APPENDIX F

Geotechnical Reconnaissance Report

RECONNAISSANCE REPORT

PROPOSED WETLANDS

PROSPECT ISLAND

31 May 94

Prepared by
Soil Design Section
Sacramento District

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1. Purpose and Scope

This report responds to Work Order Request AA213-94-1, Prospect Island, California, dated 25 April 94. The primary purpose of this report is to summarize existing geotechnical information at Prospect Island. The proposed wetlands work is described along with site conditions, borrow, constructability and future geotechnical work. Tentative recommendations and conclusions are also presented. A brief field reconnaissance was completed on 11 May 94. The following data is based on field observations and a literature search.

2. Proposed Wetlands Work

The proposed work involves breaching Miner Slough or the Sacramento Deep Water Ship channel in two or more places and inundating the interior of Prospect Island. Interior mounds or small islands will be constructed and buttress fill placed on the landside toe and slope of existing levees. To minimize wave damage, aquatic plants planted offshore or the buttress fill will be required. These will dissipate waves and minimize or avoid the use of riprap. About 1580 acres are involved which includes 1276 acres of farmland and 304 acres of dredge spoil areas owned by the Port of Sacramento. The site is shown on Figure 1 and tentative sections are shown on Figure 2 and 3.

3. Site Conditions

Surficial organic soil to include peat (OH-OL-Pt) vary in thickness from 2 feet at the north end of the Island to 21 feet at the south end. These soft and compressible soils average 10 feet thick. This surface layer is typically underlain with a firm clay (CL-CH) layer which varies from 4 to 29 feet thick and averages 12 feet. Below this, sand (SP-SW) is encountered. It varies from 5 to 10 feet thick and averages 8 feet to the average 30 foot depth explored.

a. Agricultural Soil Types

The distribution of agricultural soil types are shown on Figure 1. Soils include: the Sacramento silty clay loam (Sa), the Ryde clay loam (Ry); the Columbia fine sandy loam (Cm), the Valdez silt loam (Va) and dredge spoil (Tu). Collectively, the soils are organic, erodible, soft and mantle the surficial 5 feet of the Island. The ground water table varies between 1 and 4 feet in depth and the coefficient of permeability (K) ranges from 0.2 to 10 feet per day. In the dredge spoil area, ground water is believed to be on the order of 4 feet in depth.

b. Previous Explorations

Previous explorations and testing were carried out which determined the field conditions and soil types along the ship channel. The reach of the ship channel through Prospect Island was explored in three separate programs as the channel design developed. Eleven combination hand auger and push tube holes were drilled along the channel alignment in 1950 to a maximum depth of forty-five feet. Four rotary core holes were drilled along the channel alignment in Prospect Island during 1956 to a maximum depth of thirty feet. During 1958 an exploration program was conducted at the three construction control sections located in Prospect Island. This involved drilling 30 auger along with 19 companion swedish foil sampler holes. A total of forty-five locations were drilled to a depth of 30 to 45 feet.

c. Previous Field and Laboratory Testing

A total of 75 vane shear tests were taken between 3 and 19.5 feet adjacent to the swedish foil sample holes. Shear Strength values ranged from 0.02 to 0.34 tons per square foot. A total of 86 unconfined compression tests were performed on swedish foil samples. Shear strength values ranged from 0.02 to 0.33 tons per square foot. Mechanical analyses, moisture content, density, Atterberg limits and organic content tests were performed on representative samples. Other secondary testing included compaction, consolidation, triaxial shear and direct shear.

d. Soil Properties

Based on the above explorations and laboratory test results (See Ref e) the primary soil properties are summarized as follows:

Type of material	Approximate Depth (feet)	Field Dry Density (p.c.f.)(γd)	Moisture content	Liquid Limit (Percent)	Plasticity Index
Organic clay (CH) Organic Silt (OH) Peat (Pt)	2 to 20	14 to 87	12 to 341	49 to 248	25 to 130
Clay (CH)	2 to 18 and 20 to 30	52 to 102	19 to 90	29 to 105	9 to 64
Sandy Silt (ML) Sand (SM) Clayey Sand (SC)	18 to 30	82 to 114	16 to 47		Slight to Non-Plastic

Primary and secondary soil properties are as follows:

Soils Data	Peat and Organic Silts and Clays	Firm Clays and Clayey Sands
Dry Weight - lbs/cu.ft	40	90
Saturated Weight - lbs/cu.ft.	87	119
Moisture Content - Percent	116	32
Undrained Shear Strength (Su) in tons/square feet	0.13	-
Consolidated Undrained (Cu) Strength (ϕ) in tons/sq. ft.	12°	-
Direct Shear Strength (ϕ - degrees)	10°	25°
Cohesion - tons/sq.ft. Direct Shear Triaxial Shear (Cu)	 0.08 0.14	 0.02 -
Compression Index - Cc	0.93	0.27
50% Consolidation Time - minutes	6	2

4. Potential Borrow Source

The dredge spoil area will provide a potential borrow source. This area will yield about 1.1 million cy of material. The deposit is a heterogeneous mixture of soils with about 33 percent organic soils (OH, OL & PT), 40 percent clay (CL - CH) and 27 percent fine sand or silt (SP, SM, ML). About 0.25 million cy of buttress fill will be required along with a minimum of 0.25 million cy of interior or mound fill. Thus, the borrow area should yield about double the quantity required.

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5. Fill Properties

Based on ship channel construction the local borrow has the following properties:

SOILS DATA	BUTTRESS FILL
Dry Weight - lbs/cu.ft.	70
Moist Weight - lbs/cu.ft.	95
Saturated Weight - lbs/cu.ft.	105
Moisture Content - percent	35
Internal Angle of Friction Shear Angle - ϕ - degrees	21
Cohesion - tons/sq.ft	0

6. Constructability

Based on ship channel levee construction no more than 5 feet of fill can be placed during a construction season without overstressing the foundation. Therefor, staged construction will be required for buttress or interior fills greater than 5 feet thick. To compensate for settlement a minimum 3 year construction contract will be required. To excavate and haul borrow, special equipment such as wide track dozers, loaders and bottom dump haul trucks will be required. Heavy scrapers or end dumps will overstress the existing levee roads and not be trafficable in interior parts if the island. Spreading, mixing, moisture conditioning and compaction will have to be accomplished with relatively small equipment or with wide track or multiple-tired farm type equipment. For example, compaction should be accomplished using a procedural specification such as applying 4 coverages of a D-4 caterpillar dozer and restricting the loose lift thickness to 6 inches.

7. Future Explorations and Laboratory Testing

Future explorations and laboratory testing will be required to evaluate borrow area soils. The distribution of peat or highly organic soils in the spoil area should be determined. Further, ground water levels throughout the project should be established. About 10 auger holes should be drilled along Miner Slough to confirm exploration and test data collected along the ship channel.

8. Recommendations

a. Detailed topography at 1 inch = 100 feet at a contour interval of 1 foot will be required for PED.

b. Breaches or gaps through the existing levees will require slope protection.

c. The effects of silt transport into the ship channel or Miner Slough should be evaluated.

d. Offshore tules or aquatic vegetation should be placed early in construction to avoid wind generated wave damage.

e. Establish the elevation limits of interior mounds since settlement will continue 5 to 8 years and additional fill will need to be placed. It is noted that the average settlement near the midpoint of the Island is estimated at 10 inches, whereas the settlement at the southern tip is 21 inches (see Fig 3).

f. Mounds should be more concentrated on the east side of the island to provide additional protection to Minor Slough and the adjacent Ryer Island.

g. Open bodies of water should be oriented normal to the prevailing wind direction to minimize fetch and associated wave damage.

h. Restrict fill placement to 3 feet per year.

9. Conclusions

The project can be constructed as envisioned provided staged construction is adopted and construction equipment does not damage the existing levee system. On site borrow is adequate to construct the proposed fills.

10. References

a. Definite Project Report, Sacramento Deep Water Ship Channel Project, Sacramento River, California, 15 July 1949

b. Office Report, Program of Explorations, Testing and Instrumentation for Construction of Levees through Prospect Island, Sacramento Deep Water Ship Channel, 18 March 1958

c. Prospect Island Fish Habitat Restoration Pilot Program, Environmental Resource Branch, Sacramento District, Corps of Engineers, 6 April 1988

d. Soil Survey of Solano County, California USDA Soil Conservation Service, May 1977

e. Supplementary Soils Report, Sacramento Deep Water Ship Channel (Mile 18.2 to 26.8) Prospect Island and Little Holland Tract, 27 Mar 1959 (Rev 26 January 1960)

PHOTOGRAPHS, PROSPECT ISLAND, 11 MAY 1994

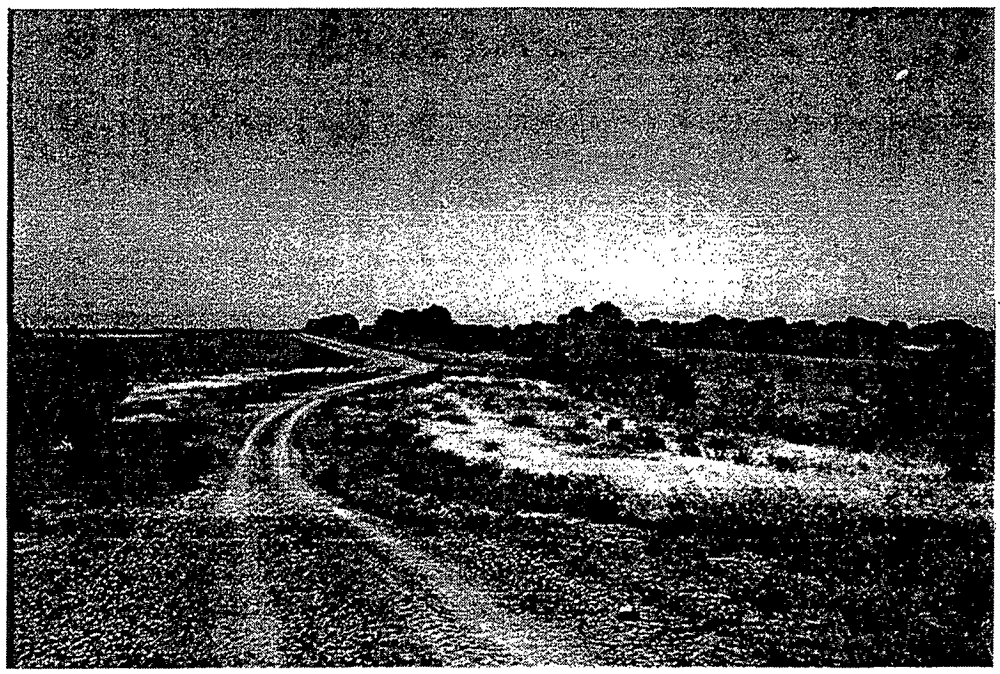


Photo 1. View looking South From mile 22.6. Ship channel to the right, Prospect Island to the upper left.

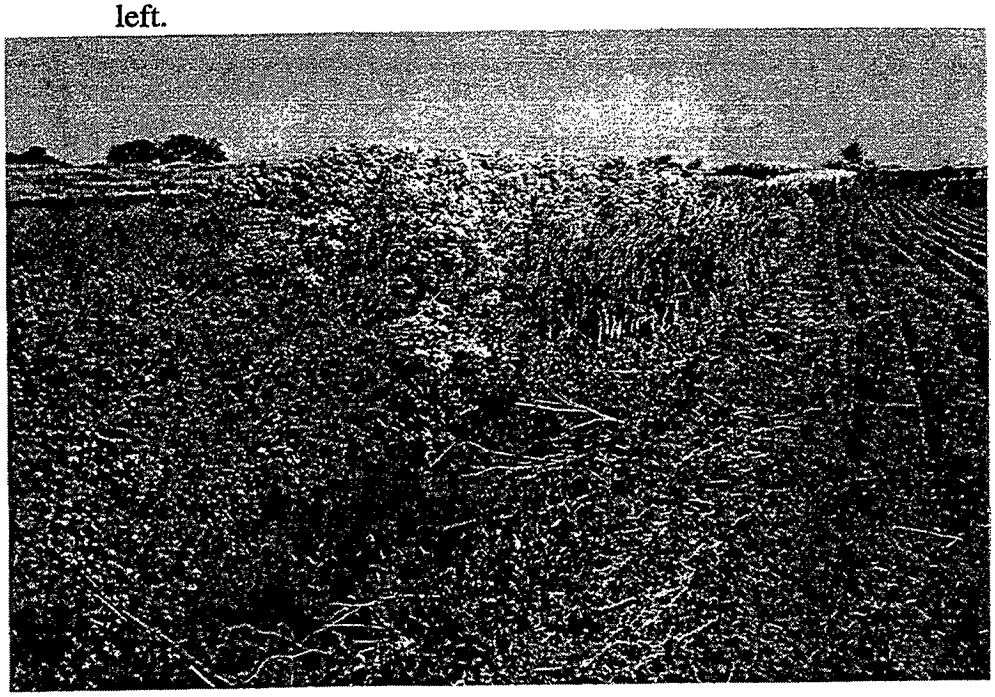


Photo 2. View of high ground water table at the north end of the Island. i.e. depth to water 2 - 3 feet.

Photo 3. View of north levee of Prospect Island looking south. Note the dark tilled farmland beyond vehicle.

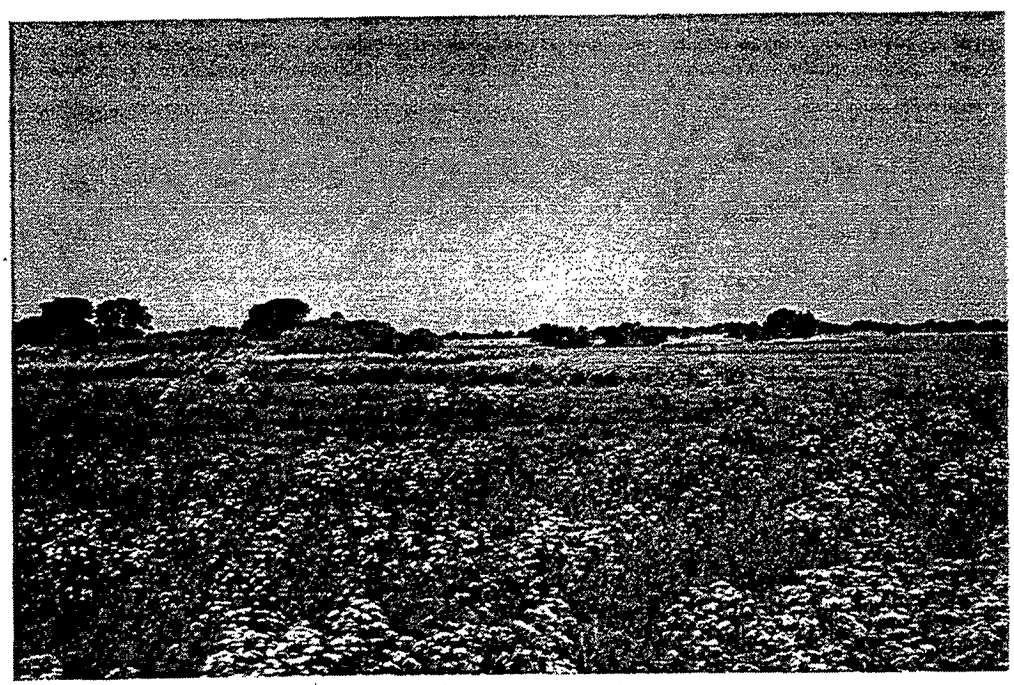
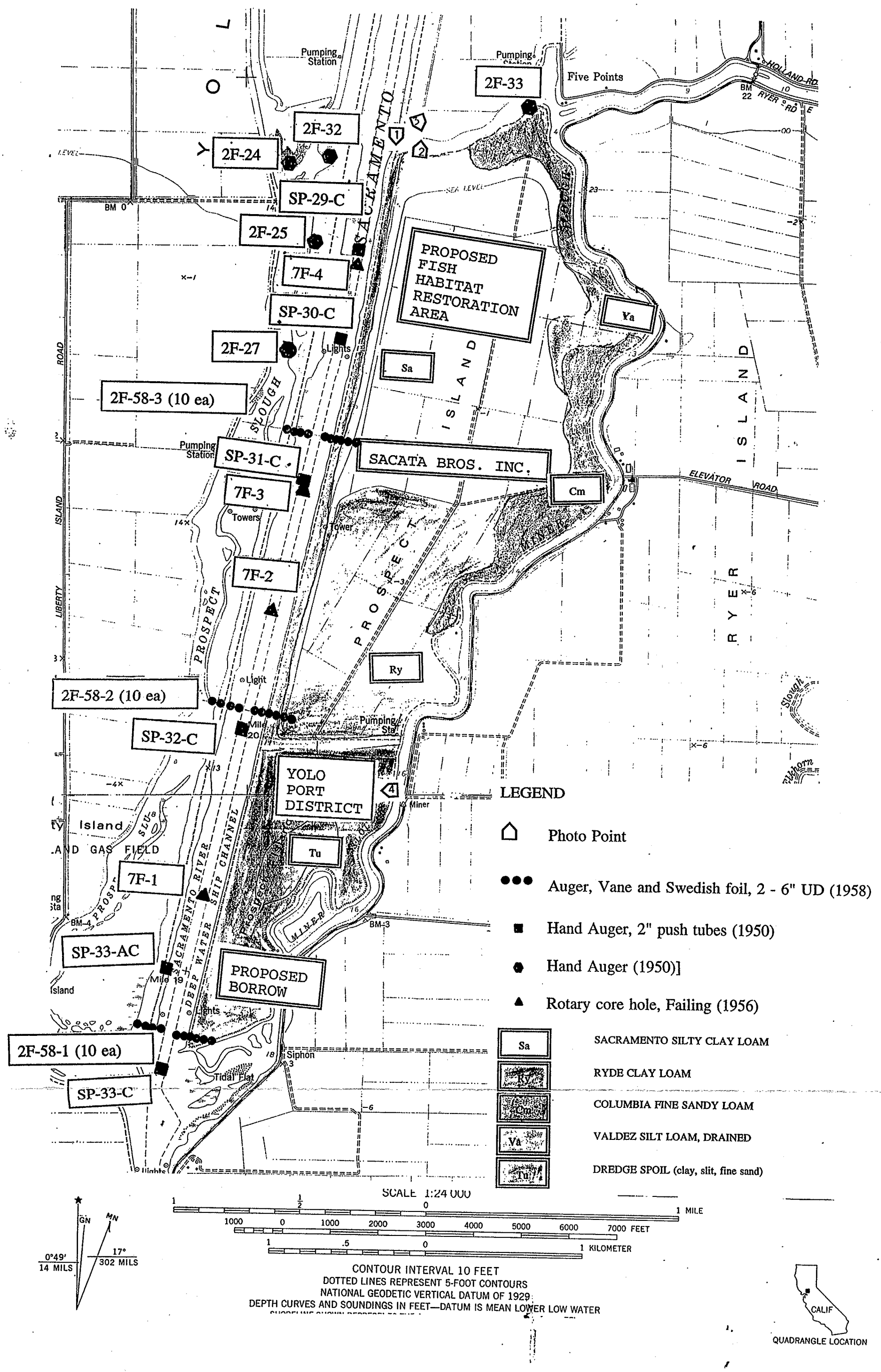


Photo 4. Dredge spoil area of Yolo Port. Note profuse vegetation growing in the organic rich soils.



PROPOSED WETLANDS PROJECT AT PROSPECT ISLAND

Fig 1

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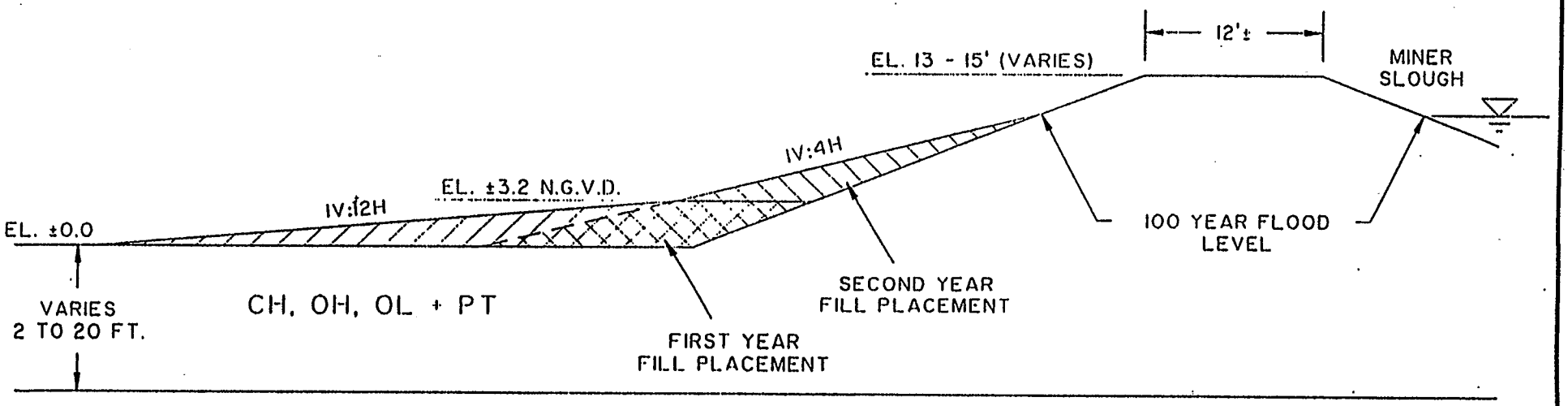
TYPICAL LEVEE SECTION

SCALE: 1" = 10'



BUTTRESS FILL

GRAPHIC SCALE

1" = 10' 0 5' 10' 20' 30'

GEOTECHNICAL BRANCH
SACRAMENTO DEEP WATER CHANNEL
PROSPECT ISLAND
TYPICAL LEVEE SECTION
U.S. ARMY CORPS OF ENGINEERS

FIG. 2

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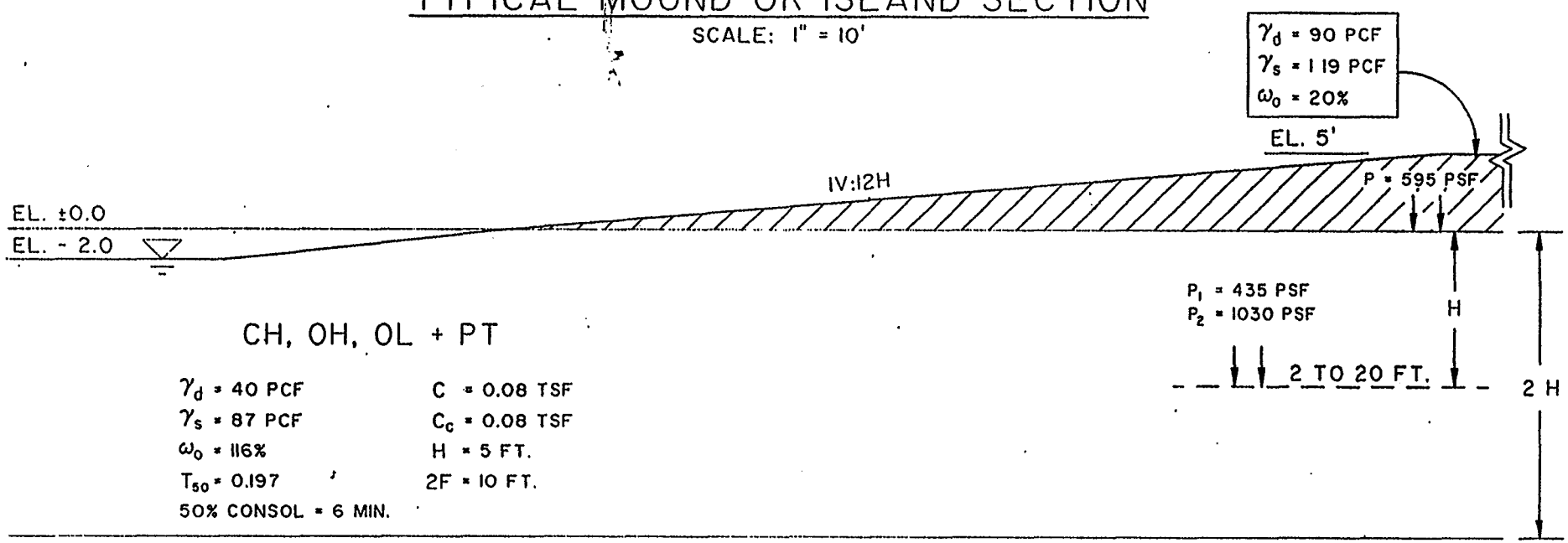
TYPICAL MOUND OR ISLAND SECTION

SCALE: 1" = 10'



CH, OH, OL + PT

γ_d = 40 PCF	C = 0.08 TSF
γ_s = 87 PCF	C_c = 0.08 TSF
ω_0 = 116%	H = 5 FT.
T_{50} = 0.197	2F = 10 FT.
50% CONSOL = 6 MIN.	

(FOR 10 FT LAYER) $\rho_u = \frac{2H_1}{1+e_1} \cdot \frac{P_1 - P_2}{1/2\,(P_1 + P_2)} \cdot 0.435\, C_c$ = 10 INCHES

$$e_1 = \frac{G\gamma\omega V}{W_s} - 1 = \frac{2.6\,(62.4)\,(1)}{40} - 1 = 3.06$$

(FOR 10 FT LAYER) t YEARS $= \frac{T \cdot H^2}{C_v}$ = 8.35 YEARS

$$C_v = \frac{T_{50} \cdot H^2}{t_{50}} = 8.83 \times 10^{-4}\ \text{CM}^2 \text{ PER SECOND}$$

GRAPHIC SCALE

1" = 10' 0 5' 10' 20' 30'

GEOTECHNICAL BRANCH
SACRAMENTO DEEP WATER CHANNEL
PROSPECT ISLAND
TYPICAL MOUND OR ISLAND SECTION
U.S. ARMY CORPS OF ENGINEERS

FIG. 3

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