western edge of the Palco Marsh from Del Norte Street to Vigo Street, before turning west towards the track. This fill and drainage alteration subsequently minimized tidal influence and altered the vegetation in the marsh.

In 1981, both a 18" and a 36" sewer main was installed adjacent to the water main, connecting the defunct McCullens Avenue plant to the new Eel River Treatment Plant. These sewer mains were placed in the maintenance dike housing the water line, from Del Norte Street to just north of the RR Marsh, where the lines run towards and follow the railroad right-of-way. This caused the culvert, which previously drained the marsh, to be removed and two 12" PVC pipes to replace it at a higher elevation.

3.72 Current Land Use

Land uses adjacent to the site generally consist of commercial/industrial development. To the north is the Halvorson "Flea Market" Building, City Garbage of Eureka (solid waste refuse transfer site) and Harbor Lanes Bowling Alley. Del Norte Street Pier, an unused dock needing repair, is located at the north-western side of the project site. Along the eastern edge (on either side) of Broadway Avenue are commercial uses including



1939 AERIAL PHOTO

Figure 8

equipment rental, truckstop, motels, and retail stores. Several parcels zoned for commercial services uses are vacant or underdeveloped. The Maurer Marsh, a 19 acre parcel consisting of ten acres of freshwater marsh and 9 acres of filled and/or developed land, is located east of the drying shed area. The Bayshore Mall, located south of the project site, is currently being constructed; completion date is estimated for November, 1987. Two wetland mitigation areas for the Bayshore Mall encompass both the east and west edges of the paved drying shed area. These, for the most part, have been restored and replanted with wetland/riparian vegetation.

The Palco Marsh area is currently used for bird watching, social gatherings, jogging, walking, and retriever training. Clamming and some incidental fishing occurs in the bay adjacent to both Del Norte Street and Truesdale Street.

Other uses observed include hunting, pistol shooting, camping and garbage dumping. Vacant boxcars on the railroad lines show evidence of past and present transient use. These "sleeping areas" also occur within the brush vegetation along the borders of the project area.

3.73 Access

Many access points into the Palco Marsh site currently exist. A person can drive to or near the site by using Railroad Avenue, Del Norte Street, Hawthorne Street, Broadway Avenue, Vigo Street or Mill Street. Pedestrian use, in addition to the above-mentioned roads, occurs from Truesdale Street through the Mall construction site, and/or along the Northwestern Pacific Railroad tracks. The City's Maintenance dike between Del Norte and Vigo Streets provides access both along and into the marshes. Many of the areas within the marsh complex show signs of pedestrian use.

Indications for Enhancement Planning

Since mixed commercial/industrial land uses surround the project site, adequate buffers may be needed to protect/enhance the integrity of the marsh environments. The site, at present, has uncontrolled access and is made use of in ways contrary to wildlife values. As the project site becomes restored for wildlife, increased interest and subsequent use by the public is anticipated. Providing controlled access for compatible uses will be necessary to achieve wildlife values for the site.

Access from public streets, where adequate parking is available, should be encouraged. Parking could be made available along and at the end of Del Norte Street. Vigo Street, in its unimproved state, does not have parking available along its width. Should commercial properties be further developed, street improvements, including parking lanes could be required. Vehicular access, as

well as parking could be made available at the west end of Vigo Street. At present, no public easement is available from Mill Street, the Bayshore Mall, nor the Northwestern Pacific Railroad right-of-way. Access from these locations should be discouraged until adequate rights are obtained. Given the access opportunities available, no need for additional access points are warranted at this time.

On-site pedestrian access includes Vigo Street and the maintenance dike from Vigo Street to Del Norte Street. Views of the site are also available from the Del Norte Street peninsula.

In order to maintain a more perfect union between wildlife and people, some effort to control use will be necessary. One of the obvious and simple, though expensive methods, would be to place fencing around the perimeter of the marsh. This would resolve most of the problem at the expense of sacrificing the aesthetic value of the area. Other methods are available and have been used successfully that not only protects wildlife values but also provides an aesthetically pleasing environment that allows people the opportunity to enjoy the area for its natural beauty. These methods, such as vegetative buffers, ditching along the perimeter of the marsh, trail improvements and signs, combined with the increase in public use and surveillance all help to define the borders for public use.

Access along the railroad right-of-way has been used by people, bicycles, motorbikes and four wheel drive vehicles. This is also true for Mill Street. A combination of ditching and vegetative plantings could be used to limit access to desired areas.

A combination of bumper logs, curbing and vegetation should be used to define parking areas. Picnic areas should be located near parking areas. A trail along the top of the maintenance dike between Vigo and Del Norte Streets should be clearly defined. Lateral ditching on both sides of this dike would discourage entrance into the marsh. The project site on the east side of the railroad right-of-way could be fenced and/or planted in areas where ditching does not now occur.

The railroad spur, located near Vigo Street, also allows access from the railroad right-of-way. If this spur becomes part of this project, the spur should be removed and the berm graded to wetland elevations. If this spur remains outside of the project, limited fencing, ditching and vegetative plantings should be implemented.

Past land use has caused an accumulation of debris throughout the project site. This gives the image of a neglected area and encourages further degrading activities, as people's perception of an area may influence their treatment of it. As such, a concerted effort should be made to clean up these areas and discourage continued misuse.

The Del Norte Street Peninsula, approximately four acres, is bordered by Del Norte Street at the north, the Bay on its west and north sides, and a dredged, drainage/tidal channel along its eastern edge. This area consists of a filled wetland area presently topped with grasslands, shrubs and a disused gravelled and/or paved road. Access to this area from Del Norte Street is limited by an open ditch and broken concrete rubble. A large gravelled# area, adjacent to this site, provides parking adjacent to the Bay and for pedestrian access to the pier ruins at the end of Del Norte Street. Eureka's LCP identifies this area for coastal access and has hopes of someday repairing the pier structure.

Periodic dredging of the drainage channel has been necessary in the past and will probably be needed sometime in the near future. This necessitates continuous, though periodic, access for incidental dredging and maintenance purposes adjacent to the channel.

4.0 ENHANCEMENT PLAN

4.1 Introduction

The development of the following Enhancement Plan takes into account agency goals, site conditions, and subsequent discussions with the City of Eureka, the Coastal Conservancy and other interested agencies.

The Palco Marsh has been a focus of concern for enhancement activities by a number of agencies; the Army Corps of Engineers designated the site as an "Area of Importance" to the functioning of the Humboldt Bay ecosystem; the California Coastal Commission included the Palco Marsh on its list of priority public acquisition sites; and the City of Eureka designated this site in its Local Coastal Plan for acquisition and enhancement activity. The City of Eureka requested funding from the Coastal Conservancy for acquisition and eventual enhancement improvements.

The Coastal Conservancy agreed to provide funding to acquire, plan and restore the Palco Marsh site with three primary objectives:

1. Enhance tidal action in the Palco Marsh.
2. Remove fill in drying shed area and restore to marsh habitat.
3. Assemble land in the project area to improve future management.

The initial enhancement phase involved a site inventory and identification of opportunities and constraints. This was completed in Section 3.0. The principle findings and opportunities for enhancement planning, summarized with goals developed by subject area, are listed below.

4.2 Site Analysis Results and Goal Development

4.21 Topography, Geology and Soils

Site topography, geology and soils are suitable for wetland restoration. Excavation will be necessary in some areas to provide channels to distribute tidal input in the salt marsh area and establish elevations which will provide open water in the freshwater marsh area. The paved drying shed area, which is several feet above native wetland soils, will require significant amounts of material to be graded to wetland elevations. Fill will be required for planting along proposed roadside buffer areas. Construction activities could subject wetland soils to compaction.

1. Improve channel capacities to minimize restrictions on tidal input.

2. Establish substrate elevations for a 1.5 acre pond conducive to open water habitat in the freshwater marsh.
3. Remove fill at drying shed area to expose native soils and establish elevations favorable to wetland development.
4. Design proposed improvements to minimize grading and equipment operation within existing marsh areas.
5. Utilize construction methods that minimize compaction (e.g. dragline, crawler tractor). Utilize hand ditching where feasible.

4.22 Hydrology

Tidal influx and runoff within the Palco Marsh are inhibited by a faulty tide gate, inadequately sized and improperly placed water exchange pipes, and inadequately sized channels for internal water distribution. Groundwater conditions appear favorable for establishment of freshwater and brackish marsh systems. Flooding conditions within the Marsh are primarily due to restriction in run-off drainage from the site. Water quality problems resulting from on-site conditions will improve with increased tidal circulation.

1. Improve tidal circulation to Palco Marsh by removing existing tide gate and install larger capacity pipes at a lower elevation across the existing City maintenance road.
2. Make selected improvements to existing drainage channels and construct new drainage channels to improve circulation within the salt marsh area.
3. Construct weirs, culverts and other water control devices as needed to maintain hydrologic conditions favorable to planned vegetation improvements.
4. Design new water exchange improvements to avoid increasing flood event water elevations.
5. Design channels and weirs to promote scour of natural drainage features in the Marsh that have filled with sediment.

4.23 Vegetation

Salt marsh vegetation west of the railroad is healthy and diverse; east of the tracks, it is degraded and low in diversity due to inadequate tidal circulation and insufficient runoff drainage. This has caused large areas of pickleweed and salt-

grass to die back, leaving bare mudflat areas. Brackish marsh vegetation is highly diversified in some areas. Existing freshwater marsh vegetation is dense and has choked almost all open-water areas. Riparian vegetation along the east side of the marsh site is encroaching westward into the freshwater marsh habitat. Freshwater marsh vegetation distribution is at least partially fed by near surface groundwater resources. The drying shed area and other upland areas presently supports no wetland habitats. Invasive exotic species have become established in several locations in the marsh, as well as upland areas. Populations of rare plant species, located outside of degraded salt marsh areas and west of the railroad right-of-way, will not be affected by. Enhancement activities should encourage further development.

1. Maintain existing overall vegetation patterns within the Palco Marsh complex.
2. Improve degraded salt marsh conditions in the Palco Marsh to pre-1981 conditions or better by hydraulic improvements and natural plant propagation.
3. Provide approximately 1.5 acres of submergent marsh (open water) area in existing cattail dominated habitats and in the Palco Marsh.
4. Rehabilitate RR Marsh to provide salt marsh habitat adjacent to existing salt/brackish marsh habitat.
5. Excavate existing upland areas along railroad spur to RR Marsh habitat.
6. Provide riparian screening along roadways and commercial development.
7. Reduce or eliminate existing invasive exotic plant species populations to the extent feasible.

4.24 Wildlife

Wildlife use of salt marsh habitat at the Palco Marsh is extremely low, both in numbers and diversity. This is primarily due to the lack of adequate invertebrate food sources resulting from poor tidal circulation. Use of freshwater/brackish marsh habitat by wildlife is low due to the lack of open water areas. None of these areas are receiving the amount of use by wildlife that would be expected, given its location to the Bay and surrounding areas.

1. Provide open water areas for waterfowl habitat.
2. Improve density of salt marsh vegetation in Palco Marsh as habitat for aquatic invertebrates.

3. Limit public access improvements to margin areas and design to limit wildlife disturbance.
4. Design channel improvements and ditching to limit public access into wetland areas.
5. Develop and adopt area use regulations which limit disturbances which adversely affect wildlife use.
6. Provide approximately 1.5 acres of submergent marsh (open water) area in existing cattail dominated habitats.
7. Provide riparian screening along roadways and commercial development.
8. Design marsh areas in the paved drying shed area to maximize wildlife habitat values by removing paving, fill, grading and providing an adequate water source.

4.25 Public Access

Existing use of site varies widely in type, amount and occurrence. The enhancement of the proposed marsh will eventually result in increasing the number of visitors to the area. Many current uses now conflict with anticipated enhancement goals. Access routes are undefined, unimproved and abundant, allowing for degradation of marsh habitats and wildlife disturbance.

1. Encourage amounts and types of public use which are consistent with enhancement goals in areas which are compatible with wildlife habitat use.
2. Provide controlled public access and wildlife viewing areas consistent with the maintenance of marsh resource values.
3. Develop a small parking area and interpretive signs at Vigo Street just east of the marsh complex.
4. Develop a small parking area, trails, viewing areas and picnic sites at the foot of Del Norte Street.

4.26 Maintenance

As the project's maintenance would be the responsibility of the City of Eureka, maintenance costs should be minimized.

1. Design improvements to minimize maintenance requirements and law enforcement demands.
2. Provide attractive public access and viewing areas by initially clearing debris followed with regular maintenance.

3. Perform preventive maintenance as needed to maintain target habitats and prevent re-invasion by exotic plant species of vegetation.
4. Upon project construction, institute a program to monitor restoration progress, identify shortfalls and take corrective action.

4.3 Proposed Enhancement Plan Summary

The improvements necessary to accomplish the previously listed goals include both improving conditions in the existing marshes, as well as creating wetlands in non-marsh areas. The following is a summary of the main enhancement implementations by project area. A map delineating the improvements (Map 1) is located at the back of this report. Associated cost estimates are listed in Appendix C.

4.31 Palco Marsh Complex

1. Remove tide gate.
2. Construct an inverted siphon under the City maintenance dike.
3. Excavate perimeter channel improvements, extend hand dug channels as necessary.
4. Construct culverts under maintenance dike to allow tidal influx to RR Marsh.
5. Remove railroad spur and grade to marsh elevations.
6. Clean out channel between RR Marsh and culvert under railroad tracks.
7. Remove exotic vegetation and excavate channels in RR Marsh.
8. Replant excavated salt marsh vegetation in Palco Marsh, RR Marsh and along channels, as appropriate.
9. Excavate permanent open water area in cattail/common rush vegetated areas; provide resting islands; provide low dike around open water area; provide adjustable weir.
10. Elevate and maintain existing maintenance dike for public access and periodic maintenance.
11. Remove exotic plants initially, maintain eradication yearly.
12. Plant riparian buffer areas along road edges, adjacent properties and around parking area for screening.
13. Access improvements
 - gravel trail, gates, signs and benches along maintenance dike and Vigo Street;
 - sidewalks along Del Norte Street, Felt Street and Broadway Avenue.

4.32 Paved Drying Shed Area

1. Remove drying sheds and other debris.
2. Remove 40' wide strip of paving outside of proposed parking area, berm and plant with riparian buffer.
3. Provide vehicular access barriers where necessary.
4. Use remaining paved area for drying dredge spoils from excavation of channels and open water area.
5. Retain majority of paved area to be removed as part of "Phase 2" of project.

4.33 Area West of Railroad Tracks

1. Provide public access improvements including parking, sidewalks information kiosk, picnic area, trail, and an elevated viewing area.
2. Provide maintenance access for periodic removal of sediment from drainage channel in the least impacting manner.
3. Provide a temporary dredge spoils drying area adjacent to Del Norte Street.

4.4 Alternatives Considered

Several alternatives were looked at within the Palco Marsh complex but not chosen for this project. These included major elevation changes in the existing marsh as well as major shifts in the amounts of different habitat types. Since the goal was to enhance existing wetland systems, these went beyond what was necessary. In addition, large scale restoration projects not only disrupt existing wildlife use but also have questionable success.

Several alternatives were considered for the paved area that involved grading for varying degrees of salt/brackish or freshwater marsh habitats, depending on the source of water utilized. Several nearby water sources, including both tidal and freshwater from the Bayshore Mall restoration areas and freshwater from Maurer Marsh, are on private lands and currently not available. In addition, on-site groundwater resources are approximately five feet below grade. Potential flooding problems with the Bayshore Mall project, as well as untested success of the restoration projects (including this project), indicated that more information was necessary before obtaining the best utilization of the surrounding areas. The relative costs associated with removal of large amounts of paving and fill, in comparison with costs associated with the rest of this project, also dictate delay of major enhancement efforts. As "Parcel 4", the adjacent coastal dependent industrial parcel is developed, wetland mitigation requirements could be partially fulfilled at this location. For these reasons, minimum excavation/grading is presently proposed within this area. The project will become fully planned as some of the above mentioned constraints are

removed. This should be undertaken as "Phase 2" for this project. (See Section 4.9)

Other opportunities for providing additional tidal influx to Palco Marsh included constructing a new or larger culvert under the railroad right-of-way. Major grading would be necessary in

the Bay, as well as the Marsh to take advantage of any benefits. A drainage structure, at the northwest corner of the Palco Marsh, also would allow additional but limited opportunities for tidal and freshwater runoff influence in the Marsh. This had the potential of causing the storm drain system to back-up during peak storm flows. In addition, a more centralized location for tidal exchange seemed more appropriate for meeting the goals of this project. This drainage structure would be an option in the future if site conditions or management goals warranted. Another option was to keep the RR Marsh drainage separate from the Palco Marsh. Tidal influx is now partially blocked by the 36 inch sewer line that crosses the channel between the railroad right-of way and the maintenance dike. Tidal input would be increased if flow lines of the ditch were excavated below the sewer line. This option may be beneficial to the Bayshore Mall Restoration Project and should be further developed as part of Phase 2 of this project.

Additional open water areas could be provided in the interior of the fresh/brackish marsh without use of heavy equipment. This would be accomplished by utilizing a technique, not common in Coastal California, but used extensively in the Mid-West and Northeast portions of the United States to open marsh areas for wildlife use. This involves placing small amounts of Ammonia Nitrate fertilizer in various locations and detonating it with an electric charge. This method could create several 20 x 20 foot freshwater pond "holes", which could have a life expectancy of 10-15 years before infilling again. This is a low cost method which is less intrusive than heavy equipment use. State certification for use of explosives is required. This alternative was not further pursued though its application at this site seemed appropriate. Additional research as to its applicability to this area should be pursued by an appropriate resource agency, and if feasible, applied to this site.

4.5 Proposed Enhancement Plan - Construction Aspects

The Enhancement Plan has been designed to minimize construction impacts on non-involved areas of the Marsh. This included avoiding the use of heavy equipment in the middle of the marsh. Except for the excavation of the open-water area in the infilled freshwater marsh and the central inlet channel, most of the proposed improvements can be completed from adjacent upland areas.

Overall clean-up of the site should be completed and temporary access controls should be installed as soon as possible. Signs describing the future enhancements efforts should be installed at

the existing access points: Vigo and Del Norte Streets. Monitoring programs should begin baseline data collection prior to construction.

4.51 Palco Marsh Complex

The tide gate at the Bay will be removed after the construction phase of the project. Until then, and just prior to construction, the gate should be put into operating condition and left in place to temporarily eliminate tidal input during construction. The flapgate should be stored for temporarily reinstallation if required for maintenance purposes.

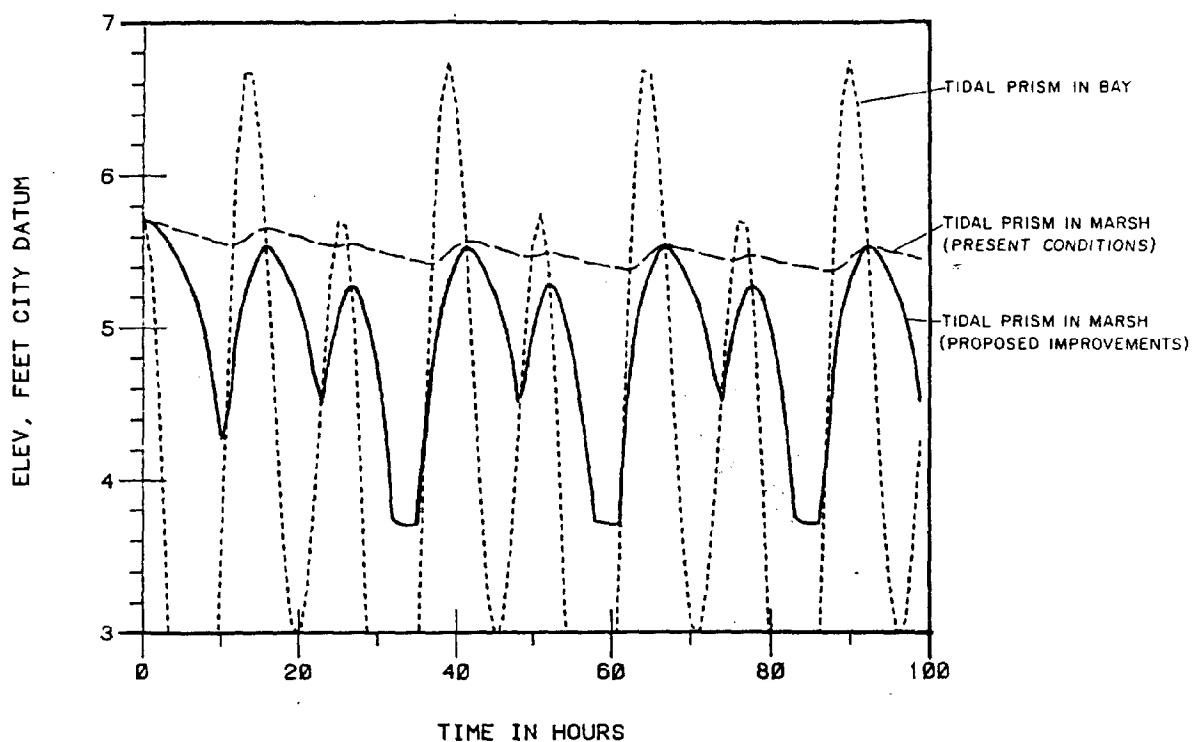
Construction of the inverted siphon will involve placing two 18 inch culverts under the sewer lines which are enclosed in the City maintenance dike. The flow line will be approximately at 0.0 foot (City Datum). A weir box will be placed at both ends of the 18 inch pipes to allow manipulation of water levels. These boxes will be covered with a debris screen for public safety purposes. Since the flow line elevation in the culvert that brings in tidal input is at 3.7 foot, all areas in this structure and within the Marsh below 3.7 foot elevation will be inundated.

The weirs will be adjustable from 3.0 to 7.0+ foot elevation, allowing a wide range of marsh management goals. Initially the weir should be set at 3.0 feet elevation. This allows the maximum amount of both tidal input and run-off drainage.

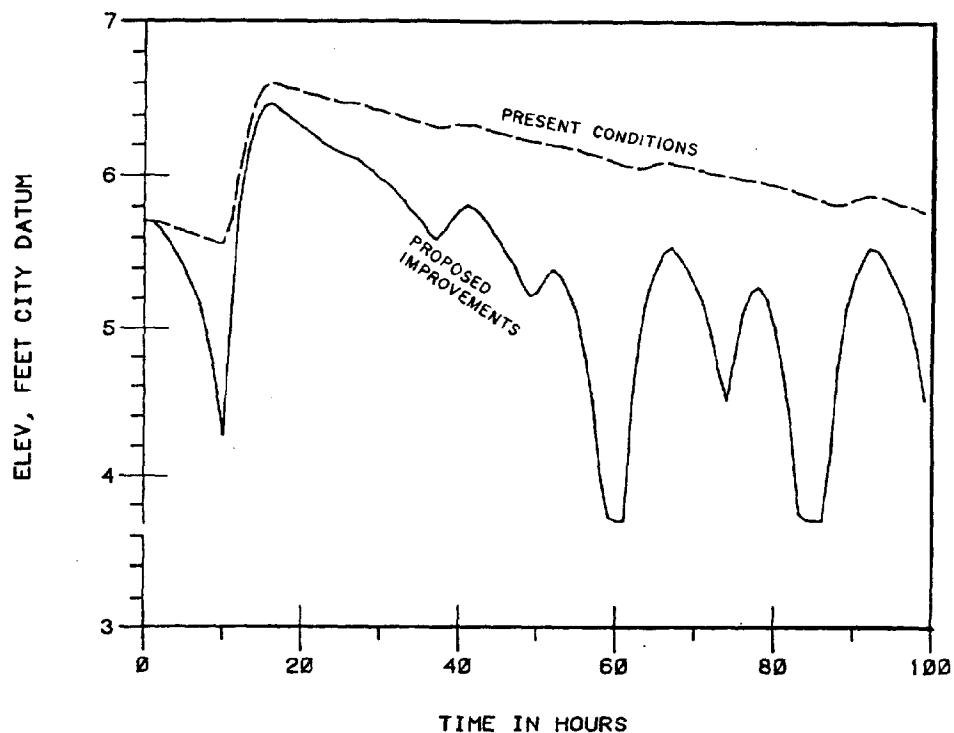
Channels will be constructed with flow lines beginning at about 3.0 foot elevation in the marsh, one towards the east, 200 feet, and two others adjacent to the maintenance dike; one north for 500 feet and one south to Vigo Street, 850 feet. Channels will be approximately 3 foot wide. Flow lines will gently slope from 3.0 feet at the inlet to 4.5 feet at the channel ends. Sides will be sloped at 2:1. Smaller channels, two foot wide, one foot deep (4.0-4.5 foot elevation) will be hand dug in locations where several existing channels have filled with sediment, as indicated on on the Enhancement Plan Map.

The hydraulic modeling, developed as part of the site analysis for this project, indicates that these improvements will increase both tidal fluctuation into the Marsh and run-off drainage from the Marsh. Figures 9 a, b, c, and d (pages 4-9, 4-10) depict both present and expected water level fluctuation during a normal tidal cycle and during periods of storm run-off. Figure 9a shows a typical tidal fluctuation in the Bay overlaid with the existing muted tidal prism, as well as the tidal variation expected from the proposed improvements. As depicted, the Marsh will be subject to a diurnal tidal cycle and in-phase with the tides occurring in the Bay. Maximum water levels will remain approximately where they currently exist. Minimum water levels will approach channel bottoms elevations. Table 6 compares tidal water elevations, volume and inlet velocities for both present and proposed

NORMAL CONDITIONS, NO PRECIPITATION (A)

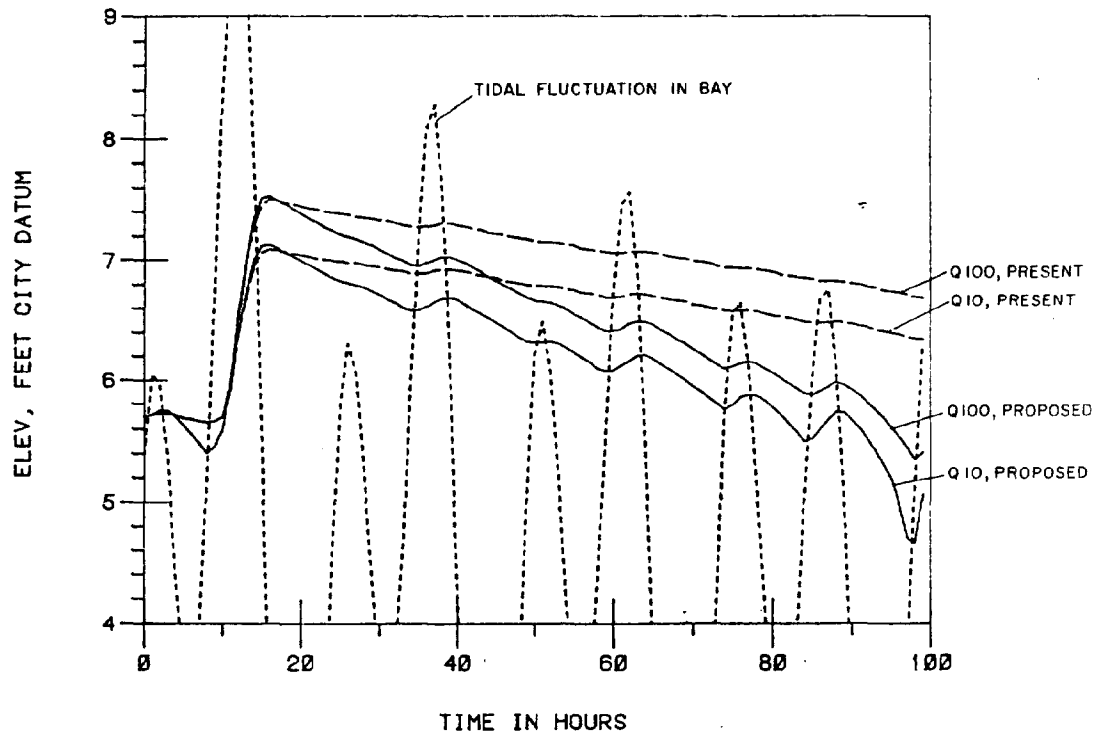


TWO YEAR STORM (B)

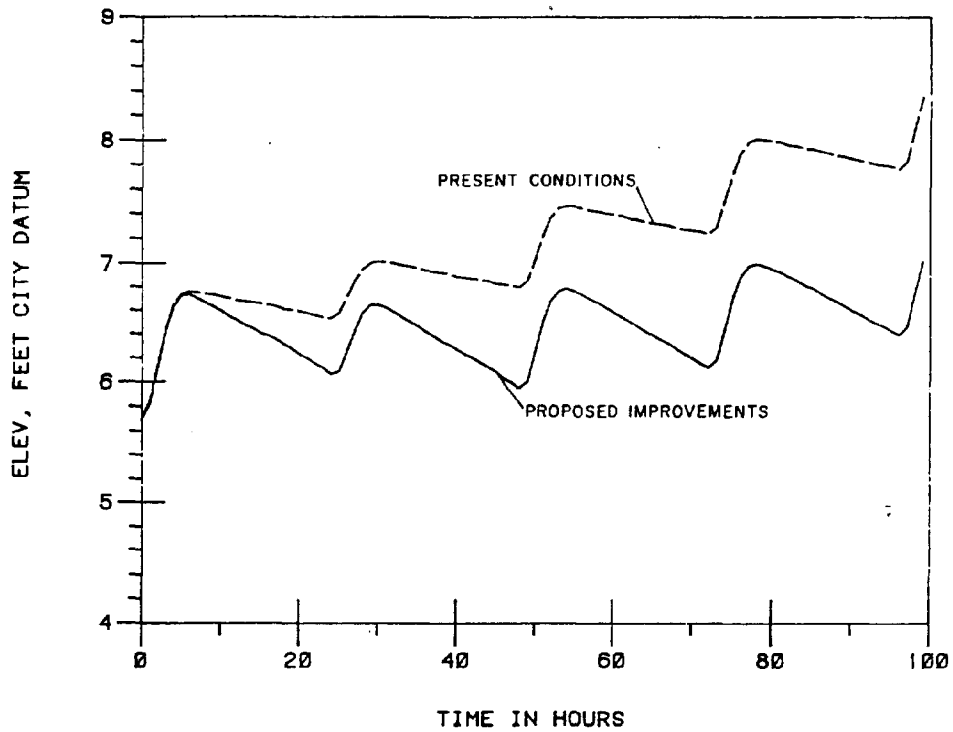


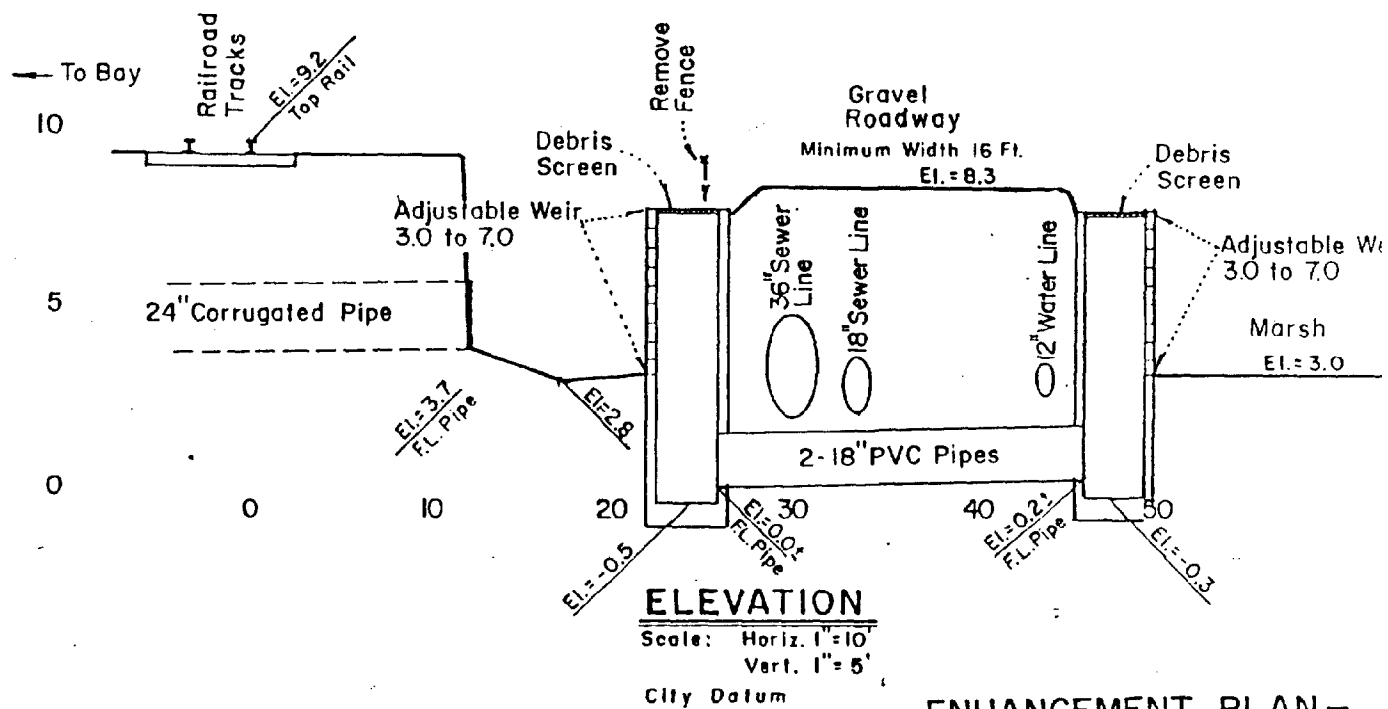
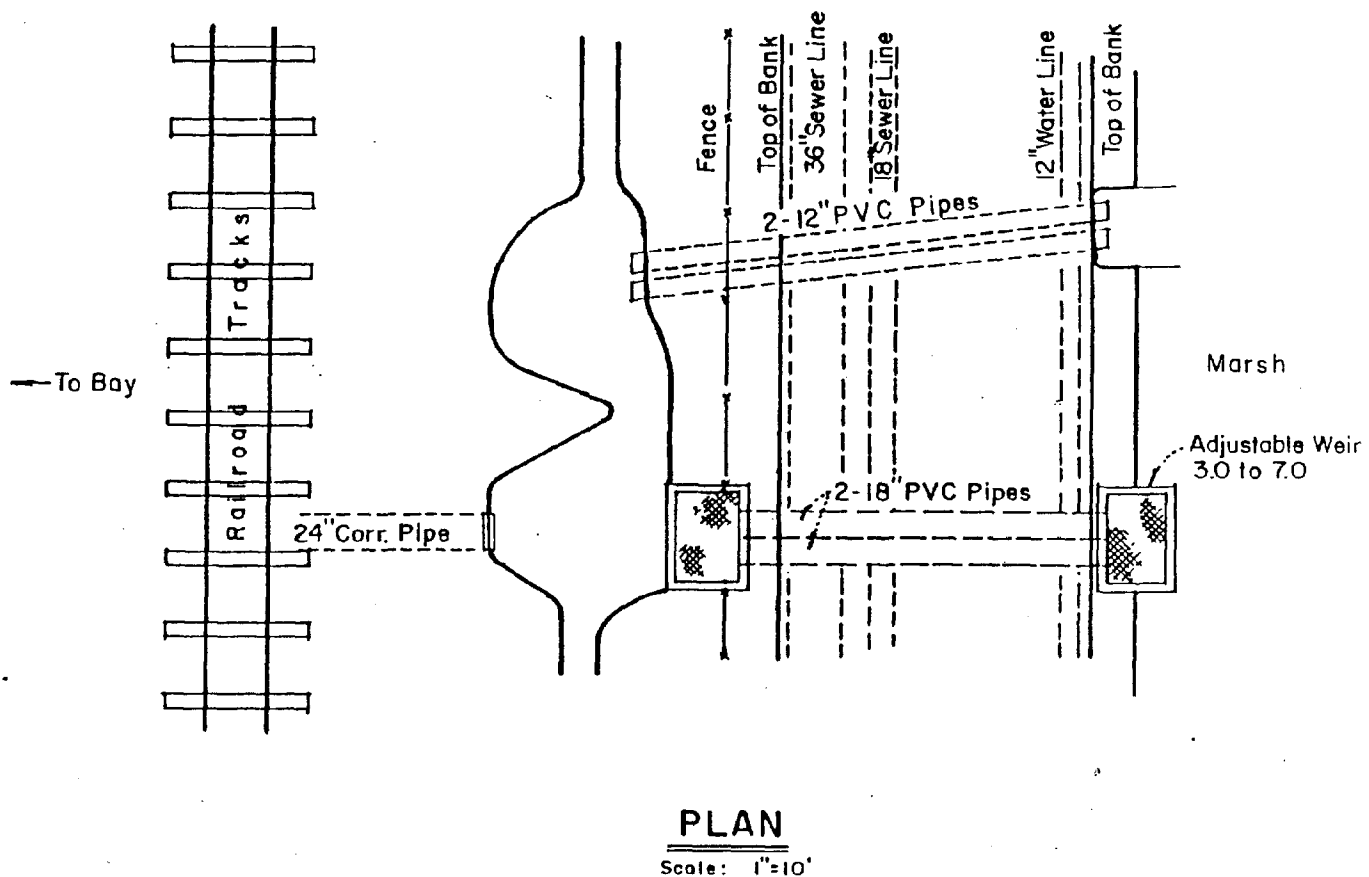
ENHANCEMENT PLAN
TIDAL PRISM / STORM RUNOFF
Figure 9 (A&B)

10 FOOT TIDAL SURGE, 10 AND 100 YEAR STORMS (C)



FEBRUARY 15 THROUGH 18, 1986 CONDITIONS (D)





ENHANCEMENT PLAN -
TIDAL EXCHANGE AREA

conditions. Figure 9b represents the response of the marsh to a "two-year flood". As depicted, the present conditions depict an extended drainage time required (58 hours after the peak) before reaching normal water surface elevation. With the proposed improvements this time is reduced to 14 hours. Figure 9c depicts the response of the marsh to extreme flooding events for both present conditions and with proposed improvements. Flood level water elevations will not be significantly increased and should be somewhat lower than depicted on the graphs; the higher levels shown represent a six hour precipitation event coinciding with a 10 foot tidal surge. Proposed improvements will improve drainage under most flood conditions. Though peak water elevations will remain the same, run-off will be discharged from the site at a more expedient rate. Table 7 compares response of the marsh to the proposed improvements.

Figure 9d depicts modeling results, which represented conditions occurring in February, 1986 (See Section 3.32). With the proposed improvements, water levels in the Marsh would respond by rising and falling after each precipitation event, drastically reducing the opportunity for water levels to build up and subsequently flood adjacent properties.

A 1.5 acre open water area will be created in the southeast corner of the Marsh which will replace dominant cattail vegetated areas. The pond will be "L" shaped, approximately 100 feet across with several island areas. Bottom elevations will be at 0.0 feet sloping upwards to existing elevations of 6.0 feet. An eight to ten foot wide dike, at approximately 7.0 foot elevation (6-12 inches high) will be placed around the north, west and south perimeter. Natural overflow will occur over the dike. An adjustable weir will be installed at the western end of the open water area to allow adjustable pond heights between 3 and 7 feet. This design incorporates measures that will lessen the current problem of backflooding into the Mauer Marsh and improve the drainage during flood conditions.

Excessively wet conditions in the open water area may require temporary fill to be placed in the construction area and utilized as a road to transport materials from the area. Fill materials will come from the paved area. This fill would be removed as surrounding excavation is completed. Several islands will be left intact as resting islands for wildlife. Fill that is removed may be utilized for the raised viewing platform on the Del Norte Street Peninsula.

Revegetation within the salt marsh will be limited, for the most part, to along the upper edges of the newly constructed channels. This will involve planting salvaged pickleweed and salt grass from excavated areas. The interior areas of the salt marsh, which have experienced die-back of vegetation, may take a year or two to have conditions conducive to revegetation. Natural revegetation should be adequate once healthy conditions return.

Salt marsh areas will be allowed to develop naturally under the influence of tidal circulation in the site and natural seed dispersal from the surrounding areas. Natural development of wetland vegetation should be favored by slow water currents and nearness of seed sources. Target species include pickleweed, saltgrass, jaumea and arrow grass. Water level management (pre-soaking of seeds) is an option that can be undertaken by the managing entity once the project is underway and specific information is available. This will be done by periodic adjustment of the weir structure at the inlet channel. The open water area will be influenced by surrounding cattail and common rush vegetation surrounding the pond. Steep sloping sides will prevent infilling by cattails, preserving the open water aspect. Sources of hydracotyl and other submergent vegetation exist in the remnant pond on the project site.

Plantings of willow and alder will occur at various locations for screening and buffering adjacent land uses. Solid plantings will occur along Felt and Del Norte Streets. Periodic clumps will be planted along the north side of Vigo Street, the east side of the maintenance dike, and in the picnic area on the Del Norte Street Peninsula.

Cuttings will consist of three sizes depending on soil moisture conditions: 1/2", 1" and 2" diameters, approximately 18 inches long, and should be planted at a density of approximately 2,000 per acre, spaced every 4 feet. Red alders should be inter-dispersed in the plantings to provide variation in canopy height, particularly near public access areas.

The four exotic species of concern should be removed as necessary and monitored yearly. This will prohibit re-establishment. The extent of scotch and/or french broom is limited and can easily be removed by hand grubbing plants. Care should be taken to remove this plant with the roots prior to seed development. Removal during flowering season will aid in identification and location of plant.

The removal of pampas grass presents a more difficult problem; but if done with care, will cut down on the intensity of growth now occurring. The majority of the pampas grass occurs along the maintenance dike, the railroad right-of-way, the northwest sector of Palco Marsh, and/or the Del Norte Street Peninsula. Seed stalks should be removed prior to major disturbance of the plant. Care should be taken not to discharge the wind dispersed seeds. The majority of the leaves should be cut down to ground level and rock salt should be poured onto the remaining clump.

Specimens located on the peninsula at the marsh edge and along the side of the maintenance dike can be removed by a backhoe, removing the rootball intact. The specimens located along the top of the maintenance dike may be scraped or dug out with special care not to disturb the underlying water or sewer lines. The specimens scraped, as well as those located on the railroad right-of-way will probably require additional hand removal of

plants. All holes should be examined for evidence of complete removal of the rootball and subsequently filled with the appropriate materials (clean, upland soil/gravel).

Removal of the common reed specimens present also requires special care. Though specimens are, for the most part, accessible by backhoe, special care is necessary to assure complete removal. Seed stems should be removed prior to disturbance and disposed off-site with care not to disperse seeds (burning on-site is an option). Specimens should be cut down and treated with rock salt and later, where appropriate, removed by backhoe. Visual checking and hand clearing should follow. Surrounding soils, which may contain dormant seeds, should also be scraped and removed off-site. Since this plant propagates from rhizomes, special care to remove all roots is necessary. Holes left from removal of plants, if not part of designed excavation plans, should be filled so as not to provide ponding for mosquito reproduction. Since this plant seems to be limited to stressed brackish marsh habitats, increasing tidal actions should eliminate this concern.

Gravel fill will be placed on top of the maintenance dike to a minimum elevation of 8.5 feet and will serve as the main pedestrian access to the site. Public access will be available from the Vigo Street entrance, along the paved road and unto the gravelled surface trail to Del Norte Street. Each end of the maintenance dike will have a walk-around entrance gate that allows pedestrian access, as well as a locked gate for maintenance purposes. Project identification and usage signs will be posted at each entrance. Eight benches will be placed at various locations between the Vigo Street entrance and Del Norte Street.

4.52 Paved Dry Shed Area / Railroad Marsh

The drying sheds should be sold as surplus property or put out to bid for salvage/removal. Other debris, left from use of the mill site, including remnants of a burned shed, fencing and the railroad spur should also be removed.

Directly at the end of Vigo Street a 100 x 200 foot paved area will be reserved for parking. A 40 foot wide strip of paving and fill will be removed from the south and west sides of the parking area to construct a barrier for vehicular access onto the remaining paved areas. This barrier will consist of a combination of berms, ditches and willow plantings. If poles were available from the salvaged drying sheds, these could be used as either bumper logs or as fence posts for an additional access barrier. A locked gate will allow access to the remaining paved area for future enhancement and maintenance purposes. Vehicular access from Mill Street to the paved area will be discouraged by a combination of fencing, berms and plantings.

The RR Marsh will be excavated and initially used as a settling basin for drainage from dredge spoils. The drainage ditch that

currently exists between the railroad right-of-way and the maintenance dike will be cleared of debris and graded to 4.5 foot elevation for a distance of 400 feet. Two 12 inch culverts will be placed under the maintenance dike just south of where the sewer line crosses the ditch. New channels in the RR Marsh will be excavated to 4.0 foot elevation, the railroad spur will be graded from 5.5 foot to 8.0 foot elevation. A channel will extend from the RR Marsh south adjacent to the railroad right-of-way 300 feet. This would limit vehicular access to or from the railroad right-of-way.

The unused, paved area could serve as a temporary area for drying and storing channel dredgings from this project. This will be particularly important for handling the saturated, organic soils removed from the freshwater open water pond. The area would be bermed to direct drainage towards the RR Marsh.

4.53 West of Railroad Tracks

Improvements west of the railroad right-of-way are limited to that portion located on or adjacent to the Del Norte Street Peninsula. A twenty spaced paved parking area will be provided off the end of Del Norte Street to be used as access to this project, as well as the Del Norte Street pier, if and when reconstruction of that project occurs. Sidewalks will extend to the end of Del Norte Street. An information kiosk will provide educational information of the project site. Curbing and fencing will limit vehicular access to the paved parking and street. A half acre flat area will be designated as a picnic/play area just south of the parking area and will be planted with native trees and shrubs around its perimeter. Typical species will include wax myrtle, ceanothus, shore pine, willows and alders. Restrooms are not being proposed as part of this project but allowances have been made to locate them adjacent to the parking area. An area directly east of the parking area will be reserved for future parking needs. Non-saline soils and fill removed from the paved drying shed area will be deposited towards the southern end of the peninsula to form a 4 foot high viewing area.

The existing drainage channel/slough between the peninsula and the railroad right-of-way tends to fill in, and needs periodic dredging. Bank slumping also occurs along both sides of the channel. According to City staff, maintenance of the channel occurs approximately every ten years. Dredgings from the channel have periodically been stored in an area adjacent to Del Norte Street and removed when dry.

A maintenance road will be constructed along the channel and connect to the existing gravelled roadway. This will be used as a trail for pedestrian use. A four foot wide trail will extend onto the viewing area mound. A steep bank, at the southern end of the viewing mound, in addition to blackberry or willow plantings, should discourage access into the fragile, narrow salt marsh bluffs at the southern end of the peninsula.

4.6 Operation/Maintenance

Facilities required for safe and effective operation and maintenance of the wetland site should be monitored and repaired as needed. Facilities to be maintained include the inverted siphon/water exchange improvements. This will include periodic sediment removal from both sides of the culvert and potential flushing of pipes. This should be inspected and corrected as needed previous to each rainy season and after each substantial storm event. Weir adjustment may also be periodically altered to obtain a preferred management goal. Other facilities to be maintained include the maintenance road, Vigo Street, parking areas, fencing, gates, signs, and culverts. Collection of litter and trash will be periodically needed, as well as street sweeping the parking areas and brushing the road sides.

4.7 Monitoring

Monitoring the site for hydraulics, vegetation, invertebrates, wildlife and mosquitoes will be necessary for several years after construction is completed to ensure that enhancement goals are satisfied and to develop a management plan for the area.

Monitoring should started prior to the construction phase to develop baseline conditions. This will be necessary to determine changes as a result of this project. In addition, yearly reports should be compiled to compare findings in the various mentioned disciplines described below

Hydraulics

1. Monitor water levels in the marsh over a complete tidal cycle quarterly, and at least once during or after a two year storm event to compare with hydraulic modeling results. Observe flow patterns and velocities, identify restrictions or flow problems and adjust weirs to decrease/increase velocities.
2. Utilize results to fine tune the system to meet management goals.

Anticipated Schedule: 10 person-days per year, 2 years

Vegetation

1. Prior to construction, establish representative test plots in existing stressed and healthy salt marsh areas. Inventory for species presence and density prior to improvements. Recheck and evaluate once a year, for years 1, 2 and 4. If significant progress does not occur after year 4, make adjustments consistent with wildlife use analysis.
2. Yearly obtain and review aerial photographs of the project site, as well as adjacent wetlands .

Anticipated Schedule: 10-15 person-days per year, 4 years

Invertebrates

1. Prior to construction, establish representative test plots in existing stressed and healthy salt marsh areas. Inventory for species presence and abundance prior to improvements. Recheck and evaluate after year 1, 2 and 4. Correlate with wildlife use of the site, particularly during fall migration of shorebirds.
2. Locate and monitor development of rare species habitat range.

Anticipated schedule: 5 person-days per year, 4 years

Wildlife

1. Starting in the fall of 1987, census the area seasonally for 3 years, at different times of day and tidal cycle. Correlate information with local birdwatchers for changes in wildlife use. Identify available food source development.

Anticipated schedule: 10-15 person-days per year, 3 years

Mosquitoes

1. Review recommendations from County Health Department's monitoring of site to identify problem areas. Incorporate needs into management goals to minimize problem.

4.8 Permit Requirements

This enhancement project will require several permits from local, State and Federal agencies. Permit types and approximate processing time requirements are listed below:

1. City of Eureka - Approval of Development Plan, processing of CEQA document. Processing time: ~30-45 days
2. Humboldt Bay Harbor, Recreation and Conservation District - permit for all construction in areas below MHHW. Processing time: 45 days
3. California Coastal Commission - Coastal Development Permit for construction within CCC permit jurisdiction Subject to review and concurrence from Department of Fish and Game. Processing time: 90 days
4. U.S. Army Corps of Engineers - Permit for construction in all wetland and slough areas pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. Subject to review by U.S. Fish and Wildlife Service, California Department of Fish and Game, Regional Water Quality Control Board and others. Processing time: 90 days
5. California Department of Fish and Game - 1603 Permit for work in wetland and sloughs. Processing time: 30 days
6. Eureka Southern Railroad - Permit required to construct any work within the railroad right-of-way. Processing time: less than 30 days

Permitting requirements of the resource agencies are interlocking and interdependent as to timing. For example, the Coastal Commission will not accept an application until the Harbor District has acted, and the Corps of Engineers will not process an application until the Coastal Commission has accepted an application. Permitting processes will probably require a total of approximately six months to complete.

This enhancement project, within the city limits of Eureka, constitutes a "development" project and, therefore, is subject to similar requirements of other projects. The City requires that any project which is the "final development" of a parcel will be improved to current standards, for, amongst other things, street improvements. The Palco Marsh project site fronts three sections of public street; Del Norte Street, Felt Street and Broadway Avenue. Discussion with City officials indicates that six foot sidewalks will be required as part of the "development" of this project. This will require placing some fill adjacent to the Marsh edges.

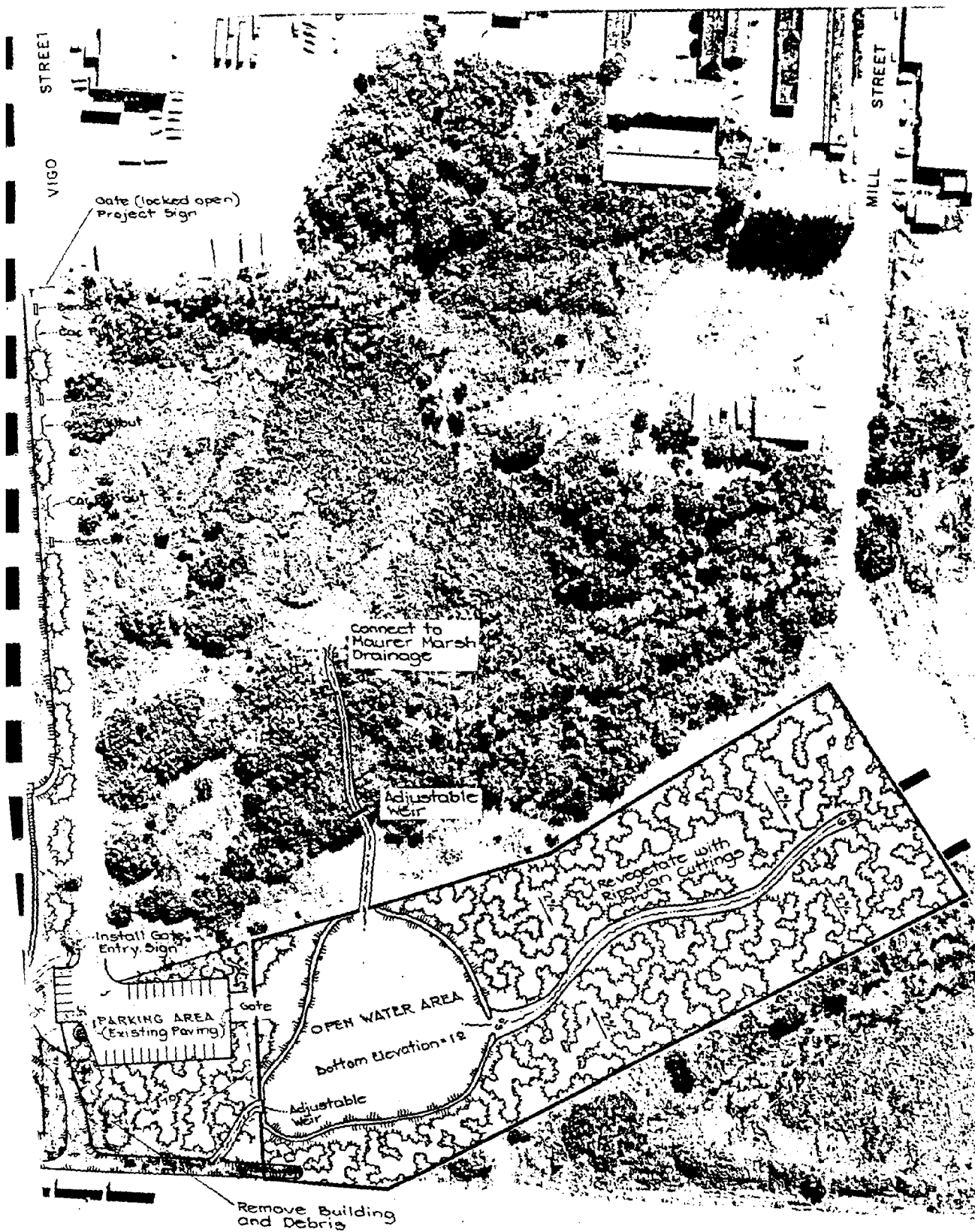
4.9 Future Enhancement Work, "Phase Two"

Removal of the majority of paving and fill in the drying shed area will occur at a later time, probably in conjunction with development of 'Parcel 4' as mitigation. An Enhancement Plan should be developed of this area which will include the surrounding restoration and enhancement areas. Results from monitoring and fine tuning the systems, and any overall required improvements, should be included in conjunction with future enhancement work.

Several alternatives were considered for the paved area that involved grading for varying degrees of salt/brackish or freshwater marsh habitats, depending on the source of water utilized. Several nearby water sources, including both tidal and freshwater from Maurer Marsh, are on private lands and currently not available. In addition, on-site groundwater resources are approximately five feet below grade. Potential flooding problems with the Bayshore Mall project, as well as untested success of the restoration projects (including this project), indicated that more information was necessary before obtaining the best utilization of the surrounding areas.

One alternative would involve removing all asphalt and fill from the project site, grading slopes towards a central channel and providing a large open water area, which would overflow into the Palco Marsh (Figure 11). Estimated construction costs (1987) associated with removal of materials from the remaining 5 acre site, considering the above enhancement alternative, are listed below.

Removal of asphalt	220,000 sf	\$22,000
Excavate to 7' elevation	16,300 cy	\$130,000
Excavate a 20 square foot channel, 700 feet long	520 cy	\$4,000
Excavate one acre pond, 5 foot deep	8,000 cy	\$64,000
Adjustable weir structures	2 ea	\$4,000
Revegetation	Lump Sum	\$8,000
Monitoring		\$6,000
	TOTAL	\$238,000



ENHANCEMENT PLAN
CONCEPTUAL PHASE TWO

Figure 11

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APPENDIX A
Some Notes on Circulation and
Sediment in Palco Marsh

1. Circulation and Hydraulic Conveyance

Circulation and the response of the marsh to tidal fluctuations will be greatly improved from present conditions by modifications of the marsh inlet and widening and deepening of channels within the marsh. Circulation will be most improved if larger channels (approximating the original marsh channels in size and cross sectional area) can be constructed to connect the proposed marsh inlet weir to the historic channels in the north and south marshes. It is important that the flow line for these channels be lowered to the three- to four-foot level. In addition to improving marsh circulation, these channels would (a) be less likely to choke with bottom and emergent vegetation or slump or experience bank failure (which would decrease channel conveyance and, in time, cause decreased flows within the marsh), and (b) limit public access to the marsh area and thereby provide a measure of site security. In the long term, the size of these channels will be key to preservation of improved marsh hydraulics and lowered associated maintenance costs.

2. Potential for Scour and Deposition of Sediment

By increasing the conveyance of the channels within the marsh, much higher flow rates will be achieved but, because of the larger channel cross sectional areas, maximum water velocities will remain low, probably smaller than 1 foot/sec for the typical tidal cycle. Throughout most of the tidal cycle, velocities will be much lower than this. This implies a potential for sediment deposition, and the aggradation of the present marsh channels is evidence of this. However, the proposed channels would be at a lower elevation than the present flow line, as would be the inlet/outlet. This might ensure that the present high bottom elevations would not return, but might also invite scour.

The prediction of deposition and scour is not an exact science. For example, the Bureau of Reclamation recommends that, in designing earth-lined or unlined canals, several tests on soil particle size, plasticity, shear strength, and tractive force be made. From these data, the resistance to scour can be theoretically estimated, but even these sophisticated descriptions of scour potential must be evaluated on the basis of experience for the probable effects of cohesion, which is still beyond the capability of sediment theory to predict.

For the proposed conditions in the Palco marsh, a potential control mechanism for both circulation and sediment deposition/scour is the weir inlet/outlet gate. By lowering the elevation of the gate, higher channel velocities will be achieved in the marsh, thereby implying better circulation and possible scour of channels that might have been aggrading at a higher gate setting. Conversely, a higher gate setting will lower the marsh channel velocities and reduce the potential for scour or increase the possibility for deposition. The point of this is that the flow control mechanism that is proposed for the marsh might also act, to a certain extent, as a device for regulating the behavior of sediment in the marsh. The proper settings of the gate to achieve desired circulation and sediment control goals will only be found by experimentation after the gate is installed.

APPENDIX B

VEGETATION DESCRIPTIONS

The vegetation of the site is described in the following discussion. The delineation of each vegetation type (or plant assemblage) is based on species composition, quantitative variations, and structure.

Salt Marsh -- SM

The salt marshes on the site are located in a narrow band west of the railroad tracks and in a broad area east of the tracks. The salt marshes west of the tracks contain the usual diversity of vascular plants typical of salt marshes around Humboldt Bay. In this narrow strip of marsh, the three dominant salt marsh species, pickleweed (Salicornia virginica), cordgrass (Spartina densiflora), and salt grass (Distichlis spicata) occur together in varying amounts. Occasional throughout these marshes are sea lavender (Limonium californicum var. californicum), jaumea (Jaumea carnosa), and arrow grass (Triglochin spp.). The rare Humboldt Bay gumplant is found along the edges of this marsh and the salt marsh snail (Ovatella myosotis) is common in this location.

The salt marshes and extensive mud flats east of the tracks are degraded and lack much of the diversity common in healthy salt marshes on Humboldt Bay. With the exception of the three main salt marsh species -- pickleweed, cordgrass, and salt grass -- none of the other salt marsh species occur in this area. The only location that contains a gumplant and a modest population of jaumea is a small portion of pickleweed marsh adjacent to the inlet. Marine infauna are only found near the inlet and the normally ubiquitous salt marsh snail is absent from these marshes.

Orache (Atriplex patula) and brass buttons (Cotula coronopifolia) are common in many of the areas east of the tracks, becoming dominant in small areas. These species are typically found in areas that are disturbed or severely stressed. Most likely, the areas more removed from the tidal inlet experience oxygen starvation and hypersalinity due to evaporation during the summer months.

One area east of the tracks seems to be eroding at an accelerated rate. Aerial photos show that the majority of the erosion has occurred since 1981, with significant differences between 1983 and 1986. Tufts of salt grass from which the substrate has been eroded still persist in this area.

Since the health of the existing salt marsh east of the tracks is one of the main concerns of the enhancement project, the vegetation was mapped in detail. Other marshes on Humboldt Bay

located at similar elevations are usually dominated by pickleweed and jaumea. The following vegetation descriptions and codes relate to the vegetation map of the site.

SM₁ -- cordgrass/pickleweed/salt grass
(Spartina densiflora/Salicornia virginica/Distichlis spicata)

The three salt marsh species do not form distinct zones within these marshes because the marsh has formed behind a steep bank and lacks a gradual interface with the bay and with tidal inundation, except during the highest tides. Generally, the species occur either in equal amounts, or with pickleweed dominating up to 70% of the vegetative cover. This salt marsh is only found west of the tracks. In addition to the dominant species, other species such as sea lavender (Limonium californicum var. californicum), jaumea (Jaumea carnosa), arrow grass (Triglochin spp.), Humboldt Bay gumplant (Grindelia stricta ssp. blakei), sea plantain (Plantago maritima ssp. juncooides), and mud-spurry (Spergularia marina) can be found. These additional species are generally lacking east of the tracks. The overall height of the vegetation varies from 0.66 feet (20 cm) in a pickleweed dominated area to 2.3 feet (70 cm) in a cordgrass dominated area; cover is usually 100%.

SM₂ -- pickleweed
(Salicornia virginica)

These marshes, which are dominated by pickleweed, are found east of the tracks in areas directly affected by tidal inundation. The pickleweed occurs in monotypic stands or as the dominant with salt grass (Distichlis spicata) and orache (Atriplex patula). Salt grass is usually less than 10% of the cover and orache can be as high as 50% of the cover (occasionally more). The height of the vegetation averages 0.98 feet (30 cm); cover is 100%.

SM₃ -- salt grass
(Distichlis spicata)

The salt grass marshes are at the upper limits of the salt marshes and intergrade with the various brackish marshes and upland grasslands. In this vegetation type salt grass is the dominant plant; pickleweed is present but only in scattered patches. Orache is present usually with less than 25% cover, and brass buttons and water foxtail are occasionally present. The height of these areas averages 0.82 feet (25 cm); cover is 100%.

SM₄ -- salt grass/barley
(Distichlis spicata/Hordeum sp.)

This vegetation type is very similar to the previous type. Salt grass is the dominate species. The main distinguishing feature is the addition of various grass species. These grass species are present in small numbers, but are consistently found intermixed with the salt grass: water foxtail (Alopecurus

genticulatus), ryegrass (Lolium perenne), and brome grass (Bromus mollis). This assemblage of plants is usually located near the upper edges of the salt marsh near the upland grasslands. Height is 1.15 feet (35 cm); cover is 100%.

SM₅ -- pickleweed/salt grass/orache
(Salicornia virginica/Distichlis spicata/
Atriplex patula)

The three salt marsh species --pickleweed, salt grass, and orache -- occur in equal amounts. This type of marsh is found east of the tracks at the middle elevations, above the pickleweed line but below the salt grass areas. The height varies from 0.46-0.92 feet (14-28 cm); cover is 100%.

SM₆ -- salt grass/tufted hairgrass
(Distichlis spicata/Deschampsia caespitosa)

This combination of salt grass and tufted hairgrass (Deschampsia caespitosa) is found only west of the railroad tracks. A few species common to dune habitats are also found in these areas: beach bur (Ambrosia chamissonis), dune tansy (Tanacetum douglasii), Tracy's salt rush (Juncus lesueurii var. tracyi), and sand sedge (Carex pansa). This combination of plants is located at the upper edge of the tidal marshes in areas underlain with sand dune soils. The height of the vegetation varies from 0.82 feet (25 cm) in the absence of tufted hairgrass to 2.95 feet (90 cm) in the presence of the hairgrass; cover is 100%.

SM₇ -- salt grass/water foxtail
(Distichlis spicata/Alopecurus genticulatus)

Salt grass and water foxtail occur in approximately equal amounts with up to 10% of salt rush (Juncus lesueurii var. lesueurii), orache (Atriplex patula), and pacific silverweed (Potentilla egedii ssp. grandis). This vegetation type is found at the upper reaches of the salt marshes which border on brackish marsh. The height of the vegetation varies but is usually 0.82 feet (25 cm); cover is 100%.

Brackish Marshes -- BM

Brackish marshes form at the interface between the salt marshes and the freshwater marshes. Therefore, the range of salinities found in these marshes is highly variable in space and time. The species composition slowly changes as one moves from the areas near the salt marshes to the areas near the willow swamps or riparian woodlands. Three species of plants which are common throughout these brackish marshes are salt rush (Juncus lesueurii var. lesueurii), pacific silverweed (Potentilla egedii ssp. grandis), and water parsley (Oenanthe sarmentosa).

In general, the brackish marshes found on the site are typical of other such marshes around Humboldt Bay. Two types of marshes

located on the site that are uncommon around Humboldt Bay are the pacific rush (Juncus effusus var. pacificus) and the common reed (Phragmites communis var. berlandieri) stands. The pacific rush marsh represents a unique resource; the common reed marsh represents a threat to Humboldt Bay marshes. Though none of the brackish marshes, or species therein, are rare, the uniqueness of this site lies in the quantity and diversity of the marshes represented. Within these parcels, most of the common types of marshes can be found.

The brackish marshes on the site are separated by species composition and structure. Structure of plant associations is believed to be very important in ascertaining wildlife uses of the habitat. The brackish marshes vary from very short areas dominated by grass species to the tall stands of slough sedge (Carex obnupta).

BM₁ -- salt grass/water foxtail/
pacific silverweed
(Distichlis spicata/Alopecurus genticulatus/
Potentilla egedii ssp. grandis)

This brackish marsh is found on the upper edges of the salt marshes and is influenced by tidal waters. Salt grass, water foxtail, and pacific silverweed are found in approximately equal amounts with scattered patches of one or more of the following: orache (Atriplex patula), spikerush (Eleocharis marostachya), and brass buttons (Cotula coronopifolia). The height of this marsh averages 1.48 feet (45 cm); cover is 100%.

BM₂ -- water foxtail/salt rush/velvet grass
(Alopecurus genticulatus/Juncus lesueurii var.
lesueurii)/Holcus lanatus)

The combination of water foxtail, salt rush and velvet grass (Holcus lanatus) is found in one area located near the salt marshes and near a freshwater inlet. This type is very similar to the previous type with the addition of grass species, most notably velvet grass and bent grass (Agrostis sp.). Salt grass and orache are present in this area but with less overall coverage. The height of the vegetation is 2.3 feet (70 cm); cover is 100%.

BM₃ -- three-corner/salt grass
(Scirpus americanus/Distichlis spicata)

Three-corner (Scirpus americanus) occurs in areas that usually have standing water throughout the year. Three-corner mixes with the salt grass in one area at the upper margin of the salt marsh, directly off the inlet to the marsh. Very few other species are associated with this type. Occasionally pacific silverweed (Potentilla egedii ssp. grandis) and water foxtail (Alopecurus genticulatus) are included. The height of this type is 2.79 feet (85 cm); cover averages 85%.

BM₄ -- salt rush/pacific silverweed/
common rush/water parsley
(Juncus lesueurii var. lesueurii/Potentilla
egedii ssp. grandis/Juncus effusus
var. brunneus/Oenanthe sarmentosa)

This vegetation type is highly variable. It changes dominant species gradually, from the mudflats to the riparian areas (or willow swamps). This vegetation type covers the majority of the brackish marshes east of the salt marshes. The plant assemblage contains a diverse mixture of species dominated by salt rush (Juncus lesueurii var. lesueurii) with pacific silverweed (Potentilla egedii ssp. grandis), some salt grass (Distichlis spicata), water parsley (Oenanthe sarmentosa), small-seeded bulrush (Scirpus microcarpus), willow herb (Epilobium watsonii var. franciscanum), fireweed (Erechtites prenanthoides), curly dock (Rumex crispus), and aster (Aster chilensis).

The dominant rush species changes from the salt rush to common rush (Juncus effusus var. brunneus) as one approaches the willows but the species composition remains very similar with two notable additions. Speedwell (Veronica scutellata) and monkeyflower (Mimulus guttatus ssp. litoralis) are more common on the eastern portion of these brackish to freshwater marshes, though still only present in very low amounts. These two species are much less salt tolerant and require very wet areas. The height of the vegetation is variable at this time of year due to the fact that the salt rush is lying down rather than standing erect; therefore a range, from 2.79-3.28 feet (85 to 100 cm), gives a better indication of the structure of the type; cover is 100%.

BM_{4a} -- pacific rush
(Juncus effusus var. pacificus)

Small, 9.8 feet diameter (3 meters), areas occur within the BM₄ brackish marsh type that are nearly monotypic stands of a tall variety of the common rush known as pacific rush (Juncus effusus var. pacificus). The species is not common around Humboldt Bay. The height of these areas is approximately 5.23 feet (160 cm); cover is 90%. These small patches are denoted as BM_{4a}. The delineation is mainly due to structure.

BM₅ -- slough sedge/water parsley
(Carex obnupta/Oenanthe sarmentosa)

This type of brackish marsh is very common around Humboldt Bay in areas that are seasonally to perennially wet. On Palco Marsh, slough sedge (Carex obnupta) attains a height of 5.58 feet (170 cm). The salinity tolerances of this species are very wide; it can be found from the upper edges of salt marshes to the freshwater marshes and willow swamps. The stands on the site are nearly monotypic, but they can contain small amounts of water parsley (Oenanthe sarmentosa) and pacific silverweed (Potentilla egedii ssp. grandis). Cover is 100%.

BM_{5a} -- Carex lyngbyei/Oenanthe

Essentially, this brackish marsh is a sub-set of the previous marsh. It is separated out due to the difference in its structure. This marsh contains a sedge species which most closely resembles Lyngbye's sedge (Carex lyngbyei), but which also contains characteristics similar to slough sedge (Carex obnupta). The taxonomic uncertainties associated with this species have been observed elsewhere on Humboldt Bay.

The height of this marsh is 2.95 feet (90 cm); cover averages 98%. Interspersed throughout the culms are the companion species of pacific silverweed and water parsley, a little more common in this type than in the previous type.

**BM₆ -- saltmarsh bulrush
(Scirpus robustus)**

The saltmarsh bulrush (Scirpus robustus) stands on the site are typical of Humboldt Bay stands, which occur in brackish marshes and in sloughs and channels at the upper reaches of salt marshes. These monotypic stands require persistent water; other species are rarely found there. The height of these stands was found to be 2.30 feet (70 cm). This figure is heavily biased by the time of year; the majority of the culms are broken and dead. Cover averages 70%.

**BM₇ -- common reed
(Phragmites communis var. berlandieri)**

The common reed (Phragmites communis var. berlandieri) occurs in the "triangle" near the railroad tracks and in an adjacent area. This species occurs in dense monotypic stands approximately 8.20 feet (250 cm) in height; cover is 98 %. Common reed is rarely found in the marshes of Humboldt Bay; as such, this population may present a threat to the Humboldt Bay marshlands. The need for eradication of this species was previously discussed.

Freshwater Marshes -- FM

The marshes included in this section range from the upper edge of the brackish marshes to the riparian habitats (or willow swamps). The freshwater marshes include two tall, emergent dominated marshes and one emergent/floating-leaved marsh. These marshes are typical of Humboldt Bay. Some have previously been described by Monroe (1973), Newton (in Koplin, et. al. 1984), and Newton (1984, 1985a, 1985b).

These freshwater marshes are extensive within the site and intergrade heavily with adjacent riparian areas. Similar freshwater marshes can be found around Humboldt Bay but are usually in narrow strips near grazed pastureland.

FM₁ -- small-seed bulrush/water parsley/
common rush
(Scirpus microcarpus/Oenanthe sarmentosa/
Juncus effusus var. brunneus)

This marsh is found on the "brackish side" of the cat-tail stands or the riparian areas. These areas are dominated by the small-seeded bulrush (Scirpus microcarpus), occasionally in nearly monotypic stands, with some amounts of water parsley (Oenanthe sarmentosa) and common rush (Juncus effusus var. brunneus). The height of these marshes is 3.28 feet (100 cm); cover is 100%. This vegetation type intergrades in some areas with the extensive BM₄ -- salt rush/pacific silverweed/common rush/water parsley.

FM₂ -- common cattail
(Typha latifolia)

Cattails (Typha latifolia) are the dominant species in this marsh. The stands can be either closed with a few incidental species occurring underneath the dense layer of cattails, or the stand can be more open with various species underneath. The species likely to found underneath the cattails are pacific silverweed (Potentilla egedii spp. grandis), water parsley (Oenanthe sarmentosa), bedstraw (Galium trifidum), willow herb (Epilobium watsonii var. franciscanum), common rush (Juncus effusus var. brunneus), monkeyflower (Mimulus guttatus ssp. litoralis), and slough sedge (Carex obnupta). The height of the stands averages 7.22 feet (220 cm); cover is 100%.

FM₃ -- water parsley/marsh pennywort/
floating fern
(Oenanthe sarmentosa/Hydrocotyle ranunculoides/
Azolla filiculoides)

There is only one location on the site where this marsh occurs in a large enough area to be mapped. This location is the remnant of the original freshwater pond present in the 1962 aerial photo of the site. In this area water parsley (Oenanthe sarmentosa) is the dominant species with marsh pennywort (Hydrocotyle ranunculoides) and spike rush (Eleocharis macrostachya) present in lesser amounts. Duckweed (Lemna sp.) and floating water fern (Azolla filiculoides) can seasonally cover all the areas of open standing water. The height of the plants above the standing water in this marsh varies depending on the presence of the rooted-emergents, 0.98 feet (30 cm), or the presence of the floating species, 0.03 feet (1 cm); cover averages 98%.

In addition to the one location of this vegetation type included on the map, this marsh type is found throughout the freshwater marshes in small openings between plants. These areas, though important, are much too small to be accurately mapped.

Riparian Woodlands (or Willow Swamps) -- R

The riparian woodlands on the sites are present in abundance around the east edges. Two riparian vegetation types are delineated based on the herbaceous layer. R_1 contains typical marsh species in the understory while R_2 contains dense blackberry hedges and various grass species in the understory.

The areas distinguished as R_1 , or "wet-site riparian", should be divided into two types based on the USFWS definitions (USFWS 1979). A forested wetland is 32.8 feet (10 meters) in height; a scrub-shrub wetland is 23 feet (7 meters) in height. The western edge of the R_1 area near Highway 101 is slowly encroaching into the adjoining marshes as evidenced by the large number of alder and willow saplings in that area. According to USFWS definitions, the area of encroachment should be designated as scrub-shrub wetland, while the more mature stand would be designated as forested wetland (despite its identical species composition). In effect, the scrub-shrub designation, in this particular case, is a transitional or successional stage of the forested wetland.

R_1 -- willow/alder/water parsley (Salix spp./Alnus oregona/Oenanthe sarmentosa)

This first type of riparian habitat is currently expanding from the area near Highway 101. This vegetation type is very similar in composition and structure to areas described by Newton (in Koplin et al 1984), Newton (1985a, 1985b). In the canopy layer, red alders (Alnus oregona) and one species of willow (Salix lasiandra) reach 30-40 feet (9-12 meters) in height. Other willow species (S. piperi and S. hookeriana) form a secondary and shorter layer attaining 15 feet (4.57 meters) in height. The overall cover of the canopy ranges from 60-90%. The tree species are invading the adjacent freshwater marshes; many saplings are becoming established in the marshes.

The herbaceous layer of the riparian habitats is highly influenced by the type of marsh adjacent to each area, but typically contains, in dense stands (averaging 80% cover), some or all of the following moisture loving species: water parsley (Oenanthe sarmentosa), slough sedge (Carex obnupta), common cat-tail (Typha latifolia), and small-headed bulrush (Scirpus microcarpus).

R_2 -- willow/alder/blackberry (Salix spp./Alnus oregona/Rubus spp.)

The second type of riparian habitat is found mainly west of the railroad tracks in the drier areas. The canopy is usually not as dense (approximately 40% cover) or as tall as the previous vegetation type; however, the same species of willow and red alder are present. The shrub layer is very dense and dominated by blackberry and himalaya berry (Rubus vitifolius and R. procerus). The herbaceous layer contains many of the same

species found in the adjacent grasslands such as vernal grass (Anthoxanthum oderatum) and orchard grass (Dactylus glomerata).

Upland Habitats

G₁ -- velvet grass/common rush (Holcus lanatus/Juncus effusus var. brunneus)

These grasslands are located in areas very near marshes and contains many weedy species as well as some marsh species. The dominant grass species is velvet grass (Holcus lanatus). Species commonly associated with this type are creeping buttercup (Ranunculus repens), common rush (Juncus effusus var. brunneus), willow herb (Epilobium watsonii var. franciscanum), and pacific silverweed (Potentilla egedii ssp. grandis). The height of these grasslands averages 2.30 feet (70 cm); cover is usually 100%.

G₂ -- perennial ryegrass/perennial trefoil

(Lolium perenne/Lotus corniculatus)

This grassland contains many weedy species commonly associated with dry areas near the coast. The dominant grass species are perennial ryegrass (Lolium perenne), vernal grass (Anthoxanthum oderatum), bentgrass (Agrostis sp.), and orchard grass (Dactylus glomerata). Other species commonly found in this vegetation type are dubious clover (Trifolium dubium), Parentucellia viscosa, english plantain (Plantago lanceolata), anise (Foeniculum vulgare), beach strawberry (Fragaria chiloensis), and cat's ear (Hypochoeris radicata). Height is variable; cover is usually 100%.

B -- blackberry/coyote bush/wax myrtle

This designation is used for small, isolated bushes of any or all of the following species: blackberry (Rubus vitifolius), himalaya berry (R. procerus), salmonberry (R. spectabilis), coyote bush (Baccharis pilularis ssp. consanguinea), wax myrtle (Myrica californica), and twin berry (Lonicera involulata). Height and cover varies with the species.

APPENDIX B. COMPILED SPECIES LIST FOR THE PALCO MARSH COMPLEX

<u>SCIENTIFIC NAME</u>	<u>FAMILY</u>	<u>COMMON NAME</u>
<u>Achillea borealis</u>	Asteraceae	yarrow
<u>Agrostis stolonifera</u>	Poaceae	creeping bent
<u>Aira caryophyllea</u>	Poaceae	hairgrass
<u>Alnus oregona</u>	Betulaceae	red alder
<u>Alopecurus genticulatus</u>	Poaceae	water foxtail
<u>Ambrosia chamissonis</u>	Asteraceae	beach bur
<u>Angelica hendersonii</u>	Apiaceae	angelica
<u>Anthoxanthum oderatum</u>	Poaceae	vernal grass
<u>Aster chilensis</u>	Asteraceae	aster
<u>Atriplex patula</u> ssp. <u>hastata</u>	Chenopodiaceae	orache
<u>Atriplex patula</u> ssp. <u>obtusa</u>	Chenopodiaceae	orache
<u>Avena sativa</u>	Poaceae	oat
<u>Azolla filiculoides</u>	Salviniaceae	floating fern
<u>Baccharis pilularis</u> ssp. <u>consanguinea</u>	Asteraceae	coyote bush
<u>Bellis perennis</u>	Asteraceae	english daisy
<u>Briza maxima</u>	Poaceae	rattlesnake grass
<u>Bromus mollis</u>	Poaceae	brome grass
<u>Bromus rigidus</u>	Poaceae	soft chess
<u>Calystegia soldanella</u>	Convolvulaceae	beach morning-glory
<u>Carex lyngbyei</u>	Cyperaceae	sedge
<u>Carex obnupta</u>	Cyperaceae	slough sedge
<u>Carex pansa</u>	Cyperaceae	sand dune sedge
<u>Cirsium</u> sp.	Asteraceae	thistle
<u>Cortaderis selloana</u>	Poaceae	pampasgrass

<u>SCIENTIFIC NAME</u>	<u>FAMILY</u>	<u>COMMON NAME</u>
<u>Cotula coronopifolia</u>	Asteraceae	brass buttons
<u>Cyperus eragrostis</u>	Cyperaceae	umbrella sedge
<u>Cytisus monspessulanus</u>	Caesalpinaceae	french broom
<u>Cytisus scoparis</u>	Caesalpinaceae	scotch broom
<u>Dactylis glomerata</u>	Poaceae	orchard grass
<u>Daucus carota</u>	Apiaceae	Queen Anne's lace
<u>Deschampsia caespitosa</u>	Poaceae	tufted hairgrass
<u>Dipsacus sylvestris</u>	Dipsacaceae	teasel
<u>Distichlis spicata</u>	Poaceae	salt grass
<u>Eleocharis macrostachya</u>	Cyperaceae	spike rush
<u>Elymus mollis</u>	Poaceae	dunegrass
<u>Epilobium angustifolium</u>	Onagraceae	fireweed
<u>Epilobium watsonii</u> var. <u>franciscanum</u>	Onagraceae	willow herb
<u>Equisetum arvense</u>	Equisetaceae	horse tail
<u>Erechtites prenanthoides</u>	Asteraceae	fireweed
<u>Festuca arundinacea</u>	Poaceae	meadow fescue
<u>Festuca</u> sp.	Poaceae	fescue
<u>Foeniculum vulgare</u>	Apiaceae	anise
<u>Fragaria chiloensis</u>	Rosaceae	beach strawberry
<u>Fuchsia</u> sp.	Epilobium	fuchsia
<u>Galium trifidum</u>	Rubiaceae	bedstraw
<u>Geranium</u> spp.	Geraniaceae	cranesbill
<u>Grindelia stricta</u> ssp. <u>blakei</u>	Asteraceae	Humboldt Bay gumplant
<u>Hedera helix</u>	Araliaceae	English ivy
<u>Heracleum lanatum</u>	Apiaceae	cow-parsnip
<u>Holcus lanatus</u>	Poaceae	velvet grass

<u>SCIENTIFIC NAME</u>	<u>FAMILY</u>	<u>COMMON NAME</u>
<u>Hordeum</u> sp.	Poaceae	barley
<u>Hydrocotyle ranunculoides</u>	Apiaceae	marsh pennywort
<u>Hypochoeris radicata</u>	Asteraceae	cat's ear
<u>Jaumea carnosa</u>	Asteraceae	jaumea
<u>Juncus effusus</u> var. <u>brunneus</u>	Juncaceae	common rush
<u>Juncus effusus</u> var. <u>pacificus</u>	Juncaceae	pacific rush
<u>Juncus ensifolius</u>	Juncaceae	rush
<u>Juncus lesueurii</u> var. <u>lesueurii</u>	Juncaceae	salt rush
<u>Juncus lesueurii</u> var. <u>tracyi</u>	Juncaceae	salt rush
<u>Lathyrus latifolius</u>	Fabaceae	everlasting pea
<u>Lemna</u> spp.	Lemnaceae	duckweed
<u>Leontodon leysleri</u>	Asteraceae	hawkbit
<u>Limonium californicum</u> var. <u>californicum</u>	Plumbaginaceae	sea lavender
<u>Lolium multiflorum</u>	Poaceae	Italian ryegrass
<u>Lolium perenne</u>	Poaceae	perennial ryegrass
<u>Lonicera involulata</u>	Caprifoliaceae	twin berry
<u>Lotus corniculatus</u>	Fabaceae	perennial trefoil
<u>Lupinus</u> sp.	Fabaceae	lupine
<u>Lupinus arboreus</u>	Fabaceae	bush lupine
<u>Melilotus albus</u>	Fabaceae	sweet-clover
<u>Mentha pulegium</u>	Lamiaceae	pennyroyal
<u>Mimulus guttatus</u> ssp. <u>litoralis</u>	Scrophulariaceae	monkey flower
<u>Myrica californica</u>	Myricaceae	wax myrtle
<u>Oenanthe samentosa</u>	Apiaceae	water parsley
<u>Parentucellia viscosa</u>	Scrophulariaceae	

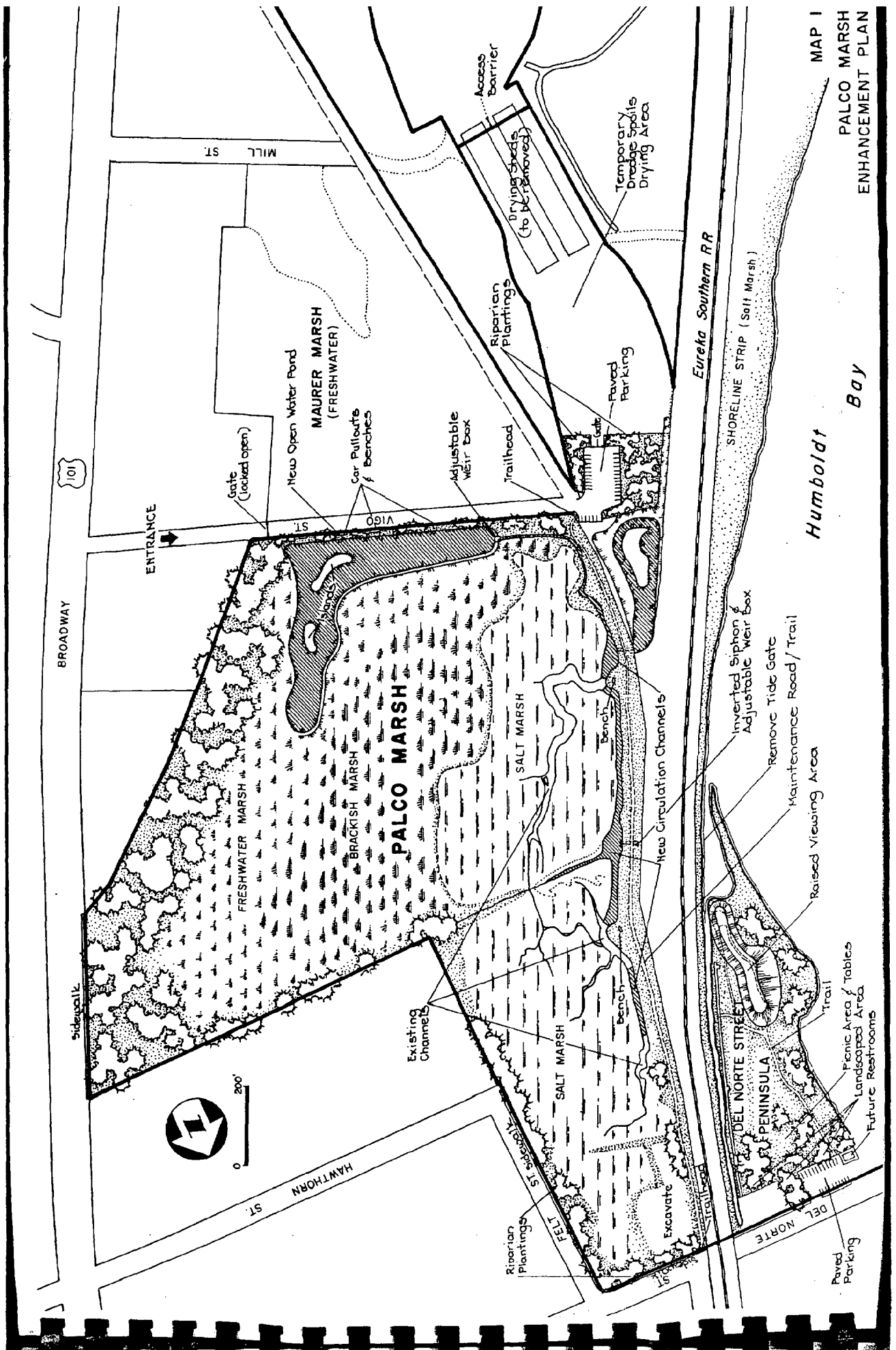
<u>SCIENTIFIC NAME</u>	<u>FAMILY</u>	<u>COMMON NAME</u>
<u>Phragmites communis</u> var. <u>berlandieri</u>	Poaceae	common reed
<u>Plantago lanceolata</u>	Plantaginaceae	english plantain
<u>Plantago maritima</u> ssp. <u>juncoides</u>	Plantaginaceae	sea plantain
<u>Poa annua</u>	Poaceae	annual bluegrass
<u>Poa douglasii</u>	Poaceae	dune bluegrass
<u>Polypogon maritimus</u>	Poaceae	rabbitfoot grass
<u>Polystichum munitum</u>	Aspidiaceae	sword fern
<u>Potentilla egedii</u> ssp. <u>grandis</u>	Rosaceae	pacific silverweed
<u>Prunella vulgaris</u>	Lamiaceae	selfheal
<u>Pteridium aquilinum</u> var. <u>pubescens</u>	Pteridaceae	bracken fern
<u>Ranunculus repens</u>	Ranunculaceae	creeping buttercup
<u>Raphanus sativus</u>	Brassicaceae	wild radish
<u>Rosa</u> sp.	Rosaceae	rose
<u>Rosa nutka</u>	Rosaceae	nutka rose
<u>Rubus procerus</u>	Rosaceae	himalaya berry
<u>Rubus spectabilis</u>	Rosaceae	salmonberry
<u>Rubus vitifolius</u>	Rosaceae	blackberry
<u>Rumex acetosella</u>	Polygonaceae	common dock
<u>Rumex crispus</u>	Polygonaceae	curly-leaved dock
<u>Ruppia maritima</u>	Ruppiaceae	ditch grass
<u>Salicornia virginica</u>	Chenopodiaceae	pickleweed
<u>Salix hookeriana</u>	Salicaceae	hooker's willow
<u>Salix lasiandra</u>	Salicaceae	willow
<u>Salix piperi</u>	Salicaceae	dune willow
<u>Scirpus americanus</u>	Cyperaceae	three-corner

<u>SCIENTIFIC NAME</u>	<u>FAMILY</u>	<u>COMMON NAME</u>
<u>Scirpus microcarpus</u>	Cyperaceae	small-seeded bulrush
<u>Scirpus robustus</u>	Cyperaceae	saltmarsh bulrush
<u>Scrophularia californica</u>	Scrophulariaceae	figwort
<u>Spartina densiflora</u>	Poaceae	cordgrass
<u>Spergularia marina</u>	Caryophyllaceae	mud-spurrey
<u>Stachys</u> sp.	Lamiaceae	hedge nettle
<u>Stellaria sitchana</u> var. <u>bongardiana</u>	Caryophyllaceae	chickweed
<u>Tanacetum douglasii</u>	Asteraceae	dune tansy
<u>Taraxacum officinale</u>	Asteraceae	dandelion
<u>Trifolium dubium</u>	Fabaceae	dubious clover
<u>Trifolium repens</u>	Fabaceae	creeping clover
<u>Trifolium wormskioldii</u>	Fabaceae	cow clover
<u>Triglochin concinnum</u>	Juncaginaceae	slender arrow grass
<u>Triglochin maritimum</u>	Juncaginaceae	arrow grass
<u>Typha latifolia</u>	Typhaceae	cattail
<u>Veronica scutellata</u>	Scrophulariaceae	speedwell
<u>Vicia angustifolia</u> var. <u>segetalis</u>	Fabaceae	vetch
<u>Zostera marina</u>	Zosteraceae	eel grass

APPENDIX C

ESTIMATED CONSTRUCTION COSTS FOR THE PALCO MARSH ENHANCEMENT PROJECT

Project Element	Quantity	Unit Price(\$)	Construction Costs (\$)
HABITAT ENHANCEMENT			
Water Exchange Improvements (Inverted Siphon/Weir, etc.)	Lump Sum	10,000	10,000
Channel Excavation	87 cy	10	8,750
Hand-ditching	300 lf	3.20	960
Open Water Pond Excavation/ Temp. Road Construction	14800 cy 750 cy	10 6	148,000 4,500
Removal of Drying Sheds	Lump Sum	5,000	5,000
Removal of Paving	28,500 sf	0.15	4,275
Gravel	1,600 cy	6	9,600
RR Marsh Excavation	3,200 cy	8	25,600
Maintenance Road Improvements (gravel)	500 cy	6	3,000
Vegetation Removal/ Revegetation	Lump Sum	25,000	25,000
Sub Total			\$244,685
PUBLIC ACCESS			
Del Norte Street Improvements			
Parking Area Base	260 cy	25	6,500
Paving	14,000 sf	0.80	11,200
Kiosk	Lump Sum	1,000	1,000
Gates	2 ea	400	800
Picnic Tables	4 ea	300	1,200
Raised Viewing Area	2,200 cy	6	13,200
Vigo Street Improvements			
Access Barrier/Bumper Logs	1,000 lf	1	1,000
Gates	2 ea	400	800
Signs	Lump Sum	1,000	1,000
Benches	8 ea	250	2,000
Sub Total			\$38,700
Sidewalks- Del Norte St.	540 lf	54	29,160
Felt St.	600 lf	56	33,600
Broadway	530 lf	68	36,040
Sub Total			\$ 98,800
MONITORING (up to 4 years)	1,000 hrs	30	30,000
Contingency 10%			\$41,200
OVERALL TOTAL			\$453,385



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