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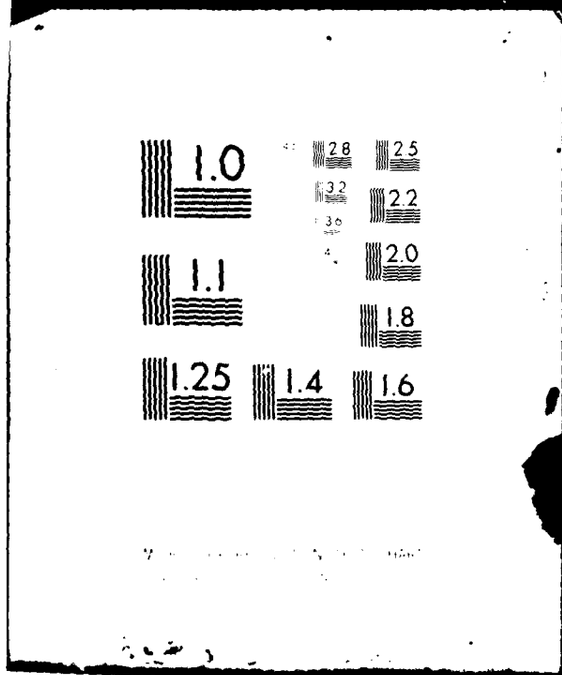

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LEVEL II

VOLUME I

SUMMARY & FINDINGS

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HUMBOLDT BAY WETLANDS REVIEW & BAYLANDS ANALYSIS

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U.S. ARMY CORPS OF ENGINEERS · SAN FRANCISCO DISTRICT

AUGUST 1980

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Volume Two is the data base which led to and supports the findings
Volume Three describes the detailed classification and mapping of habitat types

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Habitat		Biological	Economic	
Impacts		Land Use	Social	
Permits		Governmental		

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This study develops land and water classifications and criteria, based on evaluation of land values, functions, uses and potentials, which will allow rational, consistent and mutually understood decisions on preservation, enhancement, and development of the resources of Humboldt Bay; provides base information and a classification of the lands and waters of the study into categories based on resource values; identifies information gaps and recommends future studies to be done; establishes criteria on which management decisions can be based; will assist agencies in evaluating the impacts of

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20. ABSTRACT (Continued)

permit activities or projects on habitats of the study area; will assist regulatory agencies in determining whether a permit should be issued, issued with conditions, or denied, whether a specific permit request requires the preparation of a separate Environmental Statement or an Environmental Impact Report; and will also assist involved agencies in planning applicable siting and mitigating measures for developments which they are planning, or constructing. Bibliography and references.

FINAL

HUMBOLDT BAY WETLANDS REVIEW
AND
BAYLANDS ANALYSIS

Volume I

SUMMARY AND FINDINGS

Submitted to

U.S. Army Corps of Engineers
San Francisco District

Contract No. DACW07-78-C-0082

Prepared by

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August 1980

HUMBOLDT BAY WETLANDS REVIEW AND BAYLANDS ANALYSIS

The information, findings, and recommendations contained in this report are those of the consultant, Shapiro and Associates, Inc., and the consultant's subcontractors. The U.S. Army Corps of Engineers, for whom the study was completed, is fully aware of the number and complexity of regulations and legislative policies of local, state, and federal agencies with jurisdictional control over Humboldt Bay. Many of these regulations and policies, and the definitions used in them, emphasize different approaches and concerns of the different agencies. The study itself is long and in many ways complex, covering many different disciplines.

Therefore, it is our hope that agencies using the study for evaluation of permit applications or proposed projects or for planning purposes may use it as a guideline, understanding that the study findings are not regulations. Any proposed project or permit application must and should be evaluated individually and on a case-by-case basis.

It should be noted that the term "dike" is sometimes used in the document in place of the word "levee." The structures in question are protective barriers erected to reclaim wetlands and remove areas from aquatic action. As such, they are technically termed "levees." Permits for such structures are processed by the Corps under Section 10 of the River and Harbor Act of 1899 and/or Section 404 of the Clean Water Act. "Dikes" are processed under Section 9 of the River and Harbor Act, together with "dams."

TABLE OF CONTENTS

Volume I

SUMMARY AND FINDINGS

	Preface	xi
	List of Contributors	xii
	User's Guide	xiii
I.	INTRODUCTION	1
	Study Authority	2
	Importance of Wetlands	4
II.	SCOPE OF STUDY	6
	Study Purpose and Objectives	7
	Study Approach	7
	Study Assumptions	9
III.	STUDY AREA	14
	Overview	15
	Description of the Study Area	15
IV.	CORPS PERMIT AND PROJECT ACTIVITIES	17
	Corps Projects in the Study Area	18
	Corps Permit Applications in the Study Area	19
	San Francisco District Regulatory Program	20
	Permit Activities of Other Agencies	22
V.	FINDINGS IN HUMBOLDT BAY	26
	A. The Importance and Identification of Wetlands	28
	Importance of Wetlands	28
	Identification of Wetlands	28
	B. Areas of Importance and Areas of Environmental Concern	47
	Land and Water Categories	47
	Significance of the Designation	47
	Criteria for Designation	50
	Designated Areas	60
	Areas of Importance:	
	1. Mad River Dunes	65
	2. Mad River Slough	67
	3. Mad River Mill Pond	69
	4. North Bay	70
	5. Indian Island	73
	6. Woodley/Daby Islands	75

TABLE OF CONTENTS (continued)

Volume I (continued)

7. Bayside Wetlands 77
8. Eureka/Freshwater/Fay Sloughs and Wetlands 78
9. Eureka Gulches 80
10. North Broadway Wetlands and Intertidal Flats 82
11. South Broadway Wetlands 84
12. Elk River and Associated Wetlands 85
13. North Spit Wetlands 87
14. King Salmon Wetlands 89
15. Fields Landing Wetlands 91
16. South Bay 92
17. Jacoby Creek 94

Areas of Environmental Concern:

18. North Broadway Pocket Marshes 96
19. Mad River 98
20. Arcata Bottoms/Mad River 100
21. Arcata Bottoms West 102
22. Arcata Bottoms East 104
23. McDaniel Slough 105
24. Arcata Marsh and Oxidation Pond 107
25. Bayside Bottoms 109
26. Manila Dunes 111
27. North Spit, Beach, and Coast Guard Station 113
28. Eureka Bottoms 115
29. Eureka Waterfront 117
30. Martin Slough/Upper Fourth Gulch 118
31. Palco Marshes 120
32. Elk River Spit 121
33. Elk River Bottoms/Spruce Point 122
34. Entrance Bay/Buhne Point 124
35. South Spit 125
36. Beatrice Flats 126
37. Table Bluff 127

General Use Areas 128

C. Activities and Their Impacts 130

General Regulatory Policies 133
Dredging 136
Dredged Material Disposal, Fill, Dikes, and Levees 139
Piers and Docks, Pilings, Dolphins 142
Shoreline Stabilization Structures 144
Breakwaters 147
Marinas 149
Aquaculture 151
Canals and Ditches 153
Overhead Cables/Aerial Crossings 155

TABLE OF CONTENTS (continued)

Volume I (continued)

	Cables and Pipelines	156
	Outfall Structures	158
	Urban Development	160
	Agriculture	163
	Bridges, Roads, Causeways	165
D.	Development Pressure and Compensation/ Mitigation in the Humboldt Bay Study Area	167
	Development Pressure	167
	Compensation and Mitigation	173
E.	Information Needs	182
F.	Summary of Base Information	190
	Physical and Biological Profiles	190
	Land Use, Policy, and Cultural Profiles	194

List of Plates

1	Geography	16
2	Findings	48
10	Habitat Types	191
14	Land Use 1978	195

List of Figures

IV-1	Permit Review Process Flow Chart	21
V-1	Potential Wetlands Restoration and Recreation Sites	179
V-2	Land Use Changes Over Time	198

List of Tables

V-1	Biological Characteristics of Habitat Types	192
V-2	Land Use Categories	196
V-3	Land Use Summary	194
V-4	Wetland Changes by Subarea Over Time	197
V-5	Agency Policies	203

TABLE OF CONTENTS (continued)

Volume II

BASE INFORMATION

	Preface	xi
	List of Contributors	xii
VI.	ENVIRONMENTAL PROFILES	1
	Physical Profiles	
	A. Geography	2
	B. Climatology	6
	C. Geology	12
	D. Geologic Hazards	20
	E. Mineral Resources	41
	F. Soils	44
	G. Tidal Characteristics	53
	H. Hydrology	64
	I. Currents and Circulation	70
	J. Bottom Sediments	99
	K. Water Quality	107
	Biological Profiles	
	L. Habitat Types	118
	M. Mammals	130
	N. Birds	144
	O. Fish	164
	P. Invertebrates	187
	Q. Reptiles and Amphibians	201
	R. Productivity	206
	S. Food Webs	223
	T. Nutrient Cycling	234
VII.	LAND USE AND GOVERNMENTAL PROFILES	242
	A. Land and Water Use	243
	B. Land and Tideland Ownerships	257
	C. Governmental Profile	266
VIII.	CULTURAL AND ECONOMIC PROFILES	340
	A. Cultural Profile	340
	B. Aesthetic Profile	362
	C. Economic Profile	375

TABLE OF CONTENTS (continued)

Volume II (continued)

List of Plates

3	Topography	3
4	Geology	13
5	Ground Failure Hazard Zones	29
6	Flood Hazards	36
7	Mineral Resources	42
8	Soils	45
9	Bottom Sediments	100
10	Habitat Types	119
11	Rare and Endangered Plants	129
12	Known Wildlife Habitat	143
13	Spawning Areas and Shellfish Beds	197
14	Land Use 1978	245
15	Ownership	258
16	Coastal Zone	288
17	Cities	303
18	Zoning	324
19	Special Districts	338
20	Archaeology/History	343
21	Existing Recreation	351
22	Potential Recreation	356
23	Refuges and Reserves	361
24	Aesthetics	371
25	Fisheries	385

List of Figures

VI-1	Location Map	4
VI-2	Seasonal Cycles of Air Temperature, Fog, and Precipitation	7
VI-3	Daily Precipitation in Eureka, California, October 1974 to March 1975	8
VI-4	Hourly Average Surface Winds (MPH) Percentage Frequency Occurrence	9
VI-5	Regional Geologic and Fault Map	16
VI-6	Preliminary Geologic Cross Section	18
VI-7	Epicenter Map	21
VI-8	Modified Mercalli Intensity Scale	23
VI-9	Common Types of Landslides	33
VI-9a	Shoreline Changes	40
VI-10	General Soils Map	46
VI-11	Mean Tide Curve, South Jetty	54
VI-12	Tide Gauges in Humboldt Bay	55
VI-13	Tidal Datum in Humboldt Bay	57
VI-14	Tidal Datum in Humboldt Bay with Respect to NGVD	58
VI-15	Co-tidal Lines for Humboldt Bay	60
VI-16	Historic Variations in Tidal Datums	61

TABLE OF CONTENTS (continued)

Volume II (continued)

VI-17	Historic Variations in Tidal Datums with respect to NGVD at Eureka	63
VI-18	Ebb Tide Pattern in Humboldt Bay	67
VI-19	Flood Tide Pattern in Humboldt Bay	68
VI-20	Seasonal Cycles of Temperature and Salinity Based on all Available Data	73
VI-21	Horizontal Variability of Salinity in the Main Channels of Humboldt Bay for October 1961 and February 1962	75
VI-22	Results of Model Dye Studies - Flood Tide	76
VI-23	Results of Model Dye Studies - Ebb Tide	77
VI-24	Circulation Pattern at Beginning of Flood	79
VI-25	Circulation Pattern at Middle of Flood	80
VI-26	Circulation Pattern at End of Flood	81
VI-27	Circulation Pattern at Beginning of Ebb	82
VI-28	Circulation Pattern at Middle of Ebb	83
VI-29	Circulation Pattern at End of Ebb	84
VI-30	Location of Illustrations in the Tidal Cycle	85
VI-31	Average Time for Pellets to Exit Humboldt Bay Model from Various Locations in Humboldt Bay	87
VI-32	Averaged Phosphate Values at Three Stations	108
VI-33	Averaged Silicate Values at Three Stations	109
VI-34	Temperature Throughout a Tidal Cycle	112
VI-35	Salinity Throughout a Tidal Cycle	113
VI-36	Average Dissolved Oxygen at Three Stations in Humboldt Bay	116
VI-37	Food Web for Estuary Ecosystem	227
VI-38	Forest Swamp Habitat	228
VI-39	The Estuarine Carbon Cycle	235
VI-40	The Phosphorus Cycle	238
VI-41	The Estuarine Nitrogen Cycle	239
VII-1	Land Use Changes Over Time	255

List of Tables

VI-1	Geologic Time Scale	14
VI-2	Humboldt Bay Fault Information	24
VI-3	Tidal Statistics in Humboldt Bay	56
VI-4	Predicted Differences in Time of High and Low Tides in Humboldt Bay	59
VI-5	Annual Peak Discharge for Jacoby Creek	65
VI-6	General Characteristics of Humboldt Bay	71
VI-7	Sediment Sources in Humboldt Bay	107
VI-8	Nutrient Concentrations for High and Low Tide	110
VI-9	Areal Extent of Habitat Type Areas by Subarea	120
VI-10	Summary of Results of Furbearer Survey	133

TABLE OF CONTENTS (continued)

Volume II (continued)

VI-11	List of Plants Known to be Eaten by Brush Rabbits on the North Spit of Humboldt County	137
VI-12	Water Associated Bird Census	146
VI-13	Food of Four Species of Puddle Ducks, Humboldt Bay	147
VI-14	Food of Six Species of Diving Ducks, Humboldt Bay	148
VI-15	Comparative Monthly Counts of Shorebirds Censused from Coastal Wetlands	152
VI-16	Humboldt Bay Fishes Known or Suspected to be Part of the Great Egret Diet	154
VI-17	Checklist of Finfish Found in Humboldt Bay	165
VI-18	Summary of Biological Information on Fish Groups	180
VI-19	Major Groups of Humboldt Bay Invertebrates	188
VI-20	Economically Important Shellfish Inside Humboldt Bay	195
VI-21	Net Primary Productivity of Various Ecosystems	208
VI-22	Net Primary Productivity of Various Plants from Terrestrial Habitats	211
VI-23	Peak Biomass Net Primary Productivity of Various Plants in Aquatic Tidal Habitat Type	216
VI-24	Estimated Range of Net Productivity for Habitat Types in Humboldt Bay	220
VII-1	Land Use Categories	243
VII-2	Land Use, Humboldt Bay Study Area, 1978	247
VII-3	Land Use, Humboldt Bay Study Area, 1969	248
VII-4	Land Use, Humboldt Bay Study Area, 1958	249
VII-5	Land Use, Humboldt Bay Study Area, 1948	250
VII-6	Land Use, Humboldt Bay Study Area, 1926	251
VII-7	Land Use, Humboldt Bay Study Area, 1903	252
VII-8	Land Use, Humboldt Bay Study Area, 1871	253
VII-9	Land Use by Year	246
VII-10	Wetlands Changes by Subarea Over Time	256
VII-11	Aggregated Zoning Categories	328
VIII-1	Adjusted Gross Income Levels for Humboldt County	348
VIII-2	Eureka Scenic Routes	365
VIII-3	Arcata Scenic Routes within the Coastal Zone	368
VIII-4	Type I and Type II Income Multipliers by Sector	377
VIII-5	Eight-Year Summary of Landings in Eureka	381

TABLE OF CONTENTS (continued)

Volume III

HABITAT CLASSIFICATION AND MAPPING
AND APPENDICES

	Preface	xi
	List of Contributors	xii
I.	BACKGROUND	1
	A. Introduction	2
	B. Authorities	2
	C. Purpose and Objectives	3
II.	CLASSIFICATION AND MAPPING	5
	A. Review	6
	B. Evaluation and Selection	8
	C. Methods	11
	D. Results	12
	Habitat Types	12
	Habitat Type Distribution and Areal Extent	27
	Endangered and Threatened Species	32
III.	WETLAND-UPLAND BOUNDARY	35
	A. Previous Research	36
	B. Discussion of Corps Regulations	38
	C. Application of Corps Regulations	42
	D. Methods	45
	E. Results	47
IV.	SUMMARY AND CONCLUSIONS	52

List of Figures

II-1	Generalized Relationship of Water and Wetland Habitat Types	17
III-1	Substrate Saturation as a Function of Elevation in a Tidal Wetland	39
III-2	Comparison of the Potential Effect of Upland Runoff on a Generalized Wetland Transect	49

List of Tables

II-1	Habitat Type Classification System	10
II-2	Comparison with Basic Habitat Classification with NWI Classification	25
II-3	Areal Extent of Habitat Types by Subarea	28

TABLE OF CONTENTS (continued)

Volume III (continued)

II-4	Habitat Type Key	30
II-5	Rare, Threatened, and Endangered Vascular Plants in the Humboldt Bay Area	34

APPENDICES

A.	BAY AND WETLAND POLICIES	A-1
	1. Chief of Engineers' Policy on Wetlands	A-1
	2. Executive Order No. 11988	A-3
	3. Executive Order No. 11990	A-7
	4. California Coastal Act	A-10
	5. U.S. Fish and Wildlife Service Wetland Definition	A-12
	6. Department of Fish and Game Working Definition of "Wetlands"	A-13
B.	STANDARD FORM - PERMIT APPLICATION AND CONDITIONS	B-1
C.	LEGISLATIVE AUTHORITY OF THE CORPS	C-1
	1. Direct Corps Authority	C-1
	2. Related Legislation	C-4
D.	CORPS REGULATIONS 33 CFR 320-329; 33 CFR 239	D-1
E.	TECHNICAL APPENDIX	E-1
	1. Table E-1, Common Plants of Humboldt Bay Area by Habitat Type	E-2
	2. Table E-2, Invertebrate Species of Humboldt Bay, California	E-5
	3. Table E-3, Changes in the Scientific Names of Invertebrates since their Inclusion in the Earlier Humboldt Bay Literature	E-14
	4. Table E-4, Mammals of the Humboldt Bay Area	E-16
	5. Table E-5, Birds of the Humboldt Bay Area	E-22
	6. Table E-6, Amphibians and Reptiles of the Humboldt Bay Area	E-38
	7. Methodology for Evaluation of Land Use fromm Aerial Photos	E-42
	8. Details of Physical Model Construction	E-49
F.	SUMMARY OF PUBLIC INPUT	F-1
G.	BIBLIOGRAPHY AND REFERENCES	G-1

PREFACE

This document is Volume I of the Humboldt Bay Wetlands Review and Baylands Analysis, prepared by Shapiro and Associates, Inc. for the San Francisco District, U.S. Army Corps of Engineers. The general study area is Humboldt Bay, California.

The complete report is in three volumes. Volume I contains the summary and findings of the study and includes the following: the study purpose, objectives, and assumptions; a description of the study area; a discussion of the importance of wetlands and a description of wetland types found in the study area; a designation of certain parts of the study area as Areas of Importance or Areas of Environmental Concern, with a discussion of the significance of the designation and a summary description of each area; a discussion of typical activities in the study area including impacts and legal/administrative processes; a summary of development pressure and an identification and discussion of areas appropriate for compensation, mitigation, and restoration; and an identification of gaps in knowledge of the area with recommendations for future studies. Volume I covers Sections I-V of the complete report. Volume I also contains a brief summary of the detailed data base presented in Volume II.

Volume II is the data base which led to and supports the findings. It is a review and discussion of known existing information on the physical, biological, land use, and sociocultural aspects of the study area. Volume II contains Sections VI, VII, and VIII of the complete report. Section VI is the environmental profile of the study area, covering physical characteristics (geography, geology and soils, geologic hazards, tidal characteristics, hydrology, physical oceanography, bottom sediments, and water quality), and biological characteristics (habitat types, fauna, ecological processes). Section VII covers land and tideland use, ownerships, and governmental agencies with interest and/or jurisdiction. Section VIII covers cultural characteristics (historical/archaeological resources, community structure, recreation, educational/scientific uses, refuges/reserves), aesthetics, and economics.

Volume III describes the detailed classification and mapping of habitat types (land cover) conducted as part of the study. The entire study area was classified and mapped from aerial color infrared photographs at a scale of 1:6000. Volume III discusses the following: the need for habitat classification and mapping; the definition and relevance of the Corps of Engineers jurisdictional boundary under Section 404 of the Federal Water Pollution Control Act Amendments of 1972 and the Clean Water Act of 1977; a review and discussion of various land cover classification systems and a description of the system used in this study; and a discussion of mapping results, accompanied by a set of maps at 1:6000 identifying land cover and tentatively delineating the wetland boundary and/or drift line. In addition, the Appendices, including the Bibliography, are found at the end of Volume III.

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USERS' GUIDE TO THE HUMBOLDT BAY WETLANDS REVIEW AND BAYLANDS ANALYSIS

The Humboldt Bay Wetlands Review and Baylands Analysis provides base information and methodology to be used in evaluating permit applications and the environmental effects of proposed activities and in land and water use management planning for the study area.

The study is organized to be useful to San Francisco District Corps personnel in reviewing permit applications and in planning projects; however, permit applicants and personnel of other agencies will also find the information and methods helpful. The permit process described in Section IV shows how a permit application is reviewed by San Francisco District and identifies the major criteria used in the review. In the Users' Guide a method for using the study in the assessment of the specific and cumulative impacts of proposed activities and the development of permit and activity conditions is presented, with specific potential activities in the study area as examples.

Should the user desire only generalized information, the following guide to the document may be used:

a) Define the proposed activity and its location:

Activity_____ Location_____

b) Go to Volume I, Section V, FINDINGS IN HUMBOLDT BAY.

c) Review the information on various activities contained in Section V.C.

d) Determine from Plate 2, Section V.B, if the proposed site is in an Area of Importance or Area of Environmental Concern.

e) If so, review the detailed description of the Area of Importance or Area of Environmental Concern (Section V.B).

f) From Plate 10, Section V-F or from the 1:6000 scale maps in Volume III, determine whether the proposed site involves Wetland Type (Section V.A). If so, review the detailed description of the Wetland Type.

g) If the proposed site is in an Area of Importance, Area of Environmental Concern, or Wetland Type, consult a San Francisco District representative for assistance and information if a Corps permit application is involved.

Every permit application submitted to the San Francisco District will be subject to review under Corps regulations. If a proposed activity is located in an Area of Importance, Area of Environmental Concern, or Wetland Type, this does not mean that the permit application will automatically be denied.

ACTIVITY IMPACT ASSESSMENT

A simple method for quickly assessing the environmental impacts of proposed Corps permit activities in a given location is included below as part of the USER'S GUIDE. The method allows the evaluator to predict the specific and cumulative impacts of a proposed activity in a particular habitat given the dimensions of the activity and the characteristics of the habitat. It is designed to function as a desk-top analysis to allow the evaluator to assess the relative value of a wetland and the potential encroachment of the activity on the wetland's value and functional characteristics.

This approach to impact assessment is a "red flag" mechanism to separate proposed permit activities with minimal impact from those which cause more significant adverse impacts. The method should provide key input for the decision on whether an EIS on the proposed activity is necessary. It should provide the evaluator with a means of assessing the public interest.

The method sets up a framework for the assessment of wetland or habitat values using the criteria for natural functional importance and the ancillary criteria as discussed in Section V.C. The proposed activity is then evaluated in terms of its effect on the natural functional characteristics and the ancillary characteristics. The severity and significance of the effects of the activity are considered by describing the INCIDENCE, MAGNITUDE, and DURATION/TIME. DURATION/TIME assesses when and for how long an effect is expected to persist. INCIDENCE relates to a determination of what significant effect is occurring and where. MAGNITUDE addresses the question of how much of an effect, measured in absolute units (acres, cfs) or as a relative proportion (percent increase or decrease).

An activity or use shows a series of effects which can be divided into four categories of causative elements:

- Construction activities
- Physical presence of a structure
- Operation activities
- Cumulative effects and secondary effects

Cumulative effects are defined as both the loss of wetlands and habitat acreage in comparison to the remaining amount acreage of wetlands habitats of various types in the bay and as the additive effects of activities of the same type or with similar impacts. Secondary activities, which indirectly result from the implementation of the proposed activity, should be identified for each proposed activity and their impacts listed.

In general, construction activites and associated effects are viewed as short-term, while the physical presence of structures, operation, and cumulative effects are considered long-term. The mode of operation, however, may be seasonal, with short-term effects while the operation is on-going but with no significant long-term consequences.

As part of the permit application evaluation, in addition to impact assessment, Corps reviewers must also consider the need for the proposed activity, whether the activity is dependent on being near or in the aquatic environment, and whether feasible alternative sites are available. (These factors are not addressed here.)

The approach to impact assessment of a proposed activity in a given location is shown in the following example. The example involves several arbitrary assumptions which are made purely for their illustrative value; these are identified where they occur. The activity and its hypothetical location chosen for the example is related to outer continental shelf (OCS) development of oil resources. The choice of both activity and location was made by Shapiro and Associates, Inc. in coordination with Humboldt County Local Coastal Program planners and North Coast Regional Coastal Commission staff. PLEASE NOTE THAT THIS IS AN EXAMPLE ONLY AND IS NOT ACTUALLY A PROPOSED PERMIT ACTIVITY.

EXAMPLE

Titles which are underlined and in bold type are steps in the methodology. Notes in brackets and bold type are procedures to be followed. (A) means an assumption has been made for illustrative purposes.

a. **Proposed Activity**: **[Fill in the proposed activity's title and purpose.]** A permanent service base to provide onshore logistical support and services during the development of OCS resources. A permanent service base may serve one or several oil drilling and production platforms.*

b. **General Location**: **[Give the general location of the area.]** In the area just east of the King Salmon residential development and just west of Highway 101, near and around the existing oxidation ponds. The area includes mudflats and wetlands.

c. **Activity Characteristics**: **[Describe the general characteristics of the proposed activity, using the material given in the application and supplemented by the applicant, if necessary. Wherever possible, discuss both the construction and operation phases of the project.]**

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*The information on permanent service base requirements was obtained from a report entitled Anticipating and Planning for the Impacts of OCS Oil and Gas Development, sponsored by the Resource and Land Investigations Program, U.S. Department of the Interior, available from the American Society of Planning Officials, 1313 East 60th Street, Chicago, Illinois 60637.

Activity Requirements:

1) Land	25-50 acres on all-weather harbor (assume 30 acres of fill); 10,000 sq. ft. for permanent office and communications space; 1 acre per platform for helipad; remainder for warehouses and open storage
2) Waterfront	200 ft. of wharf per platform; 15-20 ft. water depth at pier.
3) Water	8.2 million gallons/platform/year during development drilling. Little during production.
4) Fuel	54,000 barrels of fuel/platform/year during development; 19,200 barrels of fuel/platform/year during production.
5) Labor	50-60 jobs/platform during drilling; 50% local iniitially, rising to 80% local.
6) Wages	Approximately $1 million; average wage $17,000.
7) Capital Investment	$1-3 million
8) Transportaiton	Good road and/or rail access

Other Characteristics of the Activity:

1) **[General description of construction and operation activities.]** The activity involves both construction and operation of the facilities. During construction, dredging of the mudflats, filling in wetlands, dredged material disposal, and possibly pile driving will be necessary (A). Breakwater construction may be required (A). Facilities and operations include fuel storage, vehicle operations, helicopter landing, shipping/docks, fuel transport, water transport, possible pipelines, fuel use, road/rail use, boat traffic.

2) Duration: **[Describe length of time the activity construction and operation will take.]** About 5 years for the OCS development phase; the actual construction of the permanent service base might not take more than one or two years (A). The facilities would operate for 10-25 years or more.

3) Incidence: **[Describe types of significant activities and effects which will occur.]** In the construction phase, dredging, filling, disposal, pile driving, and destruction of intertidal flats and wetlands habitats will occur.

4) Magnitude: **[Describe how much of an effect there will be.]** Approximately 10 acres of intertidal flat will be dredged (A)

and about 30 acres of marsh will be filled (A) during construction of the base. A total of 40 acres will be affected.

5) Long-term/Short-term: **[Describe length of time that effects will continue.]** Placing of fill is irreversible and constitutes a long-term disruption of habitat. **[Make appropriate conclusions for other activities such as dredging, disposal, etc.]**

d. **Exact Location:** **[Using the detailed habitat maps (from Volume III) and the project site plans submitted by the applicant, locate the proposed activity boundaries as exactly as possible.]** The proposed project is located in the area south of the road to Buhne Point, east of the King Salmon Channel, and west of Highway 101. It will not affect the existing sewage treatment facilities.

e. **Habitat Types Affected:** **[Identify from the 1:6000 habitat type maps (Volume III) the habitat types affected by the proposal.]**

1) Intertidal Flat (M)
2) Salt Marsh, Cordgrass (SM_1)
3) Salt Marsh, Pickleweed (SM_2)
4) Brackish Marsh, Hairgrass (BM_2)
5) Brackish Marsh, Rushes (BM_3)
6) Shrubland (S)
7) Tidal Creeks and Sloughs (Ws)

f. **General Value of Area:** **[Check the Findings (Plate 2) to see if the proposed activity is located in an Area of Importance (AOI) or Area of Environmental Concern (AEC), Section V.B.]** It is in an Area of Importance, #14, King Salmon Wetlands.

g. **General Value of Habitats:** **[Check Section V.A to see if the habitat types identified in (e) above are Wetland Types (WT).]** All the habitat types identified in (e) above, except Shrublands, are wetland types.

h. **Characteristics of Area and Habitats:** **[If the proposed activity is in an AOI, AEC, or WT, review the characteristics of the area discussed in the area-specific description (Sections V.A and V.B). In this case, the evaluator would review the following in Volume I, Sections V.A and V.B:**

- **Area of Importance #14, King Salmon Wetlands.**
- **Wetland Types including Salt Marsh, Brackish Marsh, Intertidal Flats, and Water.**

The purpose of this review is to familiarize the reader with the significant natural functional and ancillary characteristics of the area.]

i. Acreage Affected by Proposed Activity: [Determine the total acreage of the AOI and the wetland/habitat acreage which will be affected by the proposed activity as follows: Total acreage and wetland acreage in area from AOI description. Total acreage of wetland types in estuary from Table V-1, Volume I. Note that intertidal flats and tidal creeks and sloughs in the AOI/AEC descriptions must be totaled and compared against the total of intertidal flats, eelgrass, and water habitats in Table V-1. For some wetland types, it is best to work at a less detailed level than the most detailed in the classification scheme. For example, here SM_1 amd SM_2 are combined. The total acreage affected and the acreage of each wetland/habitat affected are determined from the magnitude of the activity (c. Activity Characteristics above) and any maps or locational drawings submitted by the permit applicant.]

Area of Importance, King Salmon Wetlands:

Total acreage in AOI	115
Amount affected by activity	40 (35%)
Amount remaining	75 (65%)

Wetland Types:

1) Intertidal Flat, Tidal Creeks and Sloughs

Total acreage in AOI	36.5
Amount proposed for activity	10 (27% of AOI total)
Amount remaining	26.5
Total in study area	about 10,000
Amount proposed for activity	0.1% of total

Note: the tidal creeks will be used as drainage areas; they will not be filled or diverted (A).

2) Salt Marsh, Cordgrass, and Pickleweed (SM_1, SM_2)

Total acreage in AOI	8.2
Amount proposed for activity	8.2 (100% of AOI total)
Amount remaining	0
Total in study area	970
Amount proposed for activity	0.8% of total

3) Brackish Marsh, Hairgrass and Rushes (BM_2, BM_3)

Total acreage in AOI	40.5
Amount proposed for activity	22 (54% of AOI total)
Amount remaining	18.5
Total in study area	253
Amount proposed for activity	8.6% of total

Note: this is the largest single parcel of brackish marsh in the study area.

4) Shrubland

Total in AOI	2.1
Amount proposed for activity	2.1 (100% of AOI total)
Amount remaining	0
Total in study area	342
Amount proposed for activity	0.6% of total

j. **Specific Impacts of the Proposed Activity**: **[Assess the effects of the proposed activity on the natural functional characteristics and ancillary characteristics of the area and habitat types in terms of incidence, magnitude, and duration. The assessment is most easily done if the impacts of the various activities such as dredging or filling are assessed separately. Use the general impact descriptions in Section V.C, supplemented by specific data at level of analysis desired (where available). Use the specific area descriptions (Sections V.A and V.B) to determine the existing characteristics where possible. If area is one for which there is no specific description, then information on physical and biological characteristics of habitat types may be found in Section VI and data on ancillary characteristics is in Section VII. The analysis should proceed in the order laid out in Section V.B (Criteria). Both beneficial and adverse impacts should be noted. Examples of assessment are shown for the characteristics of effects of filling and dredging on natural biological functions, general preservation policies, and specific local policy (Section V.B).]**

1) **EXAMPLE:** Natural Biologic Functions; Effects of Filling and Dredging

- The AOI: 40 acres valuable as feeding grounds for herons, egrets, and shorebirds will be destroyed by dredging and filling. The area is not an isolated unit; it already has some urban development. 30 acres of highly productive salt and brackish marsh will be destroyed by fill. Detritus export to the Bay will be

reduced. The 30 acres of fill may affect the tidal creeks and/or change the drainage characteristics in their vicinity, thereby leading to changes in detritus export from the upstream portions of these creeks. Erosion from the fill could affect the unfilled areas and intertidal flats. Initial dredging and the need for maintenance dredging in the intertidal flats could mean turbidity, changes in local hydraulics, possible chemical effects if the intertidal flats contain any buried toxic materials, and destruction of habitat and aquatic fauna.

- Intertidal Flat: 10 acres of this habitat type, representing 27% of the type in this AOI, will be destroyed by dredging; however, this is a very small percentage of this habitat type in the study area. The intertidal flats are used by shorebirds and such use would be eliminated in the dredged area.

- Salt Marsh (SM_1, SM_2): 8.2 acres, representing all the salt marsh in this AOI, would be destroyed by filling. The salt marsh is highly productive and a source of detritus export to the adjacent intertidal flats; this function would be lost. Any runoff filtration function performed by this habitat type would be eliminated. Use by herons, egrets, and shorebirds would be reduced. The 8.2 acres represents only 0.8% of the total amount of salt marsh in the study area.

- Brackish Marsh (BM_2, BM_3): 22 acres of the largest single parcel of this habitat type in the study area, representing 54% of the total type at this location, would be destroyed by filling. The 22 acres is 8.6% of this habitat type in the entire study area. The marshes are highly productive, but because of the old levees, the production is only exported during flooding situations. Filling will destroy productivity and possibly export of detritus of upstream origin if the tidal creeks and sloughs are affected. Feeding grounds for herons, egrets, and shorebirds will be lost. Any runoff filtration function performed by these marshes will be eliminated.

[Include other habitat types as necessary]

2) **EXAMPLE:** General Preservation Policies

- Because much of the area affected by the proposed activity is highly productive wetlands, its destruction by filling would be in opposition to expressed federal and state policies.

3) EXAMPLE: Specific Local Policy

- The Eureka General Plan shows the location of the proposed service base as designated for industrial use. The service base would thus be in keeping with the Eureka General Plan.

[Other impacts associated with the proposed activity, such as emission of air pollutants, noise, increased storm water runoff, etc., should be described briefly here.]

k. Summary of Specific Impact Potential: **[Summarize and judge level of specific impacts on natural functional characteristics and Ancillary characteristics. Describe impact potential as low, medium, high, and list most important reasons.]** The impact potential of the proposed 10-acre dredging and 30 acre fill on King Salmon Wetlands is high, because of the following:

1) The complete destruction of 40 acres of highly productive salt and brackish marshes and intertidal flats, representing 35% of the AOI and 8.6% of the brackish marsh habitat type in the study area.

2) The loss of habitat providing detritus export to the Bay.

3) The loss of feeding areas for heron, egret, and shorebirds.

4) (Other natural functional characteristics)

5) Inconsistency with general wetland preservation policies of federal and state agencies.

6) Consistency with the Eureka General Plan (local policy).

7) (Other ancillary characteristics affected)

8) (Other impacts listed; e.g., air quality, noise)

l. Cumulative Impacts; Loss of Wetlands: **[Review other active permit applications to determine acreage proposed for the same activity (or resulting in the same loss) and the areas and habitat types affected. Find the total amount of existing acreage of these habitats (Table V-1, Volume I) and the acreage lost if all pending permits were issued. These figures should indicate the cumulative effects of the proposed activity and other activities resulting in loss of wetlands.]**

1) Acreage proposed for this fill 30 acres

2) Other active permit applications which would result in loss of wetlands by fill (A)

(Name<s>)	Total wetland area	89 acres
	Brackish Marsh (BM_1, BM_2, BM_3)	80 acres

3) Total loss of wetlands if all permits issued 119 acres

4) Total wetlands (marsh, swamp) in study area, 1978 1,590 acres

5) Percent of total wetlands lost 7.5%

6) Total loss of Brackish Marsh, if all permits granted 102 acres

7) Total Brackish Marsh in study area, 1978 253 acres

8) Percent of total Brackish Marsh lost 40.3%

m. **Summary Statement of Loss of Wetlands:** If all permits for which applications have been made are granted, 7.5% of the study area wetlands will be lost. The proposed activity represents 30 acres of the 119 acre total (25%). Forty percent (40%) of the brackish marsh habitat in the study area would be lost; these marshes are highly productive and generally more diverse than salt marshes and usually support a diverse faunal population. The proposed activity represents 22 acres of the 102 acre total (22%)

n. **Cumulative Impacts; Additive Effects:** [Determine baseline conditions of environmental factors likely to be affected by the proposed activity. Review other activities and active permit applications to determine where other similar activities or activities with similar impacts are occurring. Qualitatively assess the likelihood of significant additive impacts. An example is shown for noise impacts.]

1) Environmental Factor: Noise affecting residential areas.

2) Baseline Condition: The King Salmon Wetlands are near residential areas on Buhne Point and in Fields Landing. These areas are presently rather quiet (A).

3) Proposed Activity: Permanent service bases are in operation 24 hours a day and generate considerable noise (up to 85 decibels). Noise sources include power tools, air

compressors, pumps, industrial trucks, cranes, and compressed air machinery. Boat traffic may also be a noise source.

4) Other Active Permit Applications:

Name	Location	Activity	Impacts
(Assumption only)	Fields Landing, south of King Salmon Wetlands	Marina for small recreational boat	Motor boat noise affecting residential areas at Buhne Point and Fields Landing

o. **Summary Statement of Additive Effects**: One permit application for an activity possibly resulting in noise impacts on residential areas at Buhne Point and King Salmon is pending; the location is in the same general area as the proposed service base. There is a potential for significant noise impacts from the additive effects of these two proposals (A).

p. **Secondary Activities and Impacts**: **[Determine allowed uses in the area from the description of development pressure in the area--specific descriptions (Section V.B), general development pressure (Section V.D) and agency plans and policies (Section V-F and Section VII, Volume II). List possible or likely secondary activities and general impacts.]**

1) Development Pressure: Medium because of the proximity of the navigation channel and other development and because of local and state policy.

2) Allowed Uses (under present zoning): Parts of the area are zoned for industrial and commercial development.

3) Possible Other Uses: Energy and/or port facilities and commercial fishing marinas, aquaculture, coastal-dependent industry (all specifically allowed in wetlands by the Coastal Act), passive recreation, educational/scientific study (incompatible with intensive development).

4) Secondary Activities and Impacts: Commercial and industrial development supporting the service base could occur in the surrounding area. Residential development could be stimulated (although permanent service bases generally hire 80% of staff from the local area). Impacts of new development would include increased storm water runoff and potential water quality problems, additional traffic and noise, further loss of wildlife habitat and wetlands and so on.

q. **Is an EIS on the Proposal Indicated?**

_____Yes _____No

The decision as to whether an EIS would be necessary on this proposed activity is not made here. It is a question of judgment, which would be made by the Corps of Engineers or other responsible agencies, considering not only the information and guidance contained in this study, but also the significance of the impacts in relation to project benefits, degree of water-dependency and alternative sites, and the public interest. This study outlines the framework and basic information that provides key input with which to make that judgment. Supplemental information may be developed in much more detail from references on activity characteristics. (For example, one could compute increased runoff volumes due to the fill and examine drainage characteristics in more detail.)

The above example is meant to show how a reader and/or a reviewer of permit applications or other potential activities in the study area could use the data and maps of this study to assess the effects of activities on the important areas, wetlands, and habitats of the Humboldt Bay area. The environmental impact assessment using the above method can be as simple or as complex as the individual reader requires.

Section I

INTRODUCTION

Section I

INTRODUCTION

The introduction describes the legal and regulatory authority under which the San Francisco District, Corps of Engineers has conducted the Humboldt Bay Wetlands Review and Baylands Analysis and presents national policy affirming the importance of wetlands.

STUDY AUTHORITY

The San Francisco District, U.S. Army Corps of Engineers, has long-established responsibilities in the Humboldt Bay including the following:

- The regulation of private and public activities in or upon the navigable waters (or waters of the United States) and adjacent wetlands of the Humboldt Bay and its tributaries under provisions of Section 10 of the River and Harbor Act of 1899 (33 USC 403) and Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500, FWPCA; 33 USC 1344) as amended by Section 404 of the Clean Water Act (CWA) of 1977 (PL 95-217; 33 USC 1344). The regulation is essentially a permitting function; permits for dredging, filling, moorage, and other activities must be obtained from the San Francisco District pursuant to Corps regulations 33 CFR 320-329.

- The operation and maintenance of deep draft navigation facilities, including entrance jetties and dredged navigation channels within the Bay. The Corps has performed such construction and maintenance work over about the last 100 years.

- The preparation of feasibility studies of potential federal projects in the area (when authorized by Congress and/or the Chief of Engineers), including such studies as led to current navigation-channel deepening and an on-going study of deepening the Fields Landing Channel to Fields Landing (under the River and Harbor Act of 1960, Section 107).

The authority for conducting the Humboldt Bay Wetlands Review and Baylands Analysis is two-fold. First, under a Resolution of the Committee on Public Works, U.S. House of Representatives, 11 April 1974, the San Francisco District is to develop data necessary for determination of the best and most compatible economic, environmental, and social uses of the Humboldt Bay area. Such data includes inventories of uses and conditions, surveys of governmental jurisdictions, evaluation of lands and wetlands for single and multiple uses, and other data needed for coordinated planning at federal, state, regional, and local levels. Second, under Corps regulations 33 CFR 320-329,

the District Engineer may conduct a wetlands review to provide an objective basis for wetlands management and the evaluation of permit requests for development activities in wetlands of the study area.

Under the authorities cited above, the San Francisco District, Corps of Engineers, has conducted this study of lands and associated aquatic resources of the Humboldt Bay Study Area that serve important purposes relating to fish and wildlife, recreation, water quality, and other elements of the general public interest. In general, this study has identified wetlands as they are defined under Executive Order (EO) 11990 (see Importance of Wetlands below):

> *The term 'wetlands' means those areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mudflats, and natural ponds.*
>
> (EO 11990, 1977)

The authority of EO 11990 relates specifically to the actions of federal agencies. As mentioned, the Corps also implements regulatory authority under Section 404 of CWA. This authority relates to all activities in waters of the United States and adjacent wetlands under Section 404 regulations.

> *The term 'wetlands' means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.*
>
> (33 CFR 323.2(c))

The principal difference between the two definitions is that EO 11990 specifically includes unvegetated intertidal flats (mudflats), while 33 CFR 323.2(c) does not. Thus, the EO 11990 "wetland" definition was used primarily throughout this study.

In contrast to EO 11990, however, Corps regulations (33 CFR 320-329) provide detailed supporting guidelines for identifying wetlands boundaries and determining wetland values. These guidelines were used extensively to assist in the delineation of wetlands boundaries (see Volume III) and to evaluate the various wetlands identified within the study area.

Under Corps regulations a general policy for evaluation of permit applications indicates that "no permit will be granted unless its issuance is found to be in the public interest" (33 CFR 320.4(a)). Factors of the public interest include the conservation and preservation of wetlands, fish and wildlife resources, water quality, and historic, scenic, and recreational values (33 CFR 320.4(b)-(3)). Further, under Corps regulations 33 CFR 320.4(b)(4), no permit will be granted for work in wetlands identified as important under 33 CFR 320.4(b)(2) unless the benefits of the proposed work outweigh the damage to the wetlands resource and the proposed alteration is necessary to realize those benefits. Under 33 CFR 320.4, the interrelated nature of wetlands and the cumulative effects of numerous piecemeal alterations of wetlands that may result in a major impairment of the wetlands resource must be evaluated. The Corps criteria for identification of wetlands important to the public interest (33 CFR 320.4 (b)) are central to the identification and evaluation of wetlands made in this study (Section V.B.).

IMPORTANCE OF WETLANDS

The Chief of Engineers' Policy on Wetlands emphasizes the importance of wetlands as a public resource. The policy is contained in its entirety in Appendix A; parts of it are reprinted here.

Chief of Engineers' Policy on Wetlands:

a. Wetlands are vital areas that constitute a productive and valuable public resource, the unnecessary alteration or destruction of which should be discouraged as contrary to the public interest.

b. Wetlands considered to perform functions important to the public interest include:

   1) Wetlands which serve important natural biological functions, including food chain production, general habitat, and nesting, spawning, rearing and resting sites for aquatic or land species;

   2) Wetlands set aside for study of the aquatic environment or as sanctuaries or refuges;

   3) Wetlands the destruction or alteration of which would affect detrimentally natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns, or other environmental characteristics;

   4) Wetlands which are significant in shielding other areas from wave action, erosion, or storm damage. Such wetlands are often associated with barrier beaches, islands, reefs and bars;

5) Wetlands which serve as valuable storage areas for storm and flood waters;

6) Wetlands which are prime natural recharge areas. Prime recharge areas are locations where surface and groundwater are directly interconnected; and

7) Wetlands which through natural water filtration processes serve to purity water.

.....

d. No construction activitiy will be performed in wetlands identified as important by subparagraph b, above, unless the District Engineer concludes that the benefits of the proposed alteration outweigh the damage to the wetlands resource and the proposed alteration is necessary to realize those benefits. In evaluating whether a particular alteration is necessary, the District Engineer shall consider whether the proposed activity is primarily dependent on being located in, or in close proximity to, the aquatic environment and whether feasible alternative sites are available. The District Engineer must demonstrate the need to locate the proposed activity in the wetland and must evaluate the availability of feasible alterantive sites.

.....

The Chief's policy is virtually the same as found in Corps regulations 33 CFR 320.4. It is this regulation under which all permit applications for work in wetlands are reviewed. The emphasis on wetlands as vital areas constituting a valuable public resource indicates the importance given in Corps regulations to all wetlands.

Executive Order (EO) 11990, issued by President Jimmy Carter on 24 May 1977, reiterates the need to preserve and protect wetlands as a national policy. The President's statement accompanying EO 11990 emphasizes wetlands as vital natural resources of critical importance to the people of the country. EO 11990 orders federal agencies to minimize the destruction of wetlands and to preserve and enhance the values of wetlands in management of federal lands, construction, and programs. EO 11990 does not applv to the issuance of Corps permits for activities by private parties in wetlands on non-Federal property. EO 11990 and the President's statement are in Appendix A.

Executive Order 11988, also issued 24 May 1977, is an order to federal agencies to preserve the natural and beneficial values of floodplains in management of federal lands, construction, and programs. The President's statement accompanying EO 11988 emphasizes the special values of the floodplains adjoining the nation's waters and calls for active floodplain management. EO 11988 and the President's statement are in Appendix A. Corps regulations 33 CFR 239 for implementation of EO 11988 are in Appendix D.

Section II

SCOPE OF STUDY

Section II

SCOPE OF STUDY

Section II describes the purpose and objectives of the Humboldt Bay Wetlands Review and Baylands Analysis. The section also presents the study approach and methodology and discusses the assumptions made.

STUDY PURPOSE AND OBJECTIVES

The purpose of the Humboldt Bay Wetlands Review and Baylands Analysis is to begin to develop land and water classifications and criteria, based on evaluation of land values, functions, uses, and potentials, which will allow rational, consistent and mutually understood decisions on preservation, enhancement, and development of the resources of Humboldt Bay. The study provides base information and a classification of the lands and waters of the study into categories based on resource values. It identifies information gaps and recommends future studies to be done. It establishes criteria on which management decisions can be based. The study will assist personnel of the Corps and other federal, state, regional, and local agencies in evaluating the impacts of permit activities or agency projects on habitats of the study area. It will assist regulatory agencies in determining whether a permit should be issued, issued with conditions, or denied, and in determining whether a specific permit request requires the preparation of a separate Environmental Statement, which is required for Federal permits if it is determined that permit issuance would constitute "Federal actions significantly affecting the quality of the human environment", as defined in the National Environmental Policy Act of 1969, or an Environmental Impact Report as may be required by the State. The review will also assist the involved agencies in planning applicable siting and mitigating measures for developments which they are planning, or constructing.

STUDY APPROACH

To accomplish the purpose and objectives of the Humboldt Bay Wetlands Review and Baylands Analysis, the following approach was used:

1) An interdisciplinary team made up of representatives of many disciplines, including geology, botany, aquatic biology, terrestrial biology, ornithology, water quality analysis, plant ecology, hydrology, fisheries research, land use planning, and policy analysis was established. The team, together with supporting staff in environmental analysis and graphic design, laid out the technical design for the study and conducted the necessary research, synthesis, and evaluation.

2) The boundaries of the study area were defined (Section III). In general, the study area encompasses the waters of Humboldt Bay and its tributary creeks and sloughs and the lands surrounding the Bay to approximately the 20 foot contour. The Table Bluff area is included. The study area includes the mouth of the Mad River on the north and Table Bluff and Hookton Roads on the south. The eastern boundary generally runs south along Highway 101, Old Arcata Road, Myrtle Avenue, Eureka city limits, Elk River Road, Highway 101, and Old Highway 101 to the southern end of the study area. The study area boundary is shown in Plate 1. Most of the coastal zone is included in the study area; only a small portion east of Highway 101 around the Mad River and parts of Humboldt Hill and Pidgeon Point (above Ryan Slough) are not included.

3) A detailed work plan and Outline Report showing the tasks necessary to accomplish the study purpose and objectives was developed. For each task, the objective, process, and expected product were described in detail as part of the work plan. A draft Table of Contents for this document describing each section and what it would contain was also developed as part of the outline report.

4) The physical and biological (Section VI), land use and governmental (Section VII), and cultural and economic (Section VIII) profiles of the Humboldt Bay study area were based on study and synthesis of existing literature and data available through federal, state, and local agencies, colleges and universities, local citizens, and research papers. Each profile presents a picture of the Humboldt Bay Study area, designed to provide an understanding of the interactions, relationships, and existing conditions in the study area. The profiles in preliminary draft were provided to federal, state, and local agencies for informal review so that any gaps or inaccuracies in the base information could be corrected in the early stages of the study. The profiles were then revised in response to this informal review.

5) Based on profile findings, study area lands and wetlands were evaluated and recommendations for areas to be designated Areas of Importance or Areas of Environmental Concern were formulated. This was done as follows: the principal members of the study team individually delineated areas to be considered Areas of Importance or Areas of Environmental Concern based on criteria derived from the profiles and related to each member's specific

discipline. Each team member listed the specific criteria used in the judgment for each area. The team members then met and compared their delineated areas to determine the extent of agreement. Any delineated area for which every team member had supporting criteria was designated an Area of Importance (Section V.B). Areas which fulfilled all natural functional (physical and biological) criteria were also designated areas of Importance. Areas which only fulfilled some of the criteria were designated Areas of Environmental Concern (Section V.B). The criteria used in the selection process are summarized as Criteria for Natural Functional Importance (physical and biological) and Ancillary Criteria (public and land use) in Section V.B. The Criteria for Natural Functional Importance are a direct reflection of Corps policy as identified in 33 CFR 320.4.

6) Types of activities undertaken and proposed in the study area were determined from reviews of permits issued and of major proposals. Impacts of each activity were assessed and a recommendation for general suitability of activities in various parts of the study area was made. Activity criteria were developed from a review of permits and projects in the study area, from agency standards, and from general studies done elsewhere. [Note: In the final revisions to the report, the Corps directed that the recommendations on activity suitability and activity standards, guidelines, and conditions be deleted.]

7) Land use trends in the study area were determined using aerial photo interpretation and planimetry to quantitatively assess land use changes over time. These land use trends and the history of permit applications were used to assess development pressure in the study area (Section V.D). Areas suitable for use as compensation areas were identified and suggestions for implementation of compensation requirements were made (Section V.D).

8) Gaps in knowledge of the area were identified during data base development and recommendations for future studies to fill these gaps were made (Section V.F).

STUDY ASSUMPTIONS

The following assumptions were made by the Corps and the Contractor at the outset of the study:

a. It is a desirable national goal to maintain and improve the coastal environment of Humboldt Bay and vicinity and that adverse impacts associated with the destruction of wetlands and related areas should be avoided, where

there is a practicable altnerative. These goals are specifically applicable to Federally-undertaken, financed or assisted construction and improvements (as stated in Executive Order 11990 of 24 May 1977). They also are consistent with current Federal permit policies regarding construction by private interests and public agencies in wetlands and related areas, which state that wetlands are vital areas that constitute a productive and valuable public resource, the alternative or destructive of which should be discouraged as contrary to the public interest.

These goals are also generally shared by the State of California and its agencies and instrumentalities as demonstrated in various public laws, and implementing-agency policies.

b. It is a desirable national goal to encourage multiple resource management of Humboldt Bay to the extent that it does not adversely impact on wetlands and the coastal environment in general. Economic development, especially if it is marine-related, may be acceptable if stringent, specific standards and guidelines in the overall public interests are met.

c. The San Francisco District, U.S. Army Corps of Engineers, has a major navigation project in Humboldt Bay; a small project study is underway and there is the potential of future project studies within the Bay. Any future Corps and other Federal or Federally-assisted projects, with the exception of emergency work, will require wetlands evaluations and consideration of the need for separate environmental impact statements. The land and water classifications and criteria to be developed in this investigation will be applicable in any such evaluation and assessments.

d. Sufficient physical and biological data exists or can be extrapolated to provide a meaningful natural profile description of the Humboldt Bay study area. The only field studies undertaken were land use/land cover mapping from color infrared aerial photography at 1:24000 and 1:6000, ground-truth verification of aerial photo interpretations, and a visual/aesthetic characterization. The wetland/upland boundary and drift line were mapped as part of the land cover classification.

e. Stated policies of federal, state, regional, and local agencies are expressions of the public interest at the national, state, and local level, and further, that any

areas called out in agency policy as areas to be preserved from development are areas in which public interest is high.

f. Certain terms must be carefully defined for purposes of the study and used consistently through the report. These terms are listed and defined following:

1) Wetland: There are many definitions of *wetland*; six are listed here and others may be found in Appendix A. For purposes of this study, the EO 11990 definition, the first listed, has generally been used. However, the Corps 404 definition (33 CFR 323.2(c)) and its associated regulations have also been used since these provide more guidance both for the delineation of wetlands boundaries and for the evaluation of the natural functional importance of wetlands. As mentioned above, the differences between these two wetlands definitions principally concern the inclusion of unvegetated intertidal flats, and do not affect identification of the wetlands-uplands boundary.

> *The term 'wetlands means those areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mudflats, and natural ponds.* (EO 11990, 1977)

> *Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.* (Corps regulations 33 CFR 323.2(c))

> *...those areas that are inundated or saturated by surface or groundwater at magnitude, frequency, and duration sufficient to select a plant community that tolerates such permanent inundation, periodic inundation or prolonged near surface soil saturation during the growing season. Certain unvegetated areas are also*

considered wet lands...These include such living assemblages as coral reefs, oyster bars, and clam flats; areas essential to and functionally related to wetlands including fluctuation zones and some transition zones where the inclusion of such an edge is essential to maintaining the functional integrity of the wetland; shallows, and flats, generally near wetlands, that are valuable, defineable and where the food chain for the animal community is in part dependent on detrital export from the nearby wetlands. (Macomber, 1978)

Lowlands covered with shallow and sometimes temporary or intermittant waters...referred to as marshes, swamps, bogs, wet meadows, potholes, sloughs and river overflow lands. (Shaw and Fredine, 1956 (Circular 39))

...land where the water table is at, near or above the land surface long enough to promote the formation of hydric soils or to support the growth of hydrophytes. In certain types of wetlands, vegetation is lacking and soils are poorly developed or absent as a result of frequent and drastic fluctuations of surface-water levels, wave action, water flow, turbidity or high concentrations of salts or other substances in the water or substrate. Such wetlands can be recognized by the presence of surface water or saturated substrate at some time during each year and their location within, or adjacent to, vegetated wetlands or deep water habitats. (Cowardin, et al., 1977)

Naturally vegetated areas located between mean high water and the yearly normal maximum floodwater level. (Clark, 1974)

(See Section III.B, Volume III, for a discussion of the differences in wetlands definitions.)

2) Tidal Datum Planes: *A plane of reference for elevations, determined from the rise and fall of the tides"* (Marmer, 1951). Examples include mean high water, mean low water and mean tide level.

3) Habitat: *Place where a plant or animal normally lives, often characterized by a dominant plant form or physical characteristic* (Ricklefs, 1973).

4) Habitat Type: As used in this study, a vegetation community, or, in the case of unvegetated aquatic lands, a substrate type, or, in the case of urban lands, a use or activity.

5) Intertidal: *Bounded by the high and low water extremes of the tide* (Sverdrup, et al., 1942). The region between extreme lowest water (-3 feet MLLW) and extreme highest water (10.0 feet MLLW) in the study area.

6) Intertidal Flats: Broad mud and/or sand deposits at intertidal or slightly subtidal elevations.

7) Navigable Waters: *Those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce* (33 CFR 329.4).

8) Waters of the United States: *The territorial seas; coastal and inland waters, lakes, rivers and streams that are navigable waters of the United States, including adjacent wetlands; tributaries to navigable waters of the United States, including adjacent wetlands; interstate waters and their tributaries, including adjacent wetlands; and all other waters of the United States.* (33 CFR 323.2)

9) Productivity: The amount of organic matter that accumulates in growing plant or animal tissues and often expressed as a rate. Primary productivity is the organic material fixed by plants using sunlight and atmospheric carbon. Secondary productivity is the organic production of animals and saprobes which consume plants. Productive areas have high rates of productivity.

Other terms which are defined in 33 CFR 323.2 (Appendix D) include:

- Adjacent (33 CFR 323.2(d))
- Ordinary High Water (33 CFR 323.2(g))
- High Tide Line (33 CFR 323.2(h))
- Dredged Material (33 CFR 323.2(k))
- Fill Material (33 CFR 323.2(m))

Section III

STUDY AREA

Section III

THE STUDY AREA

OVERVIEW

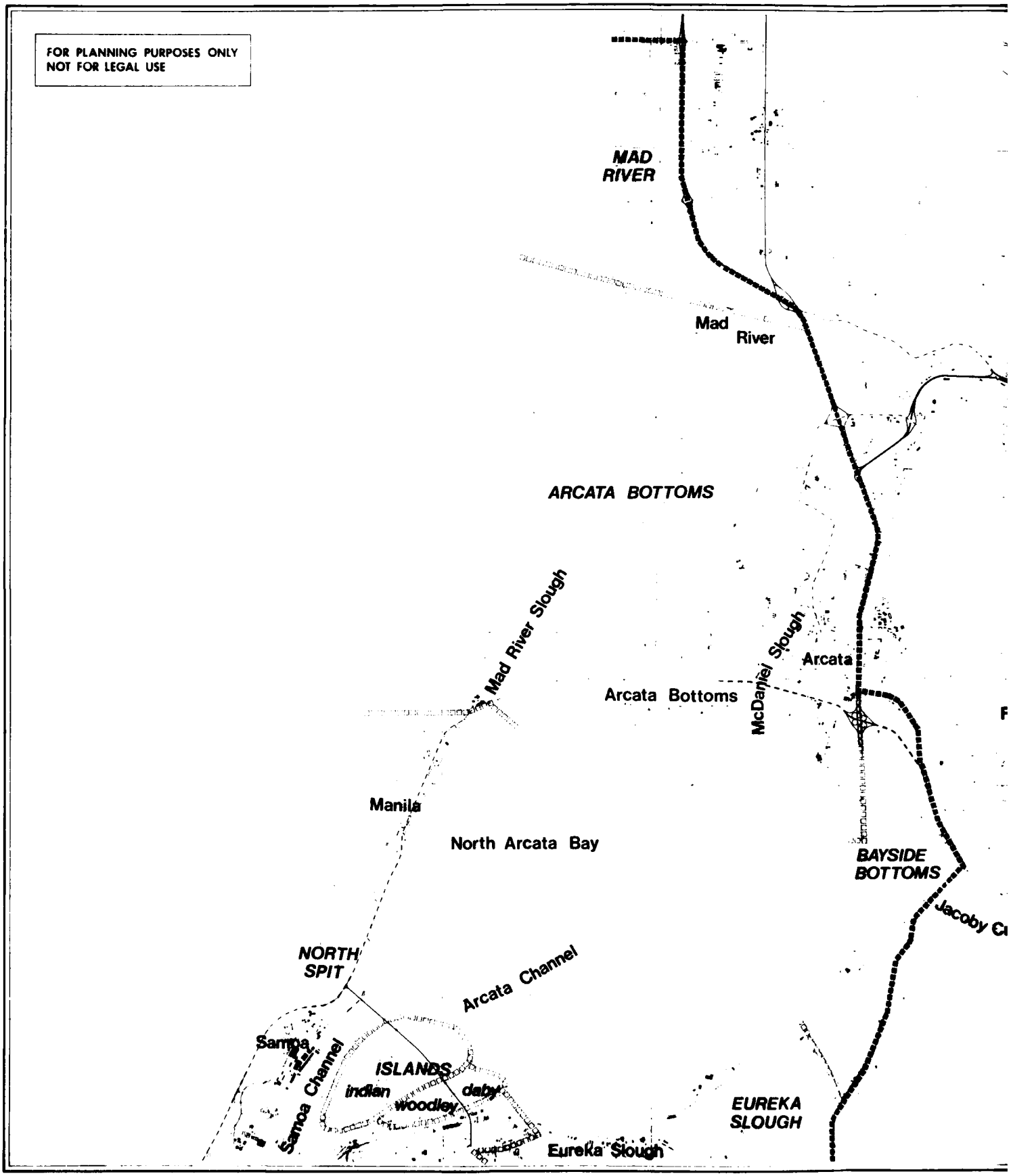
Humboldt Bay is located in Humboldt County on the coast of northern California, approximately 300 miles north of San Francisco. The Bay system consists of two large bays connected by a long narrow channel and separated from the ocean by two long narrow spits. The Bay is about 14 miles long and 0.5 to 4 miles wide; Humboldt Bay is the only deep water port between San Francisco and Coos Bay, Oregon. A more detailed description of the physical characteristics of the Bay and the study area can be found in the Geography Section (Section VI.A).

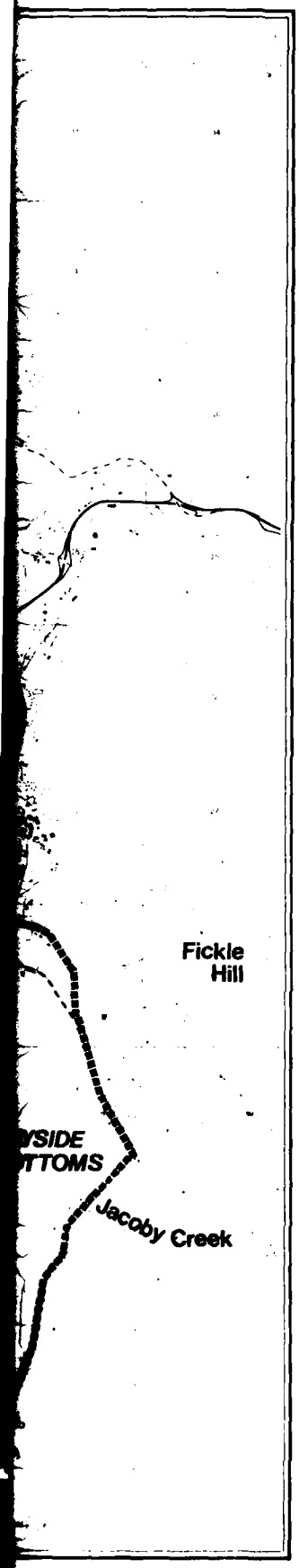
There are two major population centers adjacent to the Bay and several smaller communities. Eureka, with a population of 24,300, is the largest city on the North Coast and the county seat of Humboldt County. Arcata has a population of 9,000 and is the home of Humboldt State University. Small communities in the area include: Fields Landing, King Salmon, Bayside, Manila, Samoa and Fairhaven.

DESCRIPTION OF THE STUDY AREA

The study area includes the entire bay and surrounding lands up to at least an elevation of 10 feet above sea level, and the Mad River downstream of Highway 101 (Plate 1). From the northern boundary at Murray Road, the study area is bounded on the east by Highway 101 from McKinleyville to Arcata, and by the old Arcata Road to Eureka. South of Eureka Slough most of Eureka is included in the study area, as is the Elk River and its floodplain up to an elevation of 10 feet. From King Salmon south, old Highway 101 serves as the study area boundary to the Hookton Road. The Hookton and Table Bluff Roads serve as the southern boundary. The mean lower low water datum on the west side of the north and south spits is the western boundary.

The study area is made up of uplands, aquatic areas, and intertidal lands. Uplands includes all land not inundated by the tide. Included within this definition are the diked floodplains of Jacoby Creek, Eureka Slough, Elk River and Salmon Creek (which would be inundated if there were no dikes). Intertidal lands are those areas with an elevation between extreme low water (approximately -3.0 feet MLLW) and extreme high water (approximately 10.0 feet MLLW at Eureka). The aquatic area encompasses all the waters of the area; this includes the bay waters and the river and creek waters, from the mouth to 10 foot elevation.


FOR PLANNING PURPOSES ONLY
NOT FOR LEGAL USE
MAD RIVER
Mad River
ARCATA BOTTOMS
Mad River Slough
McDaniel Slough
Arcata
Arcata Bottoms
Manila
North Arcata Bay
BAYSIDE BOTTOMS
Jacoby Cr
NORTH SPIT
Arcata Channel
Samoa
Samoa Channel
ISLANDS
indian
woodley
daby
EUREKA SLOUGH
Eureka Slough



GEOGRAPHY

PLATE NO 1 NORTH

LEGEND

■■■■■ Study Area Boundary

□□□□□ *Land Use Subarea Boundary*

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HUMBOLDT BAY WETLANDS REVIEW
&
BAYLANDS ANALYSIS

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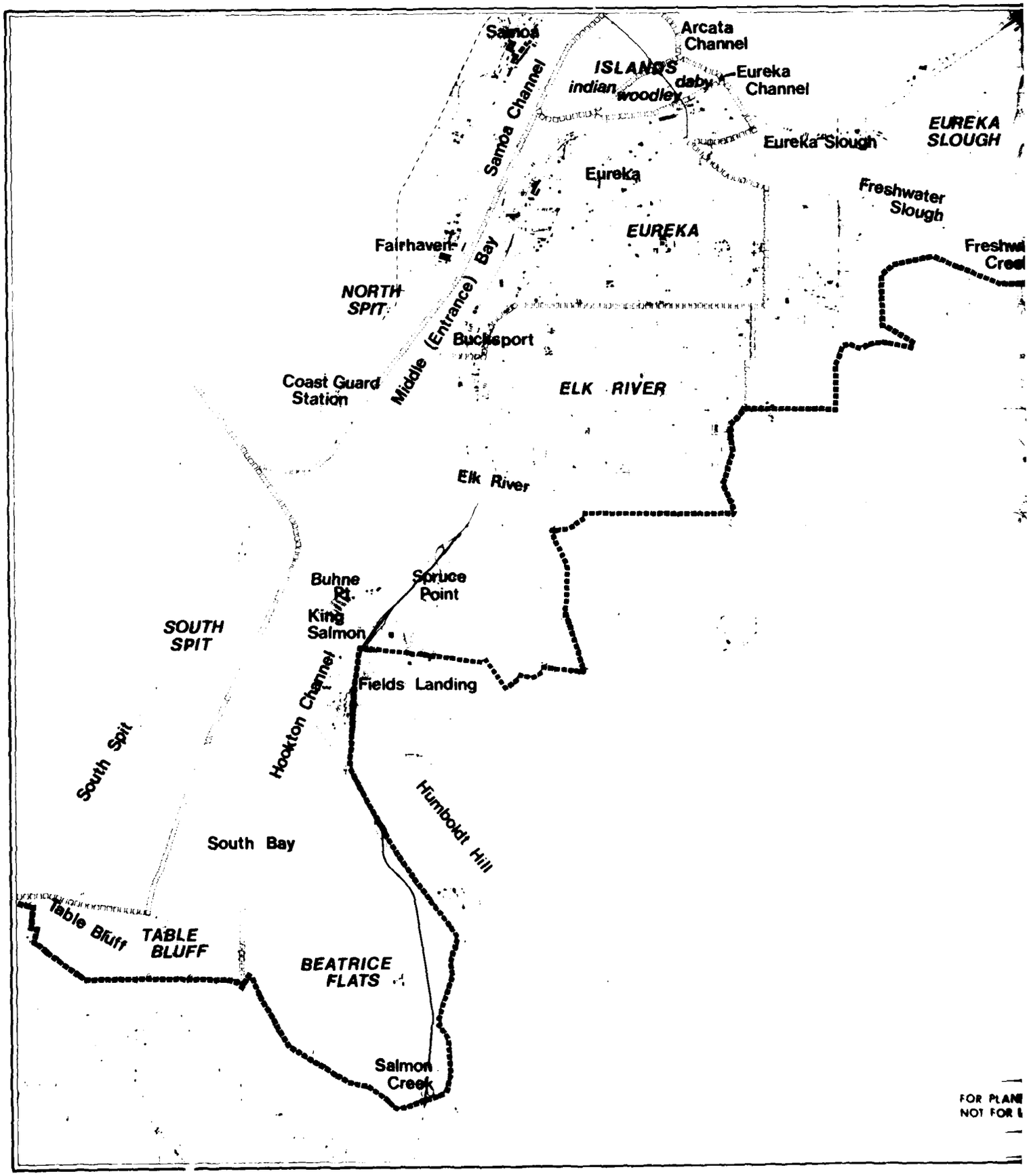

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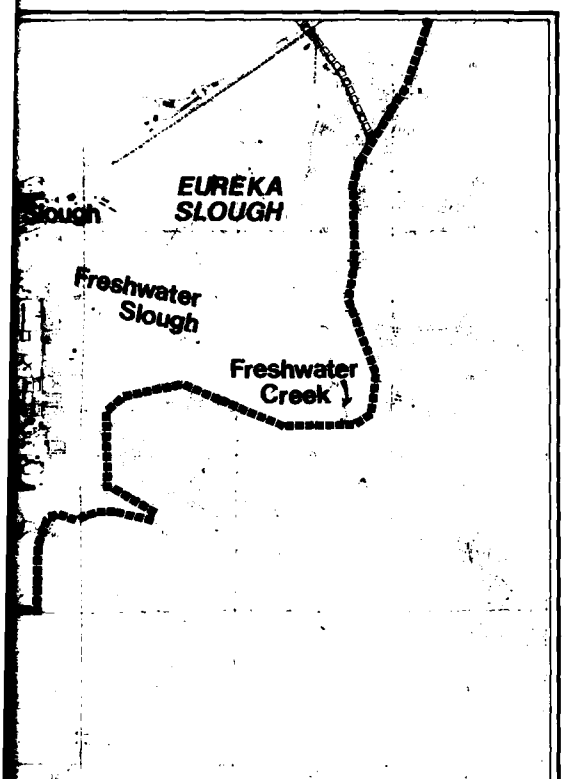

GEOGRAPHY

PLATE NO 1 SOUTH

LEGEND

▪▪▪▪▪ Study Area Boundary

□□□□□ *Land Use Subarea Boundary*

N

HUMBOLDT BAY WETLANDS REVIEW
&
BAYLANDS ANALYSIS

FOR PLANNING PURPOSES ONLY
NOT FOR LEGAL USE

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Section IV

CORPS PERMIT AND PROJECT ACTIVITIES

Section IV

CORPS PERMIT AND PROJECT ACTIVITIES

Section IV briefly describes the history and status of projects conducted by the Corps of Engineers in the Humboldt Bay study area. The history of permits and permit applications is also discussed; the numbers and types of activities and the types of applicants are analyzed. This section also summarizes the usual process used by the San Francisco District for review of permit applications. A brief discussion of permit activities of the California Coastal Commission, North Coast Region, and the Humboldt Bay Harbor, Recreation, and Conservation District is at the end of the section.

CORPS PROJECTS IN THE STUDY AREA

The first Corps of Engineers project for the improvement of navigation in Humboldt Bay was adopted by the River and Harbor Act of 1881. Under this Act a 10-foot deep channel, 240 feet wide, was dredged to Eureka. The Samoa and Arcata channels, and one to Hookton in the South Bay, were dredged shortly thereafter. Subsequent improvements authorized between 1930 and 1952 provided for deepening and widening of these channels, as well as dredging a new channel and a turning basin at Fields Landing in the South Bay. Construction of the south jetty was authorized in 1884. This project was modified in 1888 and in 1891 to provide for two parallel rubble-mound jetties which were entirely rebuilt in 1939.

In 1976 the San Francisco District completed design and evaluation of a number of navigation improvements in the Bay, including:

- deepening the North Bay channel from 30 to 35 feet and widening it at three bends.
- deepening a portion of the Eureka channel from 30 to 35 feet.
- deepening the Samoa channel from 30 to 35 feet and widening it along the entire length.
- constructing a turning basin 35 feet deep at the head of the Samoa channel.

Approximately 2.4 million cubic yards of material was dredged and placed on three disposal sites (COE, 1976(2)) on the North Spit. Two of the disposal sites are upland and one is an ocean beach site. The two upland sites (13A and 13B)* are at Fairhaven: 13A, between the Navy Base Road and the railroad tracks, and 13B, west of the Navy Base Road adjacent to the drag strip (Eureka airport). The beach site (17) is located along the ocean beach north and west of Samoa

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*Reference: COE, 1976(2), in Bibliography.

and west of an abandoned bark dump site. These sites were chosen after considerable public input; in fact, a previously chosen site, 13C just north of the Coast Guard Station, was eliminated because of public interest in maintaining the native habitat of *Erysimum menziesii*. These navigation improvements were completed in 1977.

The Corps is also designing and evaluating a navigation improvement project for the Fields Landing channel, including widening and deepening the channel. A real concern with this project is loss of eelgrass habitat.

CORPS PERMIT APPLICATIONS IN THE STUDY AREA

Summary information on all proposed activities and permit applications listed by the San Francisco District for Humboldt Bay and Harbor, Eureka Slough, and Mad River Slough in the study area was obtained from the files maintained by the Corps. The information included the following:

- Reference number, including a waterway location code
- Name of applicant
- Date application received and public notice number
- The principal activity proposed
- The type of action required by the Corps (i.e., enforcement inspection, permit, letter of permission, etc.)
- The status of the application (issued, denied, withdrawn, held in abeyance, exempt, etc.)
- The date of final action

Twelve types of activities are coded from applications; these are as follows:

Fills	Dams
Dredging/land disposal	Piers/wharfs/fixed over-water structure
Dredging/water disposal	Buoys/mooring facilities
Discharge structures/outfall pipes	Other (e.g., oyster culture, wharf reconstruction and expansion, drainage ditch construction, reconstruction of dikes, etc.)
Floating docks or piling	
Submarine pipeline/cable crossing/tunnel	
Overhead cable or power crossing	
Riprap/walls/jetty/breakwater	

Only the principal activity is coded for any given application, although several activities may be involved. The principal activity is determined by the judgment of the permit reviewer. Many of these activities are elements leading to or associated with other activities such as industrial development or shipping facilities. Permits under Section 404, CWA, are for discharge of dredged or fill material only.

Corps files list a total of 350 applications for proposed activities in the Humboldt Bay study area between 1915 and [illegible]: 215 in Humboldt Bay and Harbor, 27 in Eureka Slough, and [illegible] in Mad River Slough. Of the 350 applications, [illegible]58 were permit applications; the others were enforcement inspections, letters of permission, exemptions, disclaimers, or inquiries of jurisdiction. Of the [illegible] proposals, 248 (71%) were ultimately authorized for completion. [illegible]-six applications (12%) were withdrawn by the applicant, and the remaining [illegible]1 (17%) ranged in status from being held in abeyance to [illegible] and denial.

In the 350 applications, the most frequently proposed activities varied according to the waterway. In Humboldt Bay [illegible] which includes the entire North, South, and Middle Bays, the most frequently proposed activities were piers, wharfs, and [illegible] water structures (35%), dredging/land disposal (15%), [illegible] pilings (11%), fill (5%), submarine pipeline/cable crossings, and riprap/walls/jetty/breakwater (3%). All other categories had at least one proposal. The "other" category represented [illegible] of the applications had no code (i.e., were listed as [illegible] computer [illegible]). In Eureka Slough, the most frequently proposed activities were fill (19%), dredging/land disposal (15%), and [illegible] marine pipeline/cable crossing/tunnel (15%). Overhead cables and the riprap category were each 7% and floating docks/pilings were 4%. The "other" category represented 22% and 11% had no code. In Mad River Slough there were only 10 applications, 4 of which were "other"; the only activity mentioned in this group was oyster culture. The proposed activities included fill, discharge/outfall, floating docks and piling, and overhead cables.

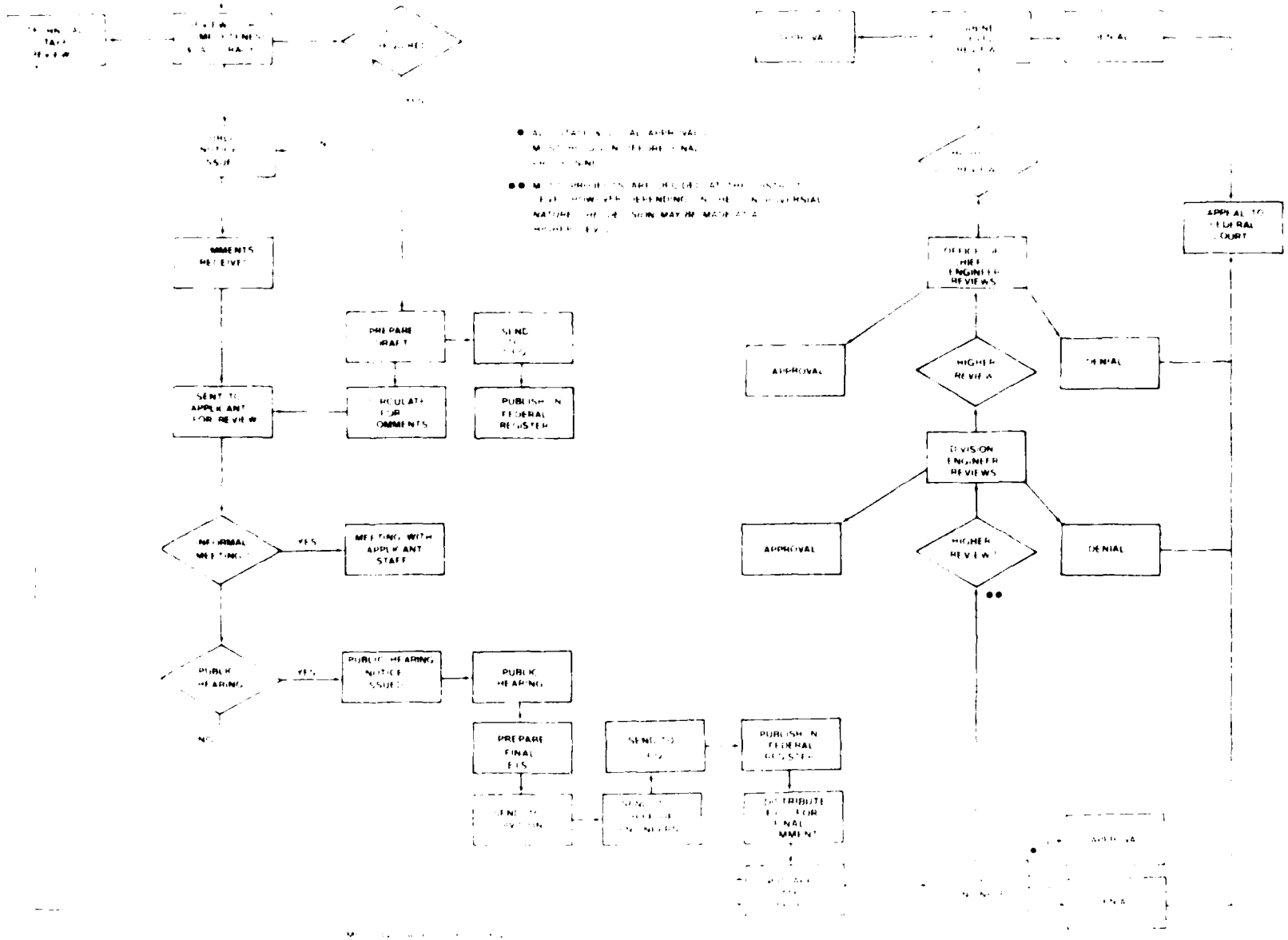
The applicants for the 350 proposed activities have been primarily private sector (76%), about 1/2 private business and the remainder individuals. Of the individual applicants, [illegible] have been proposing piers, wharfs, or fixed over-water structures and [illegible] have been proposing floating docks or pilings. Private business applicants have proposed primarily dredging/land disposal, piers/wharfs, fill, and submarine pipelines or cables. Public entities such as the City of Eureka and Arcata, Humboldt County departments, and [illegible] local agencies make up 24% of the applicants.

The results of this analysis show the significant interest of individuals in constructing piers, wharfs, floating docks, and pilings, presumably for recreational use. These activities and those dealing with land disposal may continue to be actively pursued in the future.

SAN FRANCISCO DISTRICT REGULATORY PROGRAM

The flow chart in Figure IV-1 indicates the review process through which a permit application must go before a decision [illegible]

US ARMY CORPS OF ENGINEERS
REGULATORY PROGRAM



or deny the permit is made by the District Engineer for the San Francisco District. This process is taken from Corps regulations 33 CFR 320-329 as implemented in the San Francisco District.

Every permit application requires an environmental assessment and a findings of fact as part of the review process. If an environmental impact statement (EIS) is prepared, the draft EIS may serve as the environmental assessment.

A public notice is issued for every permit application. As shown in Figure IV-1, this public notice contains a description of the proposed work, a preliminary environmental assessment, and a statement of criteria for the decision to issue or deny the permit. The criterion for the evaluation of a permit application is whether the proposed activity is in the public interest. The public notice is routinely sent to Federal, state, and local agencies, elected representatives, public and private interest groups, news media, and interested businesses and individuals. Owners of property adjacent to the proposed work are also notified. Any one may submit comments on the proposed work to the Corps or may request a public hearing.

As shown in Figure IV-1, there are several decision points for issuance or denial of a requested permit. If objections to the proposed work are raised during the public and agency review, the applicant is given opportunity to resolve these objections. If significant objections remain unresolved, then the District Engineer may issue or deny the permit or may refer it to a higher authority, depending on the nature of the objections.

The procedure depicted in Figure IV-1 insures that federal, state, and local agencies, and the public, have every opportunity for input to the Corps decision-making process. The solicitation of public and agency input is a means of identifying the public interest in the area and the probable impacts of the proposed work on that public interest. Section VII, Volume II of this study contains a detailed discussion of the various agencies with authority or interest in the study area and their stated policies. Thus, Section VII is a specific discussion of highlights of the expressed public interest in the Humboldt Bay study area.

PERMIT ACTIVITIES OF OTHER AGENCIES

Several other federal, state, and local agencies have regulatory (permitting) authority in the study area. For purposes of this study, the most pertinent are:

- U.S. Environmental Protection Agency (EPA)
- U.S. Coast Guard
- California Department of Fish and Game (DFG)
- California Coastal Commission, North Coast Region (CCNCR)

- California Energy Commission (CEC)
- State Water Resources Control Board (SWRCB) and Regional Water Quality Control Board (RWQCB), North Coast Basin
- Humboldt Bay Harbor, Recreation, and Conservation District (Harbor District)
- Humboldt County and local cities and special districts

The plans, policies, and authorities of these agencies are discussed in detail in Volume II, Section VII.C, Governmental Profile. Their regulatory authorities will be briefly summarized here. Two agencies (CCNCR and Harbor District) provided summaries of their permit activities and these are also discussed.

Environmental Protection Agency. EPA is the federal agency responsible for administering the Clean Water Act and the Clean Air Act. The agency promulgates criteria for wastewater discharges, for disposal of dredged material or fill in navigable waters, and for discharge of sewage sludge; however, the actual permit authority rests with other agencies (the Corps or the State of California). EPA can issue permits for discharge of pollutants (e.g., sewage outfalls) to aquaculture projects.

Coast Guard. The Coast Guard issues permits for bridges over navigable waters and for handling explosives or other hazardous cargo at waterfront facilities.

California Department of Fish and Game. The DFG regulates the harvest of fish and game and the taking of wildlife in the state. The agency issues stream alteration agreements for any activity which would change the flow, channel, bed, or banks of rivers, streams, and lakes having wildlife resource value.

California Coastal Commission. The CCNCR reviews proposed developments in the coastal zone; in permit decisions, the policies of the Coastal Act apply (see Section VII.C). Permit decisions for each major Coastal Act policy group are summarized below (taken from a summary prepared by the CCNCR in February 1979):

- Shoreline Access: Many permits which include offers to dedicate easements for pedestrian access have been approved; identified easements may be included in the local coastal program.

- Recreation/Visitor Facilities: New facilities, mostly restaurants and motels, have been approved in or adjacent to areas already developed for these uses.

- Housing: The intent is maintain existing low and moderate cost housing and to develop new supplies of such housing in the coastal zone.

- Water/Marine Resources: In general, approved permits have conditions to protect gulches and riparian areas and to minimize non-point wastewater discharges.

- Dredging, Diking, Filling, Shoreline Structures: The commission has reviewed a number of applications for diking and filling wetlands and has required compensation for lost wetland/habitat. Several permits to improve existing berthing areas have been approved.

- Commercial Fishing/Recreational Boating: Several permits for boat launches and the Woodley Island Marine and two permits for new aquaculture uses in the Bay have been approved.

- Environmentally Sensitive Habitats: Approved permits have conditions to minimize impacts on adjacent habitat areas, including wetlands, gulches, and dunes.

- Agriculture: Several applications for division of agricultural lands were denied because it appeared the parcels would be too small to support viable agricultural operations. The CCNCR conditioned or denied applications to prevent non-agricultural uses from crossing established urban/rural boundaries and identified some buffer zones.

- Industry/Energy: Some port-related industrial development has been approved in Eureka. An application for recreational use of land adjacent to a deep-water channel was denied. Permits have been denied to protect sites suitable for power-plant and industrial development and expansion.

California Energy Commission. The CEC certifies the siting of all new power plants over 50 megawatts and any changes or additions to existing plants.

State Water Resources Control Board and Regional Water Quality Control Board. The state and regional boards regulate all waste discharge which may affect waters of the state, including surface and ground waters. The State Board certifies wastewater treatment plant operators, registers liquid waste haulers, and administers state and and federal grants for construction of wastewater treatment facilities. The Regional Boards have primary responsibility for regulating wastewater discharges, including discharges from all point and non-point sources, for regulating any dredging, filling, diking or soils disposal through adoption of waste discharge requirements, and for enforcing these requirements through appropriate administrative action including cease and desist orders and cleanup and abatement orders. The Regional Board places specific conditions on waste discharges, including effluent limitations and receiving water limitations and may require monitoring of effluent and receiving waters to ensure

compliance with limitations; an example is Order No. 76-87 of the Regional Board, concerning waste discharge requirements for the dredging of the proposed Humboldt Harbor Marina (Woodley Island Marina). The Regional Board requires contingency plans for management of accidental spills from all entities engaged in waste discharge, conveyance, storage, and/or management. The Humboldt Bay study area is under the North Coast Regional Board.

Harbor District. The Harbor District grants three types of permits: administrative, emergency, and general. Administrative permits include activities such as replacement of pilings or replacement of damaged cables. Emergency permits are to cover unexpected occurrences demanding immediate action to prevent loss of or damage to life, health, property, or essential public services. Emergency permits in the study area have been granted for such activites as placing riprap along Buhne Drive, repairing fire damage to docks, and construction of a temporary boat ramp at Fairhaven. Dredging is not considered an emergency need at present, according to the Chief Executive Officer of the Harbor District (Glatzel, 1979, personal communication). General permits involve activities such as submarine pipelines, oyster raft moorage, floating docks, cleaning of drainage ditches, maintenance dredging, and construction of a facility for freezing, processing, and storing fish products. No applications for fill have been submitted to the Harbor District (Glatzel, 1979, personal communication). Since 1973, 22 general permits have been granted by the Harbor District; of these, there were 3 for submarine pipeline/cable crossing, 3 for dredging, 3 for floating dock/piling, 2 for boat ramps, 1 for riprap, 1 for discharge/outfall, and 8 miscellaneous (other) permits.

Humboldt County, Local Cities, and Special Districts. These agencies are responsible for regulation of the complete range of land use and development. Examples of permits they may issue include, but are not limited to, building permits, subdivision approvals, grading and filling permits, permits for use of public utilities (e.g. sewer or water hookups), and zoning change approvals. The cities of Eureka and Arcata have tidelands granted to them by the state and regulate development and activities in these tidelands.

Section V

FINDINGS IN HUMBOLDT BAY

Section V

FINDINGS IN HUMBOLDT BAY

Section V presents the findings of the study in the Humboldt Bay study area. Section V.A. reiterates the importance of wetlands per Corps policy and EO 11990 and identifies and describes all wetlands by type in the study area. Section V.B. discusses criteria for designation of Areas of Importance and Areas of Environmental Concern and the significance of such designation. The designated Areas are described in detail. Section V.C. discusses the environmental impacts of various activities in the study area and the legal/administrative processes controlling the activities. Section V.D describes the factors influencing the location of development and evaluates development pressure on the various parts of the study area. Section V.D also discusses parts of the study area identified as particularly appropriate for use as compensation areas. Section V.E identifies information gaps and makes recommendations for future studies.

Supporting data for the findings in Section V may be found in the Physical and Biological, Land Use and Governmental, and Cultural and Economic Profiles, Sections VI, VII, and VIII, Volume II, Humboldt Bay Wetlands Review and Baylands Analysis. Section V.F summarizes briefly the base information contained in Volume II. Section V is cross-referenced to Sections VI, VII, and VIII wherever possible.

A. THE IMPORTANCE AND IDENTIFICATION OF WETLANDS

IMPORTANCE OF WETLANDS

As discussed in Section I (Introduction), the policy of the Chief of Engineers has expressed the view of wetlands as vital natural resources of importance to the people of this country. The regulations of the Corps of Engineers reiterate the importance of wetlands as follows:

> *Wetlands are vital areas that constitute a productive and valuable public resource, the unnecessary alteration or destruction of which should be discouraged as contrary to the public interest.* 33 CFR 320.4(b)(1)

Executive Order (EO) 11990 emphasizes the importance of wetlands as critically important resources and directs federal agencies to preserve and enhance the natural and beneficial values of wetlands in management of federal lands, construction, and activities.

Under EO 11990 wetlands are broadly defined as areas which do (or would under normal conditions) support a prevalence of vegetative or aquatic life requiring saturated or seasonally saturated soil conditions (Section I). Areas specifically mentioned as wetlands in EO 11990 are swamps, marshes, bogs, sloughs, potholes, wet meadows, river overflows, mudflats, and natural ponds. The Corps definition of wetlands under Section 404, CWA, is more limited than the EO 11990 definition in that it is strictly based on the presence or potential presence of vegetation. Executive Order 11990 requires the protection of wetlands by federal agencies engaged in carrying out their responsibilities for federal lands, federal construction, and federal activities and programs. It is clear from these statements of national policy that proposed alteration of wetlands should be carefully reviewed and where possible, important wetlands should be protected and preserved.

IDENTIFICATION OF WETLANDS

The first major aspect of the Humboldt Bay Wetlands Review is the identification, description, and evaluation of all wetlands in the study area. All wetlands in the study area are classified and mapped as part of Volume III. As described in the Biological Profile (Section VI), Volume III classifies the study area into nine different general habitat types: Urban, Agriculture, Grassland, Shrubland, Forest, Water, Wetlands, Dunes, and Other.

Volume III of this study also designates a wetland-upland boundary in the Humboldt Bay study area. Certain of the wetland types classified as wetlands may not lie under Corps jurisdiction as

defined in 33 CFR 323. Isolated fresh marshes and closed ditches are neither tidal nor adjacent, and Corps jurisdiction may not include all such wetlands.

Because of the importance of wetlands, a detailed description of wetlands by type is included in this section. Each wetland type is described in the format shown in Template 1 (attached). Wetlands are discussed to the level of detail at which they were mapped in Section VI. (scale 1:24,000), except where differences at a scale of 1:6000 (Volume III) were judged to be biologically significant. As shown in Template 1, a general description of wetland types and the distribution of that type in the study area is given. The 1:6000 scale maps of the Bay study area were submitted with Volume III of this report; these maps show the distribution of all wetlands and other habitat types in the study area. (These maps were not reproduced in this document because significant information would be obscured in the reduction.) The history of alterations of each type is briefly discussed. The templates also describe the significant relationships and functional importance of each wetland type; these descriptions represent a summary and synthesis of material presented in the Physical and Biological Profiles.

Two important historical aspects of the habitat types are referred to in the template discussions, but are not explained in detail therein. These are succession, and the effects of dikes and breached dikes. A short discussion of these aspects follows.

Succession

Succession is the process of plant community evolution. A bare substrate is colonized by pioneer plants tolerant to the sunlight, nutrients, periodic inundation, soil saturation, soil salinity and other conditions present. Pioneer plants alter these conditions through deposition of organic material, entrapment of sediment, formation of shade, and other changes. This alteration is usually in the direction of a less stressful condition, thereby creating an environment conducive to more and different species. Each step in the process of environmental change occurs for years and sometimes centuries.

In wetland habitat types, the primary condition which changes through successional stage appears to be elevation, and the consequent frequency and duration of inundation. If this is the case, then the salt marsh pioneer in the Humboldt Bay is pickleweed, a relatively low elevation species. As the substrate elevation rises, cordgrass, saltgrass, and jaumea become established. At the upper elevation of the salt marsh, these species may be replaced by a brackish marsh community, consisting of hairgrass, rush, and silverweed. This description of succession in the study area is based strictly on observations in salt marshes around the Bay; the process also occurs in brackish and fresh marshes but appears to be much more complex. Research is needed to verify and refine the understanding of the process.

Diking, Levee Construction

The construction of dikes and levees has been an important mechanism for creating agricultural land from wetland habitats. In addition to dikes, which prevent regular tidal inundation, ditches and tide gates are also important to drain rich, lowland habitats, making them suitable for agricultural activities. Even with these construction activities, however, lowland pastures often exhibit saturated soils. In some cases, constant agricultural controls are necessary to prevent development of fresh marshes behind dikes. Dikes and associated agricultural activities have existed in the Humboldt Bay area since at least 1893.

Occasionally, dikes are breached as a result of poor maintenance or intense storm activity. A break in the dike allows tidal inundation of the lowlands behind. Pasture grasses and other agricultural crops quickly die back, and are soon replaced by pioneering wetland species. The saturated soils and near-wetland characteristic of many of these areas before a breach often results in the quick establishment of wetlands habitat types. Even if the breach is closed, wetlands may remain established for a long time thereafter, especially where reseeding or other agricultural control does not occur. If the breach is not repaired, successional processes will begin.

The deliberate breaching of dikes has been advocated and used as a means of restoring or recreating wetlands. (The State of California has a policy encouraging such wetlands restoration.) There have been few investigations of either the short-term or long-term results of this action. Research into the effects of dike breaching will be important in assessing the value of wetlands recreation. (For a further discussion of these concepts, see Section V.D., Volume I.)

Template 1 (sample format)

WETLAND TYPE

TYPE: Name

DESCRIPTION: General description; that is, flora, substrate, inundation characteristics. Discussion of any subtypes distinguished at a scale of 1:6000 and any significant differences between subtypes and whether the subtypes should be discussed separately.

DISTRIBUTION: Total acreage of this type in the Bay by subtype. Distribution of type by subarea. Distribution by parcel size; general numbers of parcels large and small.

HISTORY IN BAY: Evidence of levees/fill, levee breaching.

SIGNIFICANT RELATIONSHIPS AND FUNCTIONAL IMPORTANCE:

A. Plant diversity, and successional stages.

B. Fauna; feeding, nesting, resting. Mammals, birds and waterfowl, fish, shellfish and other invertebrates.

C. Productivity, nutrient cycles, food web.

WETLAND TYPE

WETLAND: Salt Marsh

Description

Salt marshes are low, grassy areas which are inundated almost daily by tidal bay waters. Two major vegetation types have been noted in the salt marsh: the cordgrass (*Spartina foliosa*) marsh and the pickleweed (*Salicornia pacifica*) saltgrass (*Distichlis spicata*) marsh. The lowest portion of the salt marsh is generally a low mat of vegetation which consists of a pure stand of pickleweed. As elevation increases, saltgrass and jaumea (*Jaumea carnosa*) become significant components of this association. Increased elevation appears to result in increased diversity, with orache (*Atriplex patula*), sea lavender (*Limonium californicum*), arrowgrass (*Triglochin maritimum*) and gumweed (*Grindelia stricta*) becoming apparent. The cordgrass association is a more common community at middle elevations of the marsh. The tall, dense character of this species generally precludes the presence of any other species.

Of particular interest in higher elevation salt marsh habitats are Humboldt Bay tarweed (*Grindelia stricta* ssp. *Blakei*) and Humboldt Bay owl's clover (*Orthocarpus castillejoides* var *humboldtiensis*), both considered uncommon endemic species of Humboldt Bay. Two varieties of salt marsh bird's beak (*Cordylanthus maritimus* ssp. *maritimus* and *C. maritimus* ssp. *palustris*) have been reported as rare or endangered species in Humboldt Bay salt marshes (CNPS, 1974).

Distribution

There are about 970 acres of salt marsh within Humboldt Bay. The largest single parcel, approximately 195 acres, is located on Indian Island. Mad River Slough and its islands include approximately 140 acres of salt marsh. The remainder of the salt marsh is scattered in small parcels around the periphery of both North and South Bays.

History

Old maps of the Bay (USCS, 1850; 1870) suggest that most of the bottomlands presently diked for agriculture were previously tidal wetlands. It is not known whether these wetlands were all salt marsh, or if brackish marsh and swamp were present at the upper reaches of these wetlands. Agricultural use of high marsh areas was common in Arcata Bottoms and the Elk River floodplain by 1870. Completion of the NWPRR in 1901 effectively diked larger portions of Elk River, Eureka Slough, Bayside and Arcata Bottoms. Beatrice Flats was the last to be diked, with the work not completed until about 1948.

Significant Relationships

In the upper salt marsh, the pickleweed/saltgrass association is a rather diverse community of low grasses, annuals, and herbaceous perennials. The low pickleweed and the cordgrass communities generally exhibit very low diversity. Pickleweed appears to be the salt marsh pioneer, becoming established in the lowest portions of the marsh. Cordgrass or the diverse low grasses and annuals invade when the relative substrate elevation has risen.

Salt marsh provides habitat for a wide variety of fauna. Small rodents may feed or nest in the uppermost portions of the marsh. A few birds such as wrens, rails, and snipe feed and nest in the dense cordgrass marsh. Insects may be common in the cordgrass marsh, feeding on vegetation, sap, animals, or each other. Some insects use the marsh for cover; the marsh is an important habitat for reproduction and larval stages. Wading birds feed in the tidal channels dissecting the marsh. Shore birds are often seen feeding in the lowest marsh and adjacent mudflats. Swallows and raptors (especially marsh hawks and kites) hunt over the marsh. Salt marsh is an important resting and feeding area for a wide variety of migrating birds. Many invertebrates, particularly detritovores such as crabs, shellfish, and sediment dwellers, thrive in the marsh, where high productivity results in ample detritus. Numerous snails graze on algae and other epiphytes on the marsh vegetation. Juvenile fish feed and hide in tidal channels, and the marsh itself during high water.

Salt marsh, particularly cordgrass, is one of the most productive habitat types known in the Humboldt Bay area. Organic litter from salt marshes is readily exported to the mudflats as detritus. This export is a major route of carbon and energy flow in the Bay ecosystem.

WETLAND TYPE

WETLAND: Brackish Marsh

Description

Brackish marsh is a tidal wetland inundated by low to moderate salinity water. It is usually found at the highest elevations of salt marshes where upland runoff may dilute infrequent tides, or along tidal rivers and creeks, where stream flow results in depressed salinities. Three brackish marsh associations have been identified in the study area. One brackish marsh type consists of a monotypic stand of sedge (*Carex obnupta*). A more common brackish marsh is that dominated by hairgrass (*Deschampsia caespitosa*) with rush (*Juncus* spp.), silverweed (*Potentilla pacifica*) and bentgrass (*Agrostis alba*). The third type is a rush dominated marsh in which hairgrass, silverweed, saltgrass, and orache may be present.

Distribution

Brackish marsh is usually found above salt marsh, either in areas which are inundated infrequently by Bay waters or in areas where regularly inundating waters are significantly diluted by freshwater runoff. A total of 250 acres of brackish marsh have been identified in the Humboldt Bay area. The largest parcels of brackish marsh, encompassing about 40 acres, are located behind dikes near King Salmon. (These dikes have recently been repaired; it is not known what, if any, impact this will have on the communities found there.) Parcels of about 35 acres are found near Hookton Slough and Fay Slough. Smaller parcels are widely scattered in the Broadway Marshes, Eureka Gulches, and near Arcata.

History

Brackish marshes were not recognized on the old survey maps. They were probably common at the upper reaches of most tidal marshes around the Bay in 1850. The present distribution around the Bay appears to be more a response to diking activities and subsequent breaches following local runoff alterations, rather than a remnant of pre-diking habitat. The King Salmon, Hookton Slough, and Eureka Gulch parcels were all diked at one time. Subsequent urban or agricultural development diverted much of the local runoff. Since then the dikes have been breached or exhibit slow leaks and the areas have reverted to wetlands.

Significant Relationships

As mentioned, natural brackish marshes probably represent tidal wetlands of higher elevation than the adjacent salt marshes. Deposition of sediments in high marshes created areas where the mixture of fresh

water runoff with saline waters resulted in an area that could be occupied by less salt tolerant brackish marsh species. In general, brackish marshes are more diverse than salt marshes; although sedge marshes are an exception.

Brackish marshes tend to support a more diverse faunal population. Insects are common, and rodents often feed and nest in the grass. Deer have been known to graze rush and hairgrass. Small insect and seed eating birds are also common. Waterfowl may feed on sedge seeds and nest in the marsh. Raptors, such as marsh hawks and kites, and insect eaters such as swallows and flycatchers commonly hunt over brackish marshes.

Hairgrass and sedge are highly productive species. Export of this organic material usually occurs only under extreme high water or flood situations, however.

WETLAND TYPE

WETLAND: Fresh Marsh

Description

Three distinct fresh marshes can be noted in the study area. All three are characterized by saturated or inundated soils. Cattail (*Typha* spp.) marshes are perhaps the most well known and easily recognized, although perhaps not the most prevalent, fresh marshes found in the Humboldt Bay area. Cattails may be one of the most tolerant of the fresh marsh plants; they can withstand long periods of dessication and even occasional inundation with brackish water. A more common fresh marsh is dominated by water parsley (*Oenanthe sarmentosa*) or occasionally marsh pennywort (*Hydrocotyl* sp.). Rush (*Juncus effusus*), sedge, bulrush (*Scirpus microcarpus*), buttercups (*Ranunculus* sp.), and angelica (*Angelica* sp.) may be locally common. This marsh is found in slow-moving or standing water up to 3 feet deep (rush, sedge, and buttercups are rarely found in water greater than one foot deep), often with a mucky bottom.

Distribution

There are about 170 acres of fresh marsh in the Bay area. About 45 acres are located in the Elk River subarea; either in the gulches of Martin Slough or in the area surrounding South Bay Union School. Another 40 acres are located in Arcata Bottoms, mostly in the vicinity of McDaniel Slough. Some 30 acres are located in the Eureka Slough subarea, mostly in the vicinity of Fay Slough or Third Gulch.

History

It is likely that many of the fresh marshes are found in locations which contained tidal salt or brackish marsh prior to diking activities in the area. Many fresh marshes are found in low areas which do not drain well, such as old tidal channels or low flat areas with drainage cut off by roads or dikes. The fresh marshes on North Spit, or those immediately adjacent to Highway 101 near King Salmon, are of this type. Other fresh marshes are located in low areas which were once tidal and which receive considerable upland runoff. The marshes just south of South Bay Union School near King Salmon or those in Third Gulch exemplify this other situation.

Significant Relationships

Cattail marshes tend to be monospecific in character. Water parsley marshes exhibit a wider diversity of species. Diversity of the rush marshes tends to decrease with increased rush and/or sedge. It is not readily apparent what successional sequences fresh marsh communities might represent. The presence of certain fresh marsh species is probably indicative of physical conditions at the site (such as

seasonal water depth, substrate, water velocity, etc.). Fresh marsh may be a pioneer stage which precedes swamps.

Fresh marshes, especially cattail and sedge marshes, are important habitats for a variety of birds. Red-wing blackbirds, marsh wrens, and bitterns all feed and nest in fresh marshes. Numerous waterfowl may also nest in fresh marshes. Flycatchers and swallows feed on the insects associated with the marsh. Rodents and small mammals may also nest in the marsh. Deer have been reported grazing on rush. Marsh hawks and owls often nest in nearby trees and hunt in the marshes.

Some fresh marsh species, particularly cattails and sedge, are known to be highly productive. The productivity of most others is unknown, but is probably only moderate. Export of detrital material is slow from fresh marshes, often requiring flood conditions. Freshwater runoff may bring nutrients and contaminants from adjacent uplands. These may be incorporated in the vegetation or degraded in the sediments before being exported to the Bay.

WETLAND TYPE

WETLAND: Swamp

Description

Swamps are freshwater wetlands dominated by trees and shrubs. In the Humboldt area willows (*Salix* spp.) are most commonly the dominant species, although in some situations alder (*Alnus oregana*) may dominate. The understory generally includes salmonberry (*Rubus spectabilis*), sedge, buttercup, and bulrush. Water parsley may also be present in particularly boggy situations. On North Spit, swamps have a more diverse character, with beach pine (*Pinus contorta*) and Sitka spruce (*Picea sitchensis*) adding to the overstory. The shrub understory may contain bayberry (*Myrica californica*), twinberry (*Lonicera involucrata*) and huckleberry (*Vaccinium ovatum*). Below the shrubs, silverweed, bracken fern (*Pteridium aquilinum*) and dock (*Rumex crispus*) may be present. The differences between dune swamps and others may be the coarse substrate, and the pristine nature of the dune swamps.

Distribution

There are few large parcels of swamp in Humboldt Bay. The largest, 11 acres, is found in Second Gulch in Eureka. There are numerous dune swamps scattered along the coast, but they rarely exceed 10 acres. Elsewhere in the area, swamps are scattered along the periphery of fresh marshes such as those along the east side of the Broadway Marshes.

History

Prior to [illegible] and agriculture in the area there may have been ex[illegible] swamps in the uppermost zone of wetland around the Bay proper. [illegible] probably would have been dominated by willow and Sitka [illegible] the early clearing for farmland, these would have [illegible] the first to be eliminated. Most of the swamps around [illegible] second growth, except those on North Spit which [illegible] pristine habitat types.

Biotic and Relationships

Some swamps exhibit little diversity, with a dense willow overstory and a [illegible] sedge stand below. More commonly, however, swamps tend to be [illegible] assemblages, with a tree overstory, a shrub understory, and variety of low herbaceous plants on the floor. Swamps appear to be a final wetland step in a progression from open water, through fresh marsh to swamp, and then upland. The sequence appears to be controlled by sediment deposition and character.

A variety of fauna, particularly birds, may use swamps as nesting habitat. Songbirds, expecially insectivorous types, often nest in

the trees and feed in the nearby area. Herons and egrets have been noted resting in swamps in the Bay area, especially in the winter. Where spruce are present, raptors may be noted nesting or resting in them.

Small rodents are also common nesters in swamps. Carnivores, particularly mink or weasel, find hunting in swamp habitats productive. The dense vegetation offers them the type of cover they prefer for hunting; downed trees may provide appropriate locations for denning.

Some swamp species, such as willow and sedge, exhibit high productivity; most others do not. Most organic matter produced in a swamp is either consumed or deposited on the site with little regular export to other systems. Some export may occur during flood conditions and high velocity flow. More often, however, swamps act to trap sediments, litter, and dissolved solids from runoff, thus filtering runoff water before it enters nearby creeks or the Bay.

WETLAND TYPE

WETLAND: Intertidal Flats

Description

Intertidal flats are flat areas of sand and/or mud varying in elevation from -3 (MLLW) to the lower limit of the salt marsh, usually about +6 (MLLW). Generally considered unvegetated, they usually contain large populations of diatoms, and occasional patches of algae, such as *Ulva* spp. and *Enteromorpha* spp. (Eelgrass flats are discussed in a separate template.) Although unvegetated, intertidal flats are densely populated with a wide variety of benthic invertebrate organisms. Worms, amphipods, and shellfish are just some of the inhabitants of this community.

Distribution

Intertidal flats (including those covered by eelgrass) are probably the most widely distributed and extensive habitat type in the Bay. About 80% of South and North Bays are intertidal flats, but only 4% of Entrance Bay. The flats extend from the shore or the edge of the marsh out to the edge of the channels.

History

In most places around the Bay, the upper boundary of the flats is a dike, where salt marshes were reclaimed for agriculture. Fills on the flats have been few, but often large; Fields Landing, Eureka, Bayside, Bracut, and Arcata are the most notable. In a few instances, widening channels or creating a turning basin such as that proposed for Fields Landing, have resulted in the dredging of intertidal flats. One of the most significant impacts on the flats has been the oyster dredging activities which have taken place in North Bay since the 1950's. This constant disturbance of the substrate, and the associated deposition of shell material, has resulted in much coarser sediments on North Bay flats than on those in South Bay. In addition, the benthic community on commercial oyster beds is constantly disturbed.

Significant Relationships

Intertidal flats support a diverse and abundant assemblage of invertebrate organisms. There are few, if any, plants, however, and successional features tend to be cyclic and influenced by seasonal events such as freshwater pulses. The abundant invertebrates provide food for innumerable fish and birds. Shellfish, including clams and oysters, are economically important inhabitants of the flats. Juvenile fish of all types feed on the amphipods, worms, and other soft-bodied

benthics. Shorebirds, such as godwits, willets, sandpipers, and others, feed on the numerous small organisms found in the exposed flats. Some waterfowl will feed on the invertebrates when the tideflats are covered, while others, along with wading birds, will prey at high tide on the fish which feed over the flats.

Intertidal flats are highly productive habitats for benthic invertebrates. Many of these bottom dwelling organisms are filter and detritus feeders, depending on material from adjacent marshes and eelgrass beds, and also on plankton, for food sources. The major type of invertebrates in the flats function effectively as grazers or herbivores in the food web. By converting plant material into animal protein, this is a very important step in the conversion of energy and nutrients into organic material.

WETLAND TYPE

WETLAND: Eelgrass

Description

Eelgrass occupies intertidal flats from about -3 feet (MLLW) to about +1 foot. This rooted plant often forms large dense beds; the roots and rhizomes form thick mats which resist erosion and aid in stabilizing the flats.

Distribution

Eelgrass is widely distributed in both North and South Bays, occupying almost every area of appropriate depth. Approximately 2,935 acres of eelgrass were identified in North and South Bays; eelgrass is found on 20% of the total 14,853-acre bay area. Dredged channels and the North Bay oyster beds, where disturbance is frequent, are locations where eelgrass is not found. Eelgrass is also not found in Entrance Bay, where strong currents and wave activity create a highly energetic environment, unsuitable for eelgrass.

History

The major impacts on eelgrass in the bay have been the result of dredging activities. Navigation channels and turning basins occasionally require dredging beyond the confines of the natural channel. An even more significant impact, however, has been that caused by oyster dredging in North Bay. The dredging operation removes all the eelgrass, including roots and rhizomes, from the substrate. Since the operation is repeated every few years, the eelgrass never does become firmly reestablished.

Significant Relationships

Eelgrass provides food, shelter, and substrate for a diverse population of organisms. Numerous algae, bacteria, and invertebrates reside on eelgrass blades. Many of these in turn are food for the fish and crabs which inhabit the beds. The dense vegetation and thick root mass provide shelter for fish, crabs, and benthic organisms, and food for fish and waterfowl, especially brant. All of these in turn are food for a diversity of larger fish, waterfowl, and occasional raptors. Shellfish, including cockles and some clams, are found in eelgrass beds. Detrital material, the remains of dead plants such as eelgrass, are known to be food for a variety of filter feeding organisms, including many which are residents of unvegetated flats. Eelgrass beds are also important spawning and rearing grounds for herring and smelt.

WETLAND TYPE

WETLAND: Water

Description

Five different water habitat types have been identified in the Humboldt study area. Deep channels [-17 to -50 feet (MLLW)], shallow channels [-3 to -17 feet (MLLW)], and tidal creeks and sloughs are all marine or estuarine habitats Creeks and rivers are characterized by having flowing fresh water, while ditches, ponds, and closed channels all contain standing water. Water habitats support a wide variety of organisms, and temperature, salinity, and other water characteristics determine the type and abundance.

Distribution

Water habitats are distributed throughout the study area. Deep and shallow tidal channels are located in the Bay proper. Mad River, Hookton and Eureka Sloughs, and lower Jacoby Creek and Elk River are classified as tidal creeks and sloughs. Creeks and rivers include those portions of Jacoby Creek, Freshwater Creek, Elk River, and Salmon Creek upstream of tidal interaction. Ditches, ponds, and closed channels are distributed throughout the diked agricultural areas.

History

There has been relatively little change in the tidal channels of Humboldt Bay. The deep channels are dredged regularly for navigation purposes. Few of the shallow channels have ever been dredged. Most tidal creeks and sloughs have been diked up to their edges to minimize flooding and create grazing land. In general, the impact on creeks and rivers has been levee creation and, in some cases, elimination of riparian vegetation. Ditches, ponds, and closed channels are the most severely impacted waterways. Most of these were shallow tidal channels meandering through salt marsh, before diking eliminated tidal interaction. Now their function is to drain pastureland, with the water entering the Bay through tide gates.

Significant Relationships

The water habitats are occupied by a diverse population of phytoplankton and zooplankton. These, in turn, are fed upon by plankton consumers such as filter feeders, which are especially common in marine and estuarine waters. Filter feeders are generally invertebrate benthic organisms, such as worms, molluscs, and crustaceans. These, in turn, are fed upon by fish and some waterfowl.

In marine and estuarine situations, phytoplankton may be highly productive, generating large quantities of organic matter. This becomes a second base for the aquatic food web. Invertebrates, fish, and waterfowl are all directly or indirectly dependent on algae as a food source.

WETLAND TYPE

WETLAND: Wet Pasture

Description

Some portions of agricultural land contain a variety of plant species in addition to the forage grasses normally found. Buttercups (*Ranunculus* sp.), silverweed (*Potentilla pacifica*), baltic rush (*Juncus balticus*), and soft rush (*Juncus effusus*), all well adapted to saturated soils, may be common or locally dominant due to seasonal flooding. Grazing pressure influences species composition, since wetland species may not offer prime forage; grazing animals may also compact soils, decreasing permeability or stir the substrate into a mire. The wet pasture classification notes the character of the substrate while recognizing the principally agricultural nature of the habitat. Wet pasture may not necessarily be considered a wetland according to Corps Section 404 regulations (33 CFR 323.2).

Distribution

Wet pastures are widely distributed throughout the bottomlands of the Humboldt Bay area. They are common in old tidal channels, immediately adjacent to levees, and in any low area. Wet pasture or agricultural/wetland may be found in the low portions of any agricultural area which has been leveed and drained.

History

Most of the agricultural land around the Bay was tidal wetland prior to early settlement of the area. Levees, drainage ditches, and tide gates were constructed in order to drain these areas, allowing creation of pasture land. Despite the various construction activities, the combination of low elevation, low gradient, and high rainfall results in the collection of runoff in the lowest areas for at least portions of the year. Thus, moist to wet conditions prevail and certain moisture tolerant species are able to survive.

Significant Relationships

Wet pastures are highly influenced by grazing cattle; the disturbance of this habitat type results in low plant diversity and represents a state of disclimax*. Primary productivity in these areas is probably low and isolated from other systems. However, because the wetland species are less palatable than forage grasses, their productivity may be available for a variety of consumers.

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*Disclimax - a climax vegetation community which exists as a result of continued disturbance (see Section V.A, Volume I).

Flooded pastures in winter often support a large and diverse avifauna. Migratory waterfowl, shorebirds, and gulls make frequent use of flooded pastures for feeding and foraging. High insect population levels in wet pastures attract insectivorous birds such as swallows. Herons and egrets may feed on amphibians and small mammals; the latter are also exploited by owls and hawks.

WETLAND TYPE

WETLAND: Agricultural Wetland

Description

This habitat type is a wetland within an agricultural area. Small patches of cattails in a depression or a diverse assemblage of wetland species in a relict tidal channel are characteristic examples. A wide variety of fresh and brackish wetland species may be found in these areas, such as cattails, bulrushes (*Scirpus* spp.), silverweed (*Potentilla pacifica*), pennywort (*Hydrocotyl* sp.) and numerous other species. Standing water is common in these areas through winter and spring, and sometimes into the summer also.

Distribution

Agricultural wetlands are widely distributed in all the diked bottomlands surrounding Humboldt Bay. They are most often found in old tidal channels which are presently functioning to drain the surrounding fields. The lowest areas of pasture are often agricultural wetland.

History

Most of the agricultural wetlands were tidal channels through the salt marshes around the Bay prior to construction of the levees and drainage ditches. The incomplete drainage of these channels throughout most of the year, despite the levees and ditches, results in the standing water or saturated soils which support these wetlands.

Significant Relationships

Since these are mostly fresh marshes, they have most of the same functional values. They may be monotypic stands or may consist of diverse assemblages of plant species. The impact of agricultural activities of these wetlands probably precludes successional advance.

Fresh and brackish marshes are important habitats for a wide variety of birds, amphibians, and mammals. Red-wing blackbirds, marsh wrens, and bitterns all feed and nest in fresh marshes. Numerous waterfowl may also nest here. Flycatchers and swallows feed on the insects associated with the marsh. Rodents and small mammals may also nest in the marsh. Deer have been reported grazing on rushes and hairgrass (*Deschampsia caespitosa*). Marsh hawks and owls often nest in nearby trees and hunt in the marshes.

Some fresh marsh species, particularly cattails and sedge, are known to be highly productive. The productivity of most others is unknown, but is probably only moderate. Export of detrital material is slow from agricultural wetlands, often requiring flood conditions. Freshwater runoff may bring nutrients and contaminants from adjacent agricultural lands. These may be incorporated in the vegetation or degraded in the sediments before being exported to the Bay.

B. AREAS OF IMPORTANCE AND AREAS OF ENVIRONMENTAL CONCERN

An important result of the Humboldt Bay Wetlands Review and Baylands Analysis is a designation of lands and waters of the study area into categories based on their resource values. The following discussion presents the land and water categories and describes the significance of the designation. The criteria by which areas were designated are based on the data contained in the Study Area Profiles, Sections VI, VII, and VIII, Volume II; these criteria are defined below. A detailed description of each designated area is presented. The designated areas are shown in Plate 2.

LAND AND WATER CATEGORIES

The Land and Water Categories are:

1) Areas of Importance, of unique resources or critical functions.
2) Areas of Environmental Concern, which are environmentally sensitive to development or change.
3) General Areas, in which development would have minimal impact.

SIGNIFICANCE OF THE DESIGNATION

Areas of Importance (AOI) are those areas of such importance and/or uniqueness to the functioning of the Humboldt Bay ecosystem and its aquatic resources that potential destruction or alteration would be discouraged unless it was found to be in the best public interest. Therefore, permit applications in Areas of Importance will require intensive review to determine (1) whether the public interest requires the issuance of the requested permit; (2) whether the benefits of the proposed alteration outweigh the impacts to the estuarine resource; and (3) the proposed work is necessary to realize these benefits. According to Corps regulations, 33 CFR 320.4(a)(1):

> *The decision whether to issue a permit will be based on an evaluation of the probable impact of the proposed activity and its intended use on the public interest....That decision (whether to authorize a proposal and any necessary conditions) should reflect the national concern for both protection and utilization of important resources....No permit will be granted unless its issuance is found to be in the public interest.*

Thus, the public interest is clearly established as a major criterion for the permit issuance decision. Factors in the public interest include: conservation, economics, aesthetics, general environmental concerns, historic values, fish and wildlife values, flood damage prevention, land use, navigation, water supply, water quality, energy needs, safety, food production, and in general, the needs and welfare

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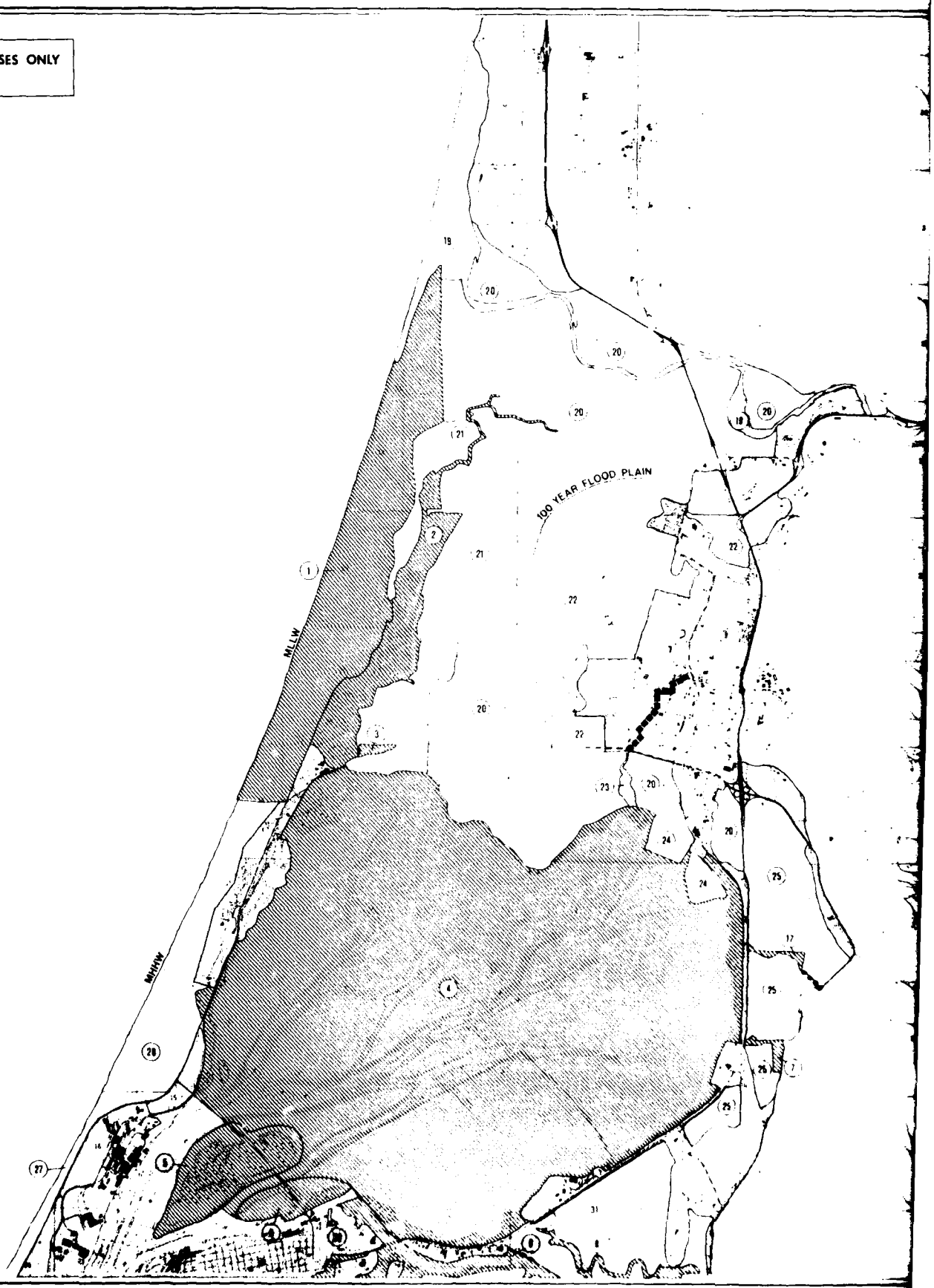


FINDINGS

PLATE NO 2 NORTH

LEGEND

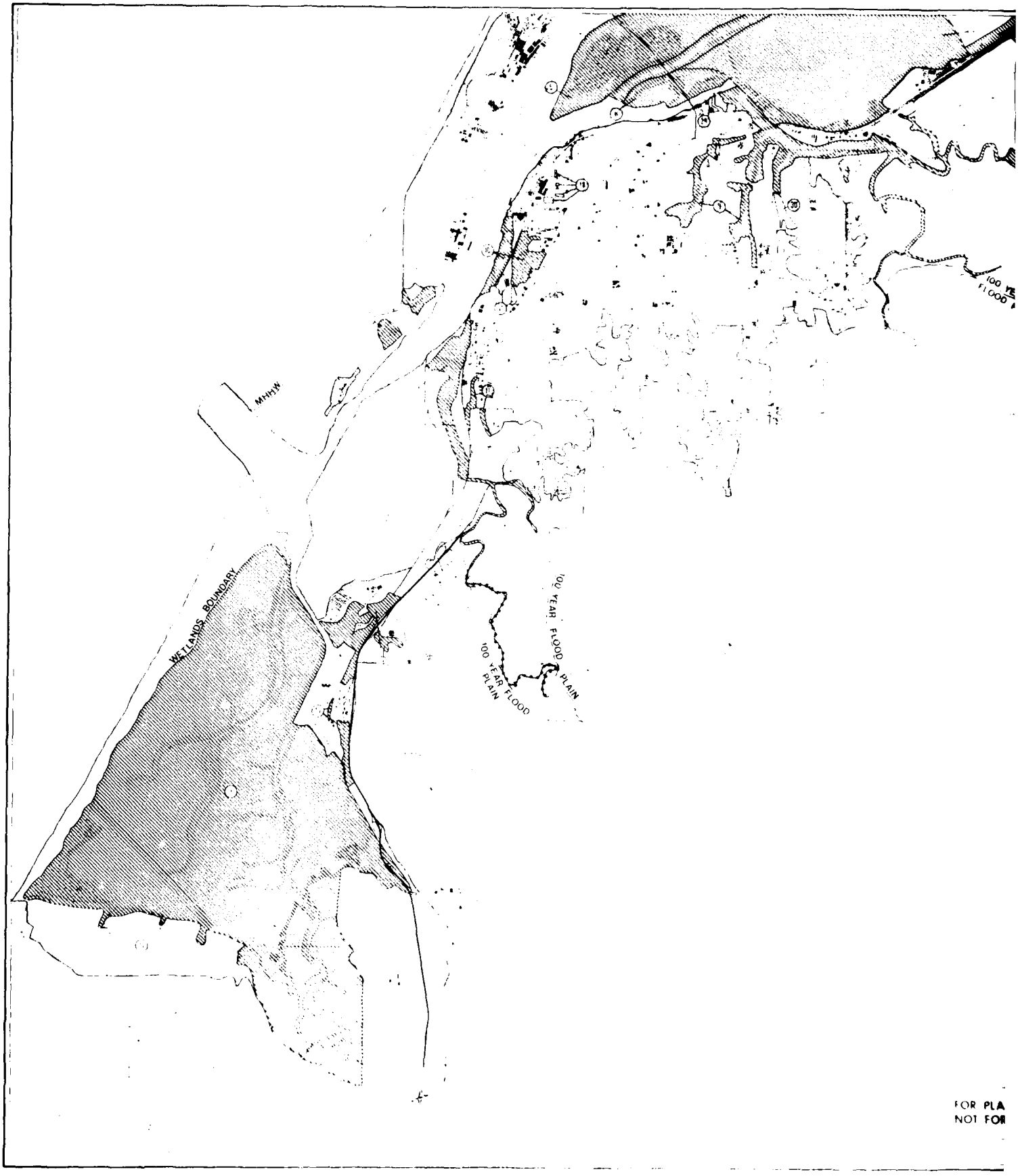
Areas of Importance

Areas of Environmental Concern

General Use Areas

N

HUMBOLDT BAY WETLANDS REVIEW
&
BAYLANDS ANALYSIS



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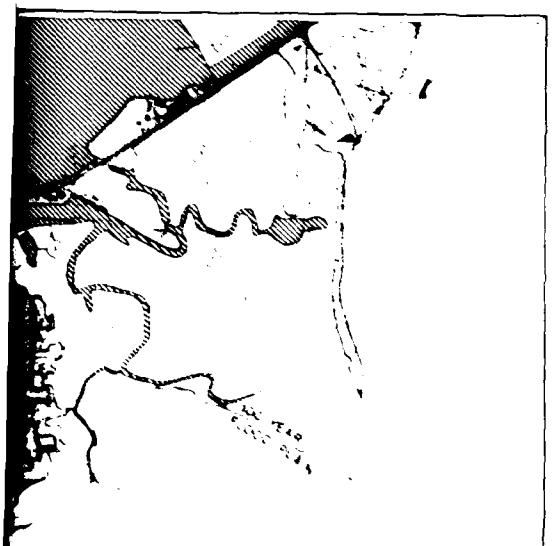

FINDINGS

PLATE NO 2 SOUTH

LEGEND

Areas of Importance

Areas of Environmental Concern

General Use Areas

N

HUMBOLDT BAY WETLANDS REVIEW
&
BAYLANDS ANALYSIS

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the people (33 CFR 320.4(a)(1)). The following general criteria will be considered in the evaluation of every permit application: the relative extent of public and private needs for the proposed project; appropriate alternative locations and methods to accomplish the proposed objective; the extent and permanence of beneficial and/or detrimental effects; and the cumulative effects of the proposed action in relation to other actions in the area (33 CFR 320.4(a)(2)). The Chief of Engineers' Policy on Wetlands and Corps regulations 33 CFR 320.4(b)(2) identify characteristics which make wetlands important to the public interest; these are listed below under Criteria for Designation. Areas of Importance include wetlands and adjacent habitats which as a unit perform functions important to the public interest and which are critical to the Humboldt Bay ecosystem. Wetlands in Areas of Importance should be viewed as Wetlands of Importance per Corps regulations 33 CFR 320.4(b)(2) and 320.4(b)(4). According to Corps regulations 33 CFR 320.4(b)(4):

> *No permit will be granted for work in wetlands identified as important in [33 CFR 320.4(b)(2)] unless the District Engineer concludes, on the basis of the analysis required in [33 CFR 320.4(a)(1 and 2); Public Interest Review], that the benefits of the proposed alteration outweigh the damage to the wetlands resource and the proposed alteration is necessary to realize those benefits.*

In evaluating the necessity of a particular alteration, the District Engineer must consider the aquatic dependency of the proposed activity and the feasibility of alternative sites.

In sum, Areas of Importance are especially critical areas which should generally be maintained in their present state. Corps permit applications in an AOI must be carefully scrutinized by the Corps and all reviewing agencies and should be approved only if the activity is clearly in the public interest.

Areas of Environmental Concern (AEC) are areas which are environmentally sensitive, in which any use or activity should be carefully controlled. The location of any permit activity in such areas must be carefully examined to make certain that the siting has considered the existing fragile resources. Any use or development in Areas of Concern must be subject to the following general guideline recognized as key to the estuarine ecosystem:

- There must be no unnecessary alteration of drainage or any other activity which would:

  a) destroy vital areas;
  b) impede the natural rate or pattern of water flows within the estuarine system;
  c) reduce the historic supply of nutrients from freshwater inflows;

d) increase the discharge of nitrogenous compounds into confined waters;
e) increase natural turbidity and temperature;
f) significantly change natural salinity and oxygen;
g) increase suspended solids or toxic materials;
h) alter or destroy shallows in inundated areas serving essential or desirable ecological functions.

In sum, Areas of Environmental Concern may have multiple uses consistent with maintenance of their habitat values. Corps permit applications must be carefully reviewed and only uses in the public interest and compatible with the habitat values should be approved.

General Areas are areas in which new development would have minimal impacts on wetlands and other valuable habitat types. Such areas might include already altered or damaged areas and/or expansions of existing development modes. General areas may be considered more appropriate for development than the AOI or AEC but proposed permits would still be reviewed on a case-by-case basis. The designation of an area as General Area does not assure permit approval in that area.

Note: It is important to restate here that any permit application for any location in the study area must and will be subject to review of the extent to which such permit is in the public interest and meets all Corps criteria, including environmental criteria, for permit issuance. It should also be noted that all wetlands, whether they be in Areas of Importance or Areas of Environmental Concern or not, *must and should be viewed as important.* Any permit application potentially affecting any wetland in the estuary must be subjected to intensive review.

CRITERIA FOR DESIGNATION

Criteria for designation of Areas of Importance, Areas of Environmental Concerns, and General Areas were developed as follows. In Corps regulations, the public interest is clearly established as a major criterion for the permit issuance decision.

Corps regulation 33 CFR 320-329 lists factors which must be considered in defining the public interest (see also Section IV). These factors include potential impacts on important wetlands. From 33 CFR 320.4(b)(2), *Wetlands considered to perform functions important to the public interest include:*

- *wetlands which serve important natural biological functions, including food chain production, general habitat, and nesting, spawning, rearing, and resting sites for aquatic or land species;*

- *wetlands set aside for study of the aquatic environment or as sanctuaries or refuges;*

- *wetlands contiguous to the above, the destruction or alteration of which would affect detrimentally the natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns, or other environmental characteristics of the aobve areas;*

- *wetlands which are significant in shielding other areas from wave action, erosion, or storm damage;*

- *wetlands which serve as valuable storage areas for storm and flood waters;*

- *wetlands which are prime natural recharge areas; and*

- *wetlands which through natural water filtration processes serve to purify water.*

Of the seven functions identified above, six are natural biological and/or physical functions. The seventh (study of the aquatic environment, sanctuaries, refuges) is a cultural determination, requiring the setting aside of wetlands (and lands) for these purposes. In identifying wetlands which perform the biological and physical functions listed above, it is essential to consider adjacent habitats, for those habitats may have characteristics vital to the continued functioning of the wetlands. Certain of the wetland functions described above are also applicable to non-wetland habitat types.

In addition to the above, there are other factors which express or contribute to the public interest. In evaluating permit applications, the Corps considers all applicable official state, regional, or local land use plans and/or policies as reflecting local factors of the public interest (33 CFR 320.4(j)(2)). The Corps also coordinates and consults with certain federal and state agencies (33 CFR 320.4) so that permit decisions will reflect factors of the national and statewide public interest. Federal, state, and local plans and policies thus provide additional criteria for the selection of areas important to the public interest. Such areas may be identified from specific policies recommending particular locations to be preserved from development and from general policies recommending types of areas to be preserved from development. In the first case, particular areas are often defined very specifically and delineated on maps; in the second case, a general type of area such as a valuable wildlife habitat, a recreational area, or a highly biologically productive area is identified for protection. Specific areas are then identified by first determining which areas fit the primary criterion of productivity, wildlife habitat, and so on.

Other expressions of the public interest may be found in cultural resources (such as archaeologic or historic sites or areas used for public recreation). Areas providing economic benefits, such as harvestable resources, agricultural lands, or prime industrial sites, or areas which are aesthetically pleasing, may also be identified as having public interest value (33 CFR 320.4(a)(1) and (e)).

The criteria used in the area designation are thus based on consideration of natural biologic and physical functions, agency plans and policies, and cultural and economic resources, for these are among the factors used by the Corps in determining the public interest value of a proposed permit activity (33 CFR 320.4). These criteria are summarized under two headings, and then discussed in more detail below:

1. Outline of Criteria for Natural Functional Importance

   a. Natural biological functions, including productivity, vegetation density, plant and animal diversity, and threatened or endangered species habitats.

   b. Ecosystem support functions, including hydrologic periodicity, location or elevation, areal extent, and ecological importance.

   c. Physical protection.

   d. Storm and floodwater storage.

   e. Natural groundwater recharge.

   f. Water filtration and purification.

2. Outline of Ancillary Criteria

   a. Specific preservation policies.

   b. General preservation policies.

   c. Archeological/Historical significance.

   d. Refuges, reserves, educational or scientific value.

   e. Value for recreation and public access.

   f. Visual/aesthetic value.

   g. Economic value.

Definitions

In applying Criteria for Natural Functional Importance, it is necessary to understand certain ecological terms and concepts. These are:

- Ecosystem: A community of organisms, both plant and animal, and its physical environment.

- Food web: This concept is used to describe the pathway of energy through the ecosystem, from primary producers (plants) to primary consumers (herbivores) to secondary consumers (carnivores), and ultimately to decomposers (detritivores).

- Riparian: Adjacent to a stream or river, used to describe a habitat type.

- Trophic: Relating to nutrition or energy conversion within an ecosystem. In a food web primary producers represent the first trophic level, primary consumers the second trophic level, and so on.

- Detritus: Particulate organic matter resulting from decomposition. In ecological systems this refers to plant and animal fragments which result from the death and decomposition of once living organisms.

- Species Diversity: A measure of the variety of species within a given habitat type or area.

- Aquatic Interaction: The periodic or permanent movement of water through an area. Water transports detritus to aquatic lands where it can be used by detritus feeders.

- Nutrient: Any substance which is necessary for the growth, maintenance and reproduction of an organism.

- Productivity: The rate at which energy is stored in an organism (usually measured as the rate at which carbon is assimilated in $g/m^2/yr$). Net primary productivity is the rate at which energy is stored in plants minus that utilized for respiration. Secondary production is the energy stored by consumer organisms.

The following discussion of area designation criteria presents a general definition and description and gives examples specific to the study area. [Note: only examples of criteria specific to the study area are given here; that is, the statement of specific preservation policies is not a complete description of such policies in the study area but only cites examples.]

1. Criteria for Natural Functional Importance

a. Natural Biological Functions

1a) Primary Productivity. Wetlands or other habitat types which have high natural rates of net primary productivity are considered highly valuable. This net primary productivity is the basic energy source for the entire food web in the estuary. Areas with high rates of productivity can support large and diverse populations of organisms. Highly productive areas include algal mats, salt marshes, brackish/freshwater marshes, and swamps. This criterion should not be used alone, however. It is principally a qualitative measure since very few quantitative productivity studies have been carried out in the Humboldt area. The estimated level of

aquatic interaction (see below) should be considered along with estimated net primary productivity. The combination of the two better describes the potential for a given area to be a source of energy for the major food webs in the estuary.

1b) Secondary Productivity. Aquatic lands with dense populations of benthic organisms have high secondary productivity. Benthic fauna store energy extracted from detritus, thus reintroducing it to the food web. Although secondary productivity has not been studied quantitatively in the Humboldt area, studies of benthic populations and their diversity may provide a qualitative indication of secondary productivity.

2) Vegetation Density. Dense vegetation provides protective cover for a wide variety of animals. This is particularly important to small animals, molting waterfowl, or other relatively defenseless animals. Dense vegetation also functions to slow water flow through a wetlands area, thus enhancing sedimentation of suspended solids and their associated nutrients and pollutants.

3) Plant and Animal Diversity. The more diverse, in terms of species number, plant communities tend to support more diverse animal communities. More diverse animal communities in turn exploit the available energy resources more efficiently. Thus, in areas with more diverse animal populations, less of the energy is stored long-term as plant material, while more is used by the animal community. In addition, diverse populations within a single trophic level result in interspecific competition and co-evolution, thus strengthening the genetic character of the species involved (Ricklefs, 1973).

4) Threatened or Endangered Species Habitats. Wetlands or other habitats where there have been observations of a threatened or endangered or otherwise rare or unique species are considered important. Habitats containing locally vanishing or restricted species are also included here.

b. Ecosystem Support

These criteria refer to those areas the destruction or alteration of which would detrimentally affect natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns or other environmental characteristics.

For example, construction of a canal between Mad River and Mad River Slough might significantly reduce salinity in the slough and result in major alteration of the habitat types found there.

1) Hydrologic Periodicity. The frequency and duration of inundation due to tides, river flow or runoff is a measure of the interaction between habitat types within an ecosystem. Subtital algal and eelgrass habitat types exhibit continuous inundation, and therefore very high interaction with adjacent aquatic areas. Salt marshes and intertidal brackish/freshwater marshes and swamps are usually inundated twice daily providing high aquatic interaction. Non-tidal marshes and swamps such as those behind dikes are inundated only by flooding and therefore have lower aquatic interaction with the estuarine ecosystem. Detailed surveys of wetland areas would be necessary to provide a quantitative assessment of hydrologic periodicity in most areas.

2) Location or Elevation. The location of a habitat is an important part of its contribution to the ecosystem. Proximity to the open water system is important when evaluating aquatic interaction. In addition, a wetland which is adjacent to other wetland areas contributes to a larger and more diverse wetland habitat. Isolated habitats, surrounded by urban or agricultural ares, may not contribute as much to the total estuarine ecosystem, although they may be productive units in themselves. Elevation of a wetland is important in evaluating the extent of the aquatic interaction between the wetland and the open water ecosystem. Hydrologic linkages deteriorate as the depth of flooding decreases.

3) Areal Extent. The size value of an area can be very important either by itself or in combination with contiguous related areas. A large unit provides cover and protection for wildlife. It may also provide a functionally intact system, relatively free from outside disturbances. A large unit made up of a variety of habitat types provides a diverse habitat. The shape of a habitat can also be very important in increasing the wildlife value of an area. For example, swamps and riparian habitats possess high wildlife values in different configurations. A swamp serves identical productivity functions whether it be compact or linear. However, wildlife values to swamp species are greatly enhanced by a compact shape. The protection and security provided by the interior of a swamp

are necessary for the survival of many animals which are very wary of, or cannot tolerate, human activity. In contrast, a riparian woodland has more value in a linear shape. The vegetation functions to support wildlife, provide shade for the stream or slough (maintenance of cool water temperature is important to fish habitat), provide a source of primary production to stream detrital feeders (through vegetation falling into the stream followed by decomposition), and provide habitat for insects, many of which become food for fish, or small birds. Also, dense stream or dike bank vegetation provides erosion protection.

4) Ecological Importance. This criterion refers to the characteristics of an area that make it valuable for resting, breeding or feeding. The characteristics required for each species are different, and include specialized nesting or spawning sites, security from predators, availability of nest sites and materials, and food sources. As knowledge of individual species requirements is refined, this criterion will become more valuable. For example, the use of the wetlands by browsing and foraging herbivores is well known. Also, the spawning and nesting of some species are known to occur in the estuary, and identification and protection of these specific habitats is important to maintain the populations.

c. Physical Protection

Areas included here are those that are significant in shielding other areas from wave action, erosion, or storm damage. For example, Elk River Spit protects the shoreline south of Bucksport from waves diffracted through the inlet.

d. Storm and Floodwater Storage

Wetlands are valuable if they are able to store storm or floodwaters and thereby protect upland areas from erosion and save private property from destruction. River and creek floodplains and diked agricultural lands serve this function throughout the Humboldt area.

e. Natural Groundwater Recharge

Areas which serve as prime groundwater recharge areas are important. These area help maintain the general groundwater table. Mad River serves to recharge the aquifer below Arcata Bottoms.

f. Water Filtration and Purification

Wetlands included here are those that serve to purify water through natural filtration processes. Suspended solids and associated contaminants are trapped in wetland sediments and may be released slowly through incorporation by wetland organisms. Recent studies have indicated that particular plant and microbial species and communities have the ability to concentrate, detoxify, or decompose contaminants, such as excess nitrogen and phosphorus compounds, heavy metals, and various hydrocarbons. For example, the cattail *(Typha latifolia)* has been shown to concentrate nitrogen, phosphorus and manganese by removing them from the sediment (Lee, et al., 1976). The wetland plant community thus incorporates free nutrients and releases them slowly as detritus.

2) Ancillary Criteria

a. Specific Preservation Policies

This criterion identifies any specific policy statements or recommendations for preservation of the area under consideration. In the Humboldt Bay study area, particular areas recommended for preservation or development restrictions are identified in several documents. For example, Ordinance No. 7 (Humboldt Bay Harbor, Recreation, and Conservation District) identifies activity type limitations in South Bay. The California Coastal Commission has designated certain parts of the study area unsuitable for power plants. Humboldt County and the cities of Eureka and Arcata have comprehensive plans and zoning (Plate 18) which contain site-specific statements. Arcata's Local Coastal Plan Drafts identify areas for general preservation. These agencies and their policies are discussed in Section VII.

b. General Preservation Policies

This criterion identifies any general preservation policies under which the area falls. For example, the U.S. Fish and Wildlife Service (FWS) discourages encroachment into biologically productive wetlands. It should be noted that FWS has a broader definition of wetlands than that stated in 33 CFR 323.4 (see Section II). Similarly, the Resources Agency has a basic wetlands protection policy. The California Coastal Commission has policies for preservation of recreation areas, marine resources, biological productivity, and water quality (Coastal Act, Chapter 3). Agencies with such general preservation policies include federal

(FWS, NMFS, EPA), state, and various local governments and agencies. These agencies and their policies are discussed in detail in Section VII.

c. Archaeological/Historical Significance

The criterion identifies whether the area under consideration has archaeological or historical significance. Archaeoligically sensitive areas and historic sites in the Humboldt Bay study area are shown in Plate 20. The existence of an archeological or historical site in a given area adds to the area's public interest value.

d. Refuges, Reserves, Educational, or Scientific Value

The criterion identifies whether an area is known to be used for educational or scientific study or is an identified refuge or reserve area. In the Humboldt Bay area certain groups were identified as users of particular wetland areas for educational or research purposes. These groups include local school districts and interest groups such as the Audubon Society. These are discussed in Section VIII.A. There are several formal refuges and reserves in the study area.

e. Value for Recreation and Public Access

The criterion is derived from the California Coastal Act policies on recreation and public access as an expression of the public interest and from Corps regulations 33 CFR 320.4(e). Areas used for recreation and access are shown on Plate 21 and discussed in Section VIII.A.; they include parks, marinas, boat ramps, and commonly used hunting and fishing areas. Potential public access points and potential recreation/park areas are shown on Plate 22.

f. Visual/Aesthetic Value

This criterion identifies whether an area is considered to provide a visually or aesthetically pleasant experience to most observers. Areas considered to provide a good view are held to be areas of public interest. In the Humboldt Bay study area, important landscape types, scenic routes, and viewpoints are identified and discussed in Section VIII.B. Plate 24 shows identified viewpoints.

g. Economic Benefits

The criterion identifies whether an area provides significant economic benefit in the study area; economic benefit is considered to be in the public interest. Areas identified as having harvestable resource value are those used for commercial or sport hunting or fishing, essential as habitat for species of commercial or recreational importance, or active agricultural areas. Spawning beds and shellfish habitats are shown on Plate 11; commercial fisheries are on Plate 25. Areas providing support services for harvestable resources would be secondarily identified under this criterion.

An important State objective in wetlands management is wetland restoration, either enhancement of existing wetlands or the creation of new wetlands. The policies of the State encouraging wetlands restoration are found in Sections 30230, 30231, and 30233 of the Coastal Act and in Senate Concurrent Resolution 28, 13 September 1979. Wetlands restoration is now a condition commonly used in Coastal Commission and Corps permits; it is encouraged by the U.S. Fish and Wildlife Service and by other Federal and State agencies. Wetland restoration was not used as a criterion for area designation because the study team felt that areas should be designated AOI or AEC based on their existing natural functional importance and supported by their existing ancillary characteristics (see following paragraph). However, the potential for wetland restoration is an important aspect of any area and this characteristic is noted where it occurs. A more detailed discussion of wetland restoration is in Section V.D under Compensation/Mitigation.

The above criteria are not all equal in importance. Those criteria derived from the factors listed in 33 CFR 320.4(b)(2) are considered more important than the others and are given greater weight in the process of areas designation. All criteria under Natural Functional Importance and the Ancillary Criterion of Refuges, Reserves, Educational or Scientific Value are considered very significant, and areas which meet many or all of these criteria will generally be designated Areas of Importance. Areas which meet fewer of these criteria were designated Areas of Environmental Concern. All criteria involving local, state, or federal policy, other than 33 CFR 320.4(b)(2) were given lesser weight than the physical and biological criteria. That is, policy alone would not be sufficient to designate an area AOI; the area must meet the physical and biological criteria. However, an area which meets fewer of the physical and biological criteria but significantly fulfills the ancillary criteria may be elevated in designation.

DESIGNATED AREAS

In the Humboldt Bay study area, 17 areas are identified as Areas of Importance (AOI) (Plate 2). These are as follows:

1. Mad River Dunes
2. Mad River Slough
3. Mad River Mill POnd
4. North Bay
5. Indian Island
6. Woodley/Daby Islands
7. Bayside Wetlands
8. Eureka/Freshwater/Fay Sloughs and Wetlands
9. Eureka Gulches
10. North Broadway Wetlands and Intertidal Flats
11. South Broadway Wetlands
12. Elk River and Associated Wetlands
13. North Spit Wetlands
14. King Salmon Wetlands
15. Fields Landing Wetlands
16. South Bay
17. Jacoby Creek

Another 20 areas are identified as Areas of Environmental Concern (AEC); these are:

18. North Broadway Pocket Marshes
19. Mad River
20. Arcata Bottoms Center/Mad River
21. Arcata Bottoms West
22. Arcata Bottoms East
23. McDaniel Slough
24. Arcata Marsh and Oxidation Pond
25. Bayside Bottoms
26. Manila Dunes
27. North Spit, Beach, and Coast Guard Station
28. Eureka Bottoms
29. Eureka Waterfront
30. Martin Slough/Upper Fourth Gulch
31. Palco Marshes
32. Elk River Spit
33. Elk River Bottoms/Spruce Point
34. Entrance Bay/Buhne Point
35. South Spit
36. Beatrice Flats
37. Table Bluff

The areas are not listed here in order of importance. Both the Areas of Importance and the Areas of Environmental Concern are shown on Plate 2; the number of each area is listed on the Plate for easy identification. The boundaries of each area are defined by physical and biological criteria.

Each Area of Importance or Area of Environmental Concern is described in detail in the format shown on Template 2 (page 60). The title of Template 2 is either Area of Importance or Area of Environmental Concern, depending on area presented. The location and total acreage of the area is shown, and the habitat types (Volume III) that constitute each area are given with their acreage in the area and percentage acreage in the estuary. The history of each area, in terms of diking, and other activities is presented. The natural functional importance of the area is discussed; the questions on Template 2 reflect the criteria for judging natural functional importance; that is, the physical and biological importance of the area. The ancillary importance of the area, that is its importance in terms of public policy and cultural resources, is also described. The pressure for development of the area is described. The purpose of a format such as Template 2 is to provide for the reader a complete description of the important characteristics of each area in a brief and easily readable manner. Such a format also allows a ready comparison between areas.

The areas designated as General Use Areas are described in a summarized form following the AOI/AEC descriptions. General Use Areas are discussed in terms of development pressure and the general kinds of activities considered suitable. Natural functional characteristics and ancillary characteristics of General Use Areas are not discussed in detail, principally because most of the General Use Areas are already substantially developed.

The following abbreviations are used in the template descriptions of AOI and AEC:

Federal Agencies

FWS	U.S. Fish and Wildlife Service
BLM	Bureau of Land Management
NMFS	National Marine Fisheries Service
EPA	Enviornmental Protection Agency
SCS	Soil Conservation Service
HCRS	Heritage, Conservation, and Recreation Service

California State Agencies

DFG	Department of Fish and Game
DBW	Department of Boating and Waterways
DPR	Department of Parks and Recreation
CCNCR	Coastal Commission, North Coast Region
ERCDC	Energy Resources Conservation and Development Commission
SLC	State Lands Commission
SWRCB	State Water Resources Control Board and Regional
RWQCB	Regional Water Quality Control Board
OPR	Office of Planning and Research
HSU	Humboldt State University

Local Agencies

HC	Humboldt County
Harbor District	Humboldt Bay Harbor, Recreation, and Conservation District
HBWA	Humboldt Bay Wastewater Authority
CSA #3	Humboldt County Service Area #3
Arcata	City of Arcata
Eureka	City of Eureka

Other

CNACC	California Natural Areas Coordinating Council (a private consulting organizaton)
ORV	Off-road vehicles

Template 2 (Sample format)

AREA OF IMPORTANCE (AOI)/AREA OF ENVIRONMENTAL CONCERN (AEC)

LOCATION: Name and identification number as indicated on maps.

Total Acreage:

Habitat Types	Acreage at Location	% of Total type in Study Area	
1. Classification name of each habitat within area.	Acreage of each habitat type at location.	% of total area of each type within the study area	Points of interest concerning each habitat type. [illegible] example, largest single [illegible] cel in study area; bra[illegible] swamp behind sali[illegible] exhibiting su[illegible] change to swamp.
2.			
3.			
4.			

History of Area:

Has the area been diked? When? Were the di[illegible] jacent activities affected the area? How? W[illegible]

Natural Functional Importance:

What important natural biological function[illegible] highly productive, providing an important [illegible] area? Is it an important nesting, resting, [illegible] wildlife in the study area? Does this area [illegible] dangered species? Does this area provide [illegible] another important wetland area? (This [illegible]

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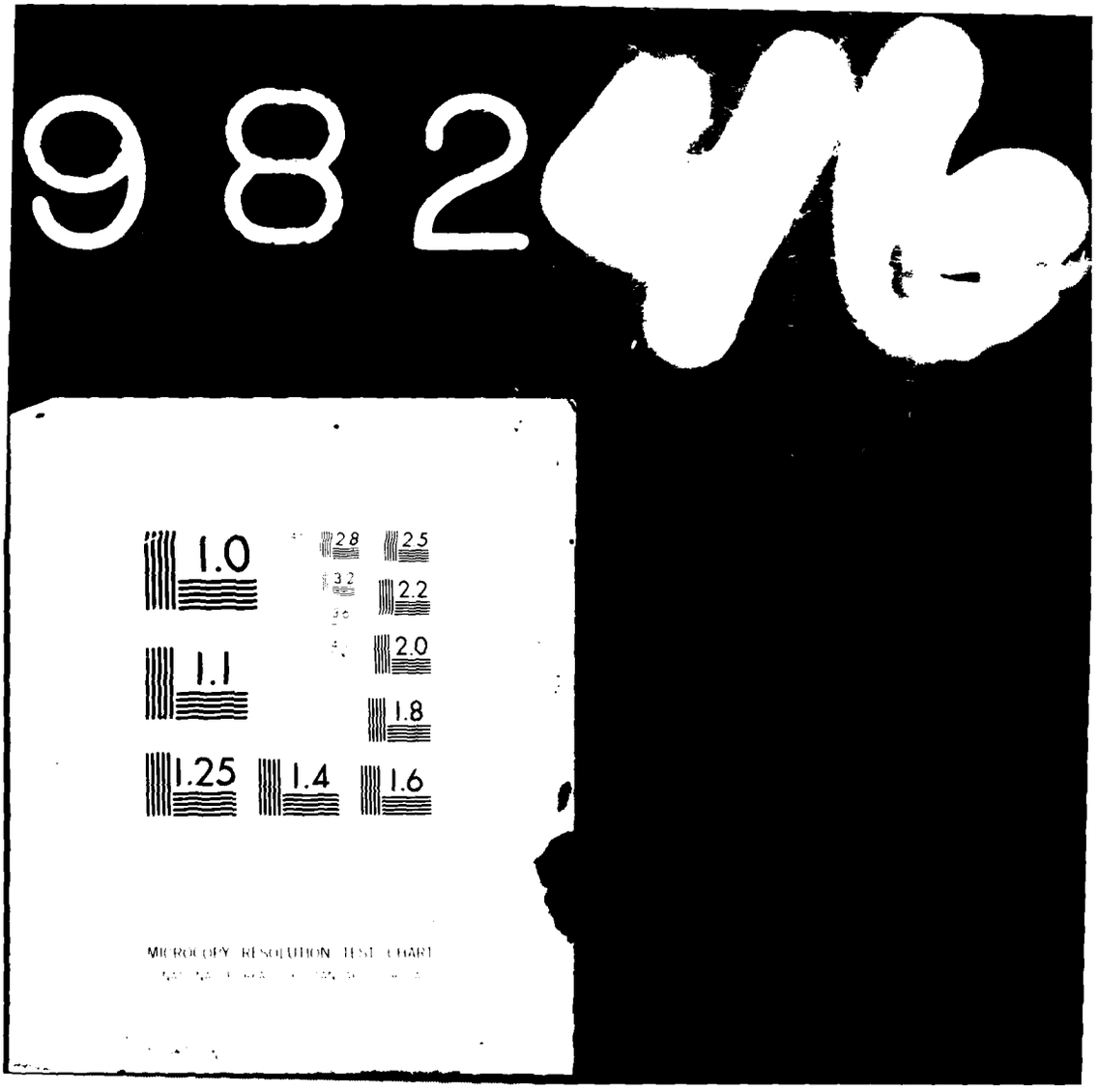
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MICROCOPY RESOLUTION TEST CHART

control of sedimentation patterns, salinity, flushing characteristics or current patterns). Does this area serve to protect other areas from storm or wave induced erosion? Does the area provide storage for floodwater? Does the area function to recharge local groundwater? Does the area act as a water filtration site, aiding in water quality maintenance?

Ancillary Importance:

How does the area relate to general federal, state, or regional preservation policies? Are there specific policies for preservation of this area? Have local jurisdictions identified this area for particular purposes, and if so, what? Is it an identified refuge or reserve area? Is there a historic site in the area or is it archaeologically sensitive? Is the area used for educational, scientific, or recreational purposes? Does it have a high aesthetic value? Is it valuable for commercial or sports fishing or hunting? Is its economic potential high?

Development Pressure:

What is the present land use and recent permit history in the area? What is the use of surrounding lands and water? What is the accessibility and availability of urban services? What are the specific policies permitting development? Ownership of the area and adjacent lands and tidelands? What uses are planned for the area and surrounding lands; general plan designations and zoning? Summary statement of development pressure.

Buffer zones or areas should generally be established around Areas of Importance and wetlands (and other sensitive habitats) in the study area, so that such areas can be protected from any adverse impacts of development activities in adjacent lands. The appropriate buffer zone width should be determined on a case-by-case basis, based on the following criteria as defined in this report and in the Coastal Commission's Draft Statewide Interpretive Guidelines for Wetlands and Other Environmentally Sensitive Areas, December 1979:

a. Natural functional importance and ancillary characteristics of the AOI, wetland, or environmentally sensitive area.

b. Biological significance of adjacent lands.

c. Sensitivity of species in the wetland or sensitive area to disturbance.

d. Susceptibility of the adjacent lands to erosion.

e. Use of natural topographic features to locate development.

f. Use of existing cultural features (e.g., roads and dikes) to locate buffer zones.

g. Lot configuration and location of existing development.

h. Type and scale of development proposed.

Suggested buffer zone widths in the study area are:

- Minimum buffer width of 100 feet around wetlands and environmentally sensitive areas. (Coastal Commission)

- Wetlands buffer areas of 450 feet <u>or</u> the nearest paved road or 50 foot contour, whichever is closer. (Humboldt County LCP)

- Riparian corridors of 100 feet on perennial streams and 50 feet on ephemeral streams. (Humboldt County LCP)

AREA OF IMPORTANCE

LOCATION: (1) MAD RIVER DUNES — Total Acreage: 1,208.9

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Urban	1.8	<0.1	
Agriculture	63.2	0.5	
Sparse dune	140.0	15.7	Largest contiguous parcel of pristine dune habitat in the study area.
Vegetated dune	226.4	14.2	
Dune hollow	33.5	26.2	
Dune swamp	25.2	29.0	
Moving sand	497.0	65.9	
Closed cone pine forest	221.4	37.8	
Closed ditch	0.4	0.2	

History of Area

This is a pristine area which has received very few impacts as a result of human activities. Along the southeastern boundary a railroad grade (now defunct) was completed in 1897. A few roads and trails have been created in recent years by ORV traffic, mainly in the southern end.

Natural Functional Importance

This area is one of the largest and most pristine ecosystems in the study area. Unfortunately, relatively little study has been carried out on wildlife in the area although such study is increasing. Closed cone pine forest and swamp exhibit medium to high productivity. Little of this is exported, but instead is incorporated into soil production. Other habitat types have low productivity. Small mammals, furbearers, and deer are common in forest, swamp, and densely vegetated dune areas. Small birds, especially seed eaters and insectivores, are common. Herons and egrets are found in swamps and adjacent open water; a night heron rookery is reported on the east side of the area. The candidate threatened species *Erysimum menziesii* has been noted in the sparse dune habitat. Snowy owls are seen here irregularly.

Ancillary Importance

As an undisturbed and unique coastal dune forest habitat with recreational value, the area falls under general preservation policies of federal (FWS, BLM, NMFS, HCRS, EPA), state (CCC and OPR) and local (Humboldt County and Arcata) agencies. It is an area designated unsuitable for power plants. The BLM lands in the area are used for outdoor recreation and wilderness preservation. The CCC identifies the North Spit dune forests as a unique habitat. The area contains the Lanphere-Christensen Dune Reserve, owned by the Nature Conservancy and used for educational and scientific purposes; these dunes were identified as an important natural area by the CNACC. The entire area is archaeologically sensitive, containing 11 identified sites.

Development Pressure

The entire area is presently in open space. It is bordered on the east and north by agriculture and a county park and by open space and a small industrial area on the south. Most of the area is privately owned (part by the Nature Conservancy), but the BLM owns about 175 acres in the southern part. There are no roads or urban services in the area; access to the Lanphere-Christensen Dunes is controlled by Humboldt State University. However, the Humboldt County CAC has endorsed the Coastal Trail Concept. The area is shown as Natural Resource/Wildlife Habitat in Arcata's General Plan. Humboldt County shows no designated zoning for the area. Local policies generally support preservation. Development pressure is negligible except for possible ORV use and impacts.

AREA OF IMPORTANCE

LOCATION: (2) MAD RIVER SLOUGH Total Acreage: 510

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Urban	6.9	<0.1	
Dune swamp	1.2	1.4	
Vegetated dune	13.2	0.8	
Closed cone pine forest	5.4	0.9	
Cordgrass marsh	2.6	0.5	
Pickleweed marsh	125.3	30.3	
Mixed fresh marsh	0.6	0.9	
Intertidal flats	105.9	35.1	
Closed ditch	0.9	0.5	
Tidal slough	248.5	35.9	

History of Area

Mad River Slough has been the center of a major wetland system since before recorded history. In 1855 a canal was constructed from Mad River to Mad River Slough to bring logs into the Bay. By 1888 this enterprise had failed and the canal was closed, after introducing large quantities of sediment into the slough. Diking of Arcata Bottoms and the east shore of Mad River Slough was completed in 1893, removing large areas of wetland from the slough ecosystem.

Natural Functional Importance

The salt marshes and intertidal flats of this area are highly productive. Primary production from cordgrass and pickleweed is exported as detritus to the intertidal flats where it is consumed by benthic organisms. These, in turn, are food for numerous fish, especially juveniles, which prefer the protected slough environment. Leopard and brown smoothound sharks have been noted mating in the upper reaches of the slough. Commercial oysters are cultured on rafts. Shorebirds, wading birds, and waterfowl commonly feed on the intertidal flats. Wilson snipe have been studied on marsh islands in the slough. The proposed endangered species *Orthocarpus castillejoides* var *humboldtiensis* has been reported in this area. The endangered clapper rail was reported here in 1932.

Ancillary Importance

As a productive water and wetland habitat, the area falls under EO 11990, the Resources Agency's wetland policy, and general preservation policies of FWS, NMFS, EPA, SCS, DFG, CCNCR, CEC, SLC, and OPR. It is an area designated unsuitable for power plants.

It was identified as an important area by the CNACC. Sloughs are under a general protection issue statement in the HC LCP workplan. Mad River

Slough is recommended for preservation as open space in Arcata's General Plan; Arcata's LCP recommends protecting aquaculture as a use. The Slough falls under the Harbor District's designation of Conservation waters. The area is used for educational and scientific study by HSU, College of the Redwoods, and Audubon. The bridges at Lanphere Road and Highway 255 provide hunting and fishing access to the slough. Near the Highway 255 bridge is a significant viewpoint. The channel of Mad River Slough is used for aquaculture, although rafts are not visible from either the Lamphere Road Bridge or the Mad River Slough Bridge. Rafts probably do not interfere with navigation.

Development Pressure

Land and water uses include aquaculture, recreation, and educational and scientific study. Surrounding lands are in agriculture (mostly pasture) and open space. The area is accessible by boat; hunting and fishing access points are at Highway 255 and Lanphere Road. There are no urban services to the area. Small portions of the wetlands are in public ownership (HSU); Pigeon Point Oyster Company leases the water for oyster culture. Arcata's General Plan shows the area as Natural Resource/Wildlife Habitat. The area is zoned Agriculture Exclusive. Development pressure for activities other than aquaculture is considered negligible.

AREA OF IMPORTANCE

LOCATION: (3) MAD RIVER MILLPOND Total Acreage: 18.6

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Shrub	0.4	0.1	
Fresh rush marsh	16.6	36.2	Largest single parcel
Mixed fresh marsh	1.6	2.4	

History of Area

This area was originally part of the wetlands adjacent to Mad River Slough. It was diked as part of the Arcata Bottoms in 1905. It was subsequently diked for use as a millpond, and abandoned in 1973. The pond has since reverted to a mixed freshwater wetland area; it has since been conveyed to Humboldt State University.

Natural Functional Importance

This mixed freshwater ecosystem is an important habitat for birds and small mammals in the area, since all adjacent areas are either agriculture, salt marsh, or sloughs. Although small, it can provide shelter and freshwater for a large number and diversity of terrestrial mammals, including some which feed in adjacent pastures.

Ancillary Importance

As a productive marsh wildlife and waterfowl habitat, the area falls under EO 11990, the Resources Agency's wetland policy, and general preservation policies of FWS, EPA, SCS, DFG, CCNCR, and OPR. It is an area designated unsuitable for power plants. It is potentially useful as an educational and scientific wetland study area and for recreation (hunting) as it is near Highway 255.

Development Pressure

This open space area is surrounded by agricultural uses. It is accessible by foot from Highway 255. It has no urban services. The area was recently donated to HSU. Although it is designated Industrial in Arcata's General Plan, it is zoned Agriculture Exclusive. Development pressure is considered to be negligible.

AREA OF IMPORTANCE

LOCATION: (4) NORTH BAY — Total Acreage: ~8,400

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Grassland	2.4	0.4	
Shrub	4.4	1.3	
Sparse dune	2.3	0.3	
Cordgrass marsh	185.8	33.4	Widely scattered around Bay perimeter.
Pickleweed marsh	148.6	35.9	
Sedge marsh	4.5	16.0	
Hairgress marsh	4.3	5.4	
Brackish rush marsh	1.7	2.0	
Fresh rush marsh	6.6	14.4	
Swamp	3.3	1.8	
Shallow tidal channel	750.0	35.0	
Deep tidal channel	830.0	24.0	
Intertidal flat	6,430.0	65.0	~1,035 acres eelgrass

History of Area

North Bay has been a major area of commercial and navigation activity since the time of settlement. Arcata (or Union) Wharf was extended south from I Street into the Bay by 1855, and functioned until about 1932. Navigation buoys to the wharf were removed during World War II. Sand Islands were formed from disposal of material dredged from the Arcata Channel by the Corps during that period. Trestles and wharfs also extended into the Bay from Jacoby Creek and Bayside; all were in ruins by 1927. Marshes southwest of the mouth of Mad River Slough were diked between 1903 and 1927, and had reverted to wetland by 1948. Log rafts were stored along the southwest shore of the Bay from the 1930's to the 1950's. The marsh at Bracut was filled between 1903 and 1927. Commercial oyster culture has been conducted in North Bay intermittantly since 1910, and continuously since 1955. Commercial fishing has also been a major activity in the Bay. The Samoa Bridge was completed in 1971. Eureka Oyster Farms built oyster racks in North Bay between 1967 and 1973.

Natural Functional Importance

The marshes surrounding North Bay are all highly productive, as are the eelgrass beds. Detritus from these sources support a wide variety of invertebrate benthic organisms, including the commercial oysters. Native oysters and clams are also widely dispersed throughout the flats. Large populations of waterfowl, shorebirds, and wading birds feed in the marshes and intertidal flats. The Bay serves as a nursery area for a wide variety of fish, including juvenile salmon that use the intertidal flat and marsh areas. There are also commercial herring, anchovy, and surf-perch fisheries within the Bay. Many fish feed in part on benthic organisms living in intertidal flats. Cormorants and caspian terns nest in

the vicinity of the Old Arcata Wharf. Seals haulout for pupping on intertidal flats of the Bay. Marshes along the east shore provide some protection from wave and storm damage. The endangered species *Cordylanthus maritimus* ssp. *maritimus* and the proposed endangered *Orthocarpus castillejoides* var. *humboldtiensis* have both been found in the marshes of the Bay.

Ancillary Importance

As highly productive wetlands, intertidal flats, and shellfish habitat, the area falls under EO 11990, the Resources Agency's wetland policy, and general preservation policies of FWS, NMFS, EPA, SCS, DFG, DPR, CCNCR, CEC, SLC, SWRCB (RWQCB), and OPR. The SWRCB and RWQCB are concerned about protecting water quality in the Bay, in particular in aquaculture areas. The entire Bay is a "premium waterway" and an "extraordinary wildlife waterway," as designated by OPR. The Arcata Bay North intertidal flats are identified as a natural area by the CNACC. The area is under general preservation policies of the General Plans of HC and Arcata. Portions of the marshes are zoned Natural Resource Preservation by Arcata. The Eureka General Plan describes eelgrass and intertidal flats as critical habitat areas to be protected. The various LCP documents of local jurisdictions all identify North Bay as an important wildlife habitat and shellfish area. The Harbor District designates North Bay as Conservation Water and the marshes as Public Open Space/Agricultural lands. Parts of the area are approved (and acquired) for the National Wildlife Refuge (FWS) and as such constitute a CNACC natural area. Part of the area are in DFG shellfish reserves (oyster and clam). Much of the shoreline is archaeologically sensitive. The area is used for education and research by HSU, College of the Redwoods, and the Audubon Society. The area is used for sport fishing as well as a significant commercial fishery (anchovy and herring). It is also used for commercial aquaculture, in particular bottom-based oyster culture. Parts of the area are commonly used for hunting (but hunting is no longer allowed in the portion of the National Wildlife Refuge around the mouth of Jacoby Creek). The area is an aesthetic resource, visible from numerous places and containing several important viewpoints.

Development Pressure

The area is open space, marsh/wetlands, intertidal flats and channels; it is used for aquaculture, commercial and sports fishing, and hunting. It is bordered by various uses including agriculture, highways, residential development, and industry. The shoreline is readily accessible from the dikes along the north part of the Bay and from the bordering developments. The Bay itself is only accessible by boat. Urban services to the land portions are available only in Eureka and Arcata. Local policy supports development of the aquaculture industry. A significant portion of the tidelands is privately owned; all tidelands not privately owned are granted to the Harbor District or to the Cities of Eureka or Arcata. The Eureka and

Arcata tideland grants cover large parts of the area. Much of the wetland area is in private ownership, but wetlands near the mouth of Jacoby Creek are in public ownership (Wildlife Refuge). All the land area is designated Open Space or Natural Resource/Wildlife Habitat by the Eureka and Arcata General Plans. The land area in Eureka is zoned Industrial, that in Arcata is zoned Natural Resource Preservation, and areas along the North Spit are not zoned. Zoning does not apply to the Bay itself. The Pigeon Point Oyster Company proposes to develop tray oyster culture on 60 acres on the west side of Mad River Slough 500 yards south of the Highway 255 bridge. Development pressure is considered low for parts of the land area along the west, north, and east sides of the Bay and low to medium for the part of the land area in Eureka. In the Bay itself, pressure for expansion of aquaculture is moderate to high; Weyerhaeuser would like to locate a salmon ranching facility there.

AREA OF IMPORTANCE

LOCATION: (5) INDIAN ISLAND — Total Acreage: 266.7

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Urban	8.9	<0.1	
Grassland	8.8	1.4	
Shrub	2.2	0.6	
Dune hollow	2.9	2.3	
Dune sparse	22.1	2.5	
Deciduous forest	10.3	4.8	
Evergreen forest	3.1	0.2	
Cordgrass marsh	167.6	30.1	Largest salt marsh parcel in study area.
Pickleweed marsh	25.3	6.1	
Hairgrass marsh	1.9	2.4	
Intertidal flat	7.0	2.3	
Tidal slough	6.6	1.0	

History of Area

Prior to settlement, most of Indian Island was salt marsh. A saw mill was constructed on the southeast shore about 1867. By 1870, approximately 100 acres had been diked for agricultural purposes; the dikes were breached in 1885 and the area reverted to salt marsh. Between 1927 and 1939, dredge material was deposited on the south end of the island. In 1971, the Samoa Bridge was completed from Eureka to North Spit, bisecting the island.

Natural Functional Importance

The salt marshes on the island are highly productive and export considerable detritus to the adjacent intertidal flats. A large egret and heron rookery is located on the island. This is the northernmost coastal breeding site for the American egret. Shorebirds commonly feed in the adjacent intertidal flats. Kites and rails (probably Virginia) have been noted on the island. The endangered clapper rail was last reported in Humboldt Bay on Indian Island in 1966. The proposed endangered plant *Orthocarpus castilleioides* var. *humboldtiensis* has been reported here. *Cordylanthus maritimus* (ssp.?) has also been reported here.

Ancillary Importance

Since the island is mostly salt marsh and vegetated dune, it falls under EO 11990, the Resources Agency's wetland policy, and general preservation policies of FWS, NMFS, EPA, SCS, DFG, CCNCR, CEC, SLC, OPR, Humboldt County (General Plan and LCP), and Eureka (General Plan). It is an area designated unsuitable for power plants. It is in the Harbor District's Public Open Space designation and is a CNACC natural area. The island is part of the approved National Wildlife Refuge (FWS). There is a DFG clam reserve around the southern tip of the island. The entire island is archaeologically sensitive; it has two prehistoric Indian sites (Gunther Island Sites 67 and 68),

one of which is on the National Register. The island is visible and offers an important scenic view.

Development Pressure

The island is in open space and wetlands; it has shipping channels on both sides. It is not readily accessible by car or foot, since it is fenced off from Highway 255; however, the Coastal Commission shows a potential access point from the bridge. It is accessible by boat. A permit to access the public land on the island must be obtained from the City of Eureka. There are no urban services on the island. It is in public ownership, except for a small area if privately owned land on the southeast shore. The Eureka General Plan designates it as Open Space. No zoning is shown on Eureka maps. Development pressure is considered negligible except for possible access for recreation, educational, and scientific purposes.

AREA OF IMPORTANCE

LOCATION: (6) WOODLEY/DABY ISLANDS Total Acreage: 141.5

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Urban	2.0	<0.1	Note: areal extent determined prior to marina construction.
Grassland	31.6	4.8	
Cordgrass marsh	21.7	3.9	
Pickleweed/saltgrass marsh	4.5	1.1	
Brackish rush marsh	3.6	4.5	
Intertidal flat	5.2	<0.1	
Shrub	6.7	2.0	
Deciduous forest	12.5	5.8	
Mixed fresh marsh	1.4	2.1	
Cattail marsh	0.1	<0.1	
Shallow tid[illegible] channel	52.2	2.5	

History of Area

In 1850 these two islands were totally covered by salt marsh; Daby Island remains so. A wharf and log booms were in place on Woodley Island by 1880. Dredge material was first deposited on Woodley Island prior to 1927. In 1971 the Samoa Bridge was completed across Woodley Island. Marina development on the southeast shore of Woodley Island has been discussed in the Humboldt Bay area for many years, principally because of the protected nature of this area (it is located on the river reach of the Eureka channel). With the completion of the Samoa Bridge, the accessibility of Woodley Island was greatly increased. A marina development study was undertaken for Woodley Island in 1975. The Woodley Island Marina was finally approved and funded by EDA and marina construction began in 1979.

Natural Functional Importance

The salt marshes of both Daby and Woodley Islands are highly productive and export much of the products to the adjacent flats and bay. Shrews, mice, rats, rabbits, deer, mink and river otter have been found living on the island. Numerous birds are reported to visit or breed on the island. The proposed endangered species *Orthocarpus castillejoides* var. *humboldtiensis* has been identified on Woodley Island.

Ancillary Importance

As a valuable and highly productive wetland and forest habitat, the area falls under EO11990, the Resources Agency's wetland policy, and general preservation policies of FWS, NMFS, EPA, SCS, DFG, CCNCR, CEC, and OPR. It is designated unsuitable for power plants. Eureka's General Plan designated the islands as Forest/Open Space, and the Harbor District designated the northwesterly two-thirds of Woodley Island adjacent to the Arcata Channel as Public Open Space. About 25 acres of Woodley Island will be

a habitat reserve, set aside as part of the mitigation requirements for the Woodley Island Marina. The entire area is archaeologically sensitive. The approved Woodley Island Marina and associated habitat reserve will be a major recreational area and the habitat will be used for educational and scientific purposes.

Development Pressure

Woodley Island is unused open space except for the Woodley Island Marina being constructed on the southeast shore with funds granted by EDA. Historically the area was inaccessible except by boat, but the Samoa Bridge increased its accessibility. The marina development will also make it more accessible. There will be roads and urban services connected with the marina. The marina will put some development pressure on the part of Woodley Island not reserved for habitat. Both islands are shown as privately owned, but the Harbor District now owns the marina and habitat areas. The Eureka General Plan shows a marina and waterfront plaza on the south shore. Development pressure is high for the marina site, negligible for the habitat area and for Daby Island, and low for the remainder of Woodley Island.

AREA OF IMPORTANCE

LOCATION: (7) BAYSIDE WETLANDS Total Acreage: 25.4

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Cordgrass marsh	13.7	2.5	
Pickleweed/saltgrass marsh	8.1	2.0	
Intertidal flat	0.9	<0.1	
Tidal slough	2.1	0.3	
Shrub	0.6	0.2	

History of Area

This area was originally a small lagoon surrounded by wetlands and tidally connected to North Bay. Several creeks, including those in Washington Gulch and Rocky Gulch, drained into the lagoon (probably creating a brackish environment). Completion of the NWPRR in 1901 along the bay shore was followed by dikes around the lagoon, reclaiming the adjacent wetlands. The lagoon area remains tidal, but has become so shallow that salt marsh species now dominate.

Natural Functional Importance

The cordgrass and fresh marshes are highly productive. The production is probably slowly exported by the tides and more readily exported under flood conditions. The cordgrass and freshwater marshes and adjacent swamp lands provide nesting and feeding habitat for small birds and mammals. Herons and egrets feed in the marshes and tidal sloughs. Storm water runoff from the gulches is stored in this area. Cutthroat trout migrate through this area into Washington Gulch.

Ancillary Importance

As a wetland habitat, the area falls under EO11990, the Resources Agency's wetland policy, and general preservation policies of FWS, SCS, DFG, CCNCR, CEC, and OPR. It is an area designated unsuitable for power plants. It is under the general natural resource preservation policy of HC's General Plan. It is in an area designated Public Open Space/Agricultural by the Harbor District.

Development Pressure

The area and its surroundings are in agricultural (pasture) use. It is easily accessible from Old Arcata Road and is near Highway 101. No sewer service exists to the area. It is privately owned and is shown as agriculture/open space in Eureka's General Plan. No zoning classification is shown on Humboldt County maps. Residential development has been increasing along Old Arcata Road north of the area; this may contribute to development pressure in the area. A housing development was proposed for this area in 1975 but was turned down on appeal to the State Coastal Commission. Development pressure on this area is low to moderate.

AREA OF IMPORTANCE

LOCATION: (8) EUREKA/FRESHWATER/FAY SLOUGHS AND WETLANDS — Total Acreage: 321.6

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Cordgrass marsh	22.3	4.0	
Pickleweed/saltgrass marsh	54.5	13.2	
Hairgrass marsh	14.1	17.6	
Sedge marsh	8.6	30.7	
Cattail marsh	3.0	10.7	
Tidal creek	130.1	18.8	
Closed ditch	2.1	1.3	
Intertidal flat	56.2	0.6	
Swamp	3.7	2.0	
Mixed forest	26.5	5.8	
Urban	0.5	<0.1	

History of Area

Prior to completion of the NWPRR in 1901 all of the lowlands from Eureka northward to Bayside were tidal wetlands. Following completion of the railroad most of Fay and Freshwater Sloughs were diked and the wetlands reclaimed for agriculture. By 1927 wetlands remained only in the vicinity of Freshwater Corners, west of Ryan Slough, in First, Second (Cooper), Third and Fourth Gulches in Eureka, and at the present sites of the airport and the commercial area west of the airport. The latter two sites were diked and reclaimed about 1930. Most of the wetlands around freshwater corners have been drained since 1945. In the 1950's, the northern channel of Fay Slough was cut off during an extension of the airport runway.

Natural Functional Importance

The cordgrass and sedge marshes are highly productive. Most of this production is readily exported during regular tidal inundations. Herons and egrets feed in the sloughs and nest in adjacent woods. Salmon, steelhead and cutthroat spawn in Ryan and Freshwater Creeks. The juveniles probably use the marshes along the sloughs as nursery areas. The fresh marshes of the old Fay Slough Channel are an important waterfowl feeding area. The lowlands adjacent to the sloughs have been noted as waterfowl nesting areas. *Orthocarpus castillejoides* var. *humboldtiensis*, a proposed endangered species, has been found along the upper reaches of Fay Slough.

Ancillary Importance

As a wetland/tidal slough habitat, serving for fish rearing and migration and for hunting and fishing, the area falls under EO11990, the Resources Agency's wetland policy, and general preservation policies of FWS, NMFS, EPA, HCRS, SCS, DFG, DPR, CCNCR, CEC, SLC, SWRCB, and OPR. It is an area designated unsuitable for power plants. Eureka Slough is a CNACC natural

area. The Eureka General Plan shows part of the south bank of Eureka Slough, the gulches, and the lands around Freshwater and Fay Sloughs as Agriculture/ Open Space. The Harbor District designates this area as Conservation Water and Public Open Space/Agricultural lands. The area is archaeologically sensitive and is used for education and research by HSU. Part of the area is commonly used for hunting and fishing (DFG) and there are several potential access points. The fish population has both commercial and sports value.

Development Pressure

The sloughs are open water and the surrounding lands are mostly in agriculture/open space, except for the airport and the industrial/commercial area on the north bank of Eureka Slough. The Harbor District's compensation area for the Woodley Island Marina is located at an old filled pond area west of Freshwater Slough. Access is generally good by boat and by road to various parts of the area. Urban services are available to the north bank developed area. Most of the land area is privately owned; however, at least part of the small wetland on the south bank of Eureka Slough is publicly owned. The Eureka General Plan shows part of the south bank of Eureka Slough as Suburban Residential and part of the north bank as Central Business District. Most of the lands around the sloughs are not shown in any zoning, but the gulch areas and the south bank of Eureka Slough are in commercial, residential, and agricultural zoning. Several proposed developments are located in or near this area; these include:

- Proposed residential development in part of Second Slough and the adjacent gulch.
- Expansion of Murray Field by extending the runway about 1,000 feet into the Slough, requiring a bridge or rechannelization of the Slough.
- Recommended construction of a new road paralleling Myrtle Avenue to relieve the West Avenue congestion.

Development pressure is considered medium because of the proposed projects.

AREA OF IMPORTANCE

LOCATION: (9) EUREKA GULCHES Total Acreage: 165.6

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Urban	12.4	0.2	
Grassland	21.5	3.3	
Shrub	21.0	6.1	
Deciduous forest	4.7	2.2	Forested slopes mitigate urban impacts on gulch wetlands.
Evergreen forest	5.7	0.3	
Mixed forest	57.5	12.6	
Cordgrass marsh	0.6	0.1	
Pickleweed marsh	3.6	0.9	
Mixed brackish marsh	1.9	6.8	
Hairgrass marsh	4.2	5.3	
Brackish rush marsh	0.7	0.8	
Swamp	30.7	16.6	Largest collection of swamp within the study area
Intertidal flat	0.7	<0.1	
Tidal creek	0.5	<0.1	

History of Area

Impacts and activities in the gulches have not been well documented. The slopes of many of them were logged between 1852 and 1875. Other areas, particularly Third Gulch, were diked early for agriculture. The dikes are now defunct and the pasture has reverted to wetland. In recent years, the upper reaches of the gulches have been filled for construction of public facilities. A large portion of Second (Cooper) Gulch has been cleared and filled for a park.

Natural Functional Importance

Fresh and brackish marshes are highly productive habitat types, and much of the production is exported to Eureka Slough and the estuary during high flow conditions. The wetlands and adjacent woodlands provide important habitat for a wide range of small mammals and birds. Herons, egrets and raptors are also seen feeding in the marshes. The gulches provide storage for storm runoff from adjacent uplands, and also act to filter that runoff before it enters Eureka Slough. The gulch slopes have a low slope stability hazard potential.

Ancillary Importance

As mixed wetland/forest habitat, the area falls under EO 11990, the Resources Agency's wetland policy, and general preservation policies of FWS, EPA, SCS, DFG, DPR, CCNCR, and OPR. The Eureka General Plan shows the gulches as greenbelts. The City of Eureka has made Cooper Gulch a park/recreation site. The gulches provide a visual transition between lowland and upland and are an aesthetic resource to residents in their vicinity.

AREA OF IMPORTANCE - Continued
(9) EUREKA GULCHES

Development Pressure

The gulches are open space/recreational use, surrounded by residential development on the uplands. They are accessible from the lowland side; the steep side slopes restrict access from above. Urban services are available in the general area. The area is not designated unsuitable for power plants. Cooper Gulch Park is publicly owned; the rest of the area is privately owned and zoned for residential development. Development pressure is considered low to medium because of the proximity to existing development offset by the City's greenbelt policy.

AREA OF IMPORTANCE

LOCATION: (10) NORTH BROADWAY WETLANDS AND INTERTIDAL FLATS

Total Acreage: 93.3

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Agriculture	0.9	<0.1	
Pickleweed/saltgrass marsh	14.9	3.6	
Hairgrass marsh	1.6	2.0	
Brackish marsh	14.5	22.7	
Brackish rush marsh	3.6	4.4	
Fresh oenanthe marsh	1.2	2.9	
Fresh rush marsh	0.9	2.1	
Fresh cattail marsh	5.1	18.2	
Swamp	6.5	3.5	
Intertidal flats	32.9	0.3	
Tidal creek	0.7	<0.1	
Grassland	3.6	0.6	
Shrub	3.7	1.1	
Deciduous forest	1.4	0.7	
Riparian forest	1.8	3.1	

History of Area

Essentially the entire shoreline from Elk River to Eureka was wetland (probably salt marsh) with a narrow band of shallow tidal flats in 1850. By 1870 most of the area south of Vigo Street was dikes as agricultural land. In addition, a race track was constructed at the present location of the Murray Street Sewage Treatment Plant. The Northwest Pacific Railroad was completed along the shore of this area in 1901, but it did not eliminate tidal influence in the marsh. By 1927, the area west of the railroad had been filled and was being used for industrial activities. At that time, log rafts were stored over the flats and a railroad trestle was built across them. Since 1944 numerous small fills have slowly encroached on the marshes, especially from the north and east. During the same period, most of the agricultural land from Vigo Street to Bucksport has been converted to industrial and commercial uses, mostly through filling. The remaining pasture immediately south of Vigo Street has slowly reverted to brackish and fresh marsh, with swamp and deciduous forest creating a buffer against the urban activities. Only lines of pilings mark the location of the trestle in the intertidal flats.

Natural Functional Importance

This area is an extremely diverse wetland ecosystem with salt, brackish and fresh marsh surrounded by swamp and forest. Cattail and brackish marshes have very high productivity, and most of the production is readily exported to the adjacent flats. Little sampling of flora or fauna has taken place on the flats, however, barring toxic discharges in the area, they probably support significant populations of invertebrate fauna. In addition, the tidal waters which inundate the Broadway Marshes must cross these flats. This

hydrologic connection is imperative to the continued survival of the Broadway Marshes. The swamp and forest are important winter resting areas for herons and egrets. These birds also feed in the adjacent marshes. The area provides storage for floodwaters and runoff from the adjacent uplands.

Ancillary Importance

As a diverse and productive wetland protected by a probably productive intertidal flat area, the area falls under EO 11990, the Resource Agency's wetland policy, and general preservation policies of FWS, NMFS, EPA, SCS, DFG, CCNCR, CEC, and OPR. It is designated unsuitable for power plants. Eureka has a protection policy for critical habitat areas; the definition of critical habitat meets the general description of the area, but the area is not specifically mentioned. It has recently (1978-1979) been the subject of discussions between the CCNCR and Eureka because the CCNCR wants to preserve it as wetlands and has conducted a detailed study of the area. It is in an archaeologically sensitive area. The intertidal flats include a commonly used fishing area. There are several potential public access points in and near the area.

Development Pressure

The area is presently wetland open space intertidal flats with industrial uses to the east, north, and south and navigation channels to the west. It is generally accessible by road and boat and has urban services available because of its location in the Eureka-Bucksport strip west of Broadway. The Harbor District designates the land area for port and water-related industry and the intertidal flats as development waters. The land area is privately owned; the intertidal flats are in public ownership. The Eureka General Plan designates the land area for Industrial uses (it does not designate the intertidal flats). The land area and part of the intertidal flats are zoned for industry. Development pressure is considered extremely high because of local policies favoring industrial development, proximity to navigation channels and harbor areas, and lack of alternative industrial sites in Eureka.

AREA OF IMPORTANCE

LOCATION: (11) SOUTH BROADWAY WETLANDS Total Acreage: 21.5

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Swamp	9.0	4.9	
Brackish sedge marsh	6.5	23.2	
Fresh cattail marsh	0.8	2.7	
Fresh oenanthe marsh	0.1	0.2	
Fresh rush marsh	1.6	3.5	
Ponds (closed ditch)	0.3	0.2	
Shrub	3.0	0.9	
Grassland	0.3	<0.1	

History of Area

Essentially the entire shoreline from Elk River to Eureka was wetland (probably salt marsh) in 1850. By 1870 most of the area south of Vigo Street was diked as agricultural land. The Northwest Pacific Railroad was completed along the shore of this area in 1901. Encroachment, resulting in increased runoff, inadequate drainage, and acessation of agricultural activities, has converted this area to a mixture of brackish and freshwater wetlands.

Natural Functional Importance

Both cattail and sedge marshes exhibit high primary productivity, which may be exported to the estuary during high water conditions. The marshes provide habitat for small birds and rodents which in turn are prey to marsh hawks, kites and other raptors. Herons and egrets use the swamp as a resting area during the winter. The small pond is probably used by some waterfowl for at least portions of the year.

Ancillary Importance

As productive wetland/swamp habitat, the area falls under EO11990, the Resource Agency's wetland policy, and general preservation policies of FWS, NMFS, EPA, SCS, CCNCR, CEC (south portion only), and OPR. It is an area designated unsuitable for power plants. The Eureka General Plan shows the southern part of the area as Agriculture/Open Space. The area is archaeologically sensitive and is identified as a potential public access point.

Development Pressure

The area is unused open space with industrial development ot the north and major transportation corridors through and west of it. It is generally accessible and has available urban services. The Eureka General Plan and the Harbor District's Ordinance 7 both designate the area for industry. The area is privately owned. The southern part is not zoned; the northern part is zoned partly Agriculture and partly Commercial. Development pressure is considered high because of local policy and lack of alternative industrial sites.

AREA OF IMPORTANCE

LOCATION: (12) ELK RIVER AND ASSOCIATED WETLANDS

Total Acreage: 165.4

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Shrub	0.1	<0.1	
Riparian Forest	25.6	44.2	Largest expanse of riparian forest within study area.
Pickleweed marsh	16.2	2.9	
Cordgrass marsh	5.2	1.2	
Mixed brackish marsh	2.7	3.4	
Sedge marsh	2.2	7.8	
Hairgrass marsh	2.7	3.4	
Swamp	0.8	0.4	
Intertidal flat	30.9	0.3	
Tidal river	41.8	6.0	
River	37.5	59.5	
Sparse dune	0.5	<0.1	

History of Area

As early as 1870 the lower reaches of the Elk River floodplain were being used for agriculture, necessitating levees along the river shore. The levees extend about 3.5 miles upstream of Highway 101. Elk River Spit began forming between 1930 and 1935. Since that time it has extended northward about 6,500 feet (2 km) from the river mouth. Several small marshes have formed on both the east and west shores of the river behind the spit.

Natural Functional Importance

Cordgrass is a highly productive salt marsh plant. Production is readily exported to the river and the bay during high tides and flood stages. Elk River is the major salmon and steelhead spawning river in the Bay; marshes at the river mouth serve as acclimation and feeding habitat for juveniles. Most of the river is bordered by a narrow strip of riparian forest, an extremely important habitat for a wide variety of birds and mammals. Small mammals and birds nest and feed in this area. Carnivors and raptors nest in this habitat nad prey on small animals both here and in adjacent pastures. The trees and shrubs also provide shade and cover over the river necessary for fish. Marsh hawks and kites feed on rodents in the marsh and adjacent dunes. Numerous osprey nests have been noted in the upper reaches of the Elk River, just beyond the study area boundary.

Ancillary Importance

As productive wetlands and a river in an area suitable for recreation, the area falls under EO 11990, the Resources Agency's wetland policy, and general preservation policies of FWS, NMFS, EPA, SCS, DFG, CCNCR, CEC, and OPR. It is an area designated unsuitable for power plants. The Eureka

General Plan shows the wetlands area as Open Space (along with the entire spit). The Elk River is designated Conservation Water by the Harbor District. The area is used by HSU for education and research. A proposed recreation trail would pass the marshes, improving access to them.

Development Pressure

The marshes are pristine wetlands on an isolated sand spit. They are presently rather inaccessible and have no urban services. The river runs through bottomlands mostly in agriculture and open space and is accessible by boat and on foot across pastures and occasionally from roads. Because the spit is an accreting area, ownership is not shown on the Humboldt County Assessor's maps. The Eureka General Plan shows the area as Open Space. No zoning classification is shown on County maps. Development pressure on the spit wetlands is negligible. Residential development in the bottomlands around the river could cause adverse impacts to the riparian habitat.

AREA OF IMPORTANCE

LOCATION: (13) NORTH SPIT WETLANDS Total Acreage: 23.0

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Pickleweed marsh	2.4	0.6	
Brackish sedge marsh	5.4	19.3	
Mixed fresh marsh	4.5	1.0	
Fresh oenanthe marsh	4.3	10.2	
Dune swamp	5.5	6.3	
Pond	1.0	0.6	

History of Area

In 1850 this area was a mixed dune habitat. By 1870 the southern unit was used for agriculture. A railroad grade was established to Samoa by 1897, bisecting the southern unit. In recent years, agricultural use of the land has stopped, the drainage system has failed, and the southern unit has reverted to wetland. The northern unit was not affected by the railroad, however, present grazing activities encroach on the pond. Disposal of dredge material in the early 1970's filled a portion of the wetland area.

Natural Functional Importance

These marshes are moderately productive, and much of the production is probably exported to the bay as detritus during flood conditions. The pond and adjacent fresh marshes are an important source of fresh water for many organisms living in the adjacent dunes. The swamp provides resting and/or nesting habitat for numerous birds including herons; waterfowl feed and rest on the pond. Present grazing pressure in the pond area has led to some degradation.

Ancillary Importance

As wetland habitat adjacent to navigable waterway, the area falls under EO 11990, the Resources Agency's wetland policy, and general preservation policies of FWS, SCS, CCNCR, CEC, and OPR. It is partly an area designated as unsuitable for power plants. The Eureka General Plan appears to show part of the area as Open Space. The southern part of the area is designated Public Open Space lands by the Harbor District. The entire area is archaeologically sensitive. Together with the Coast Guard station, it is used for educational and research purposes by HSU and College of the Redwoods, Humboldt County schools, and the Audubon Society. It is identified as a potential public access point and as part of an identified view. The off-shore area to the east is used for sport fishing.

Development Pressure

The area is in open space with residential uses to the north and the airport, Coast Guard Station, and Samoa Boat Ramp to the west and south. It

is easily accessible by road and has water but not sewer service available. The northern part of the area is designated for Port and Water-related Industry by the Harbor District. The area is partly in public ownership. In the Eureka Conceptual General Plan, the area is partly in a General Industrial designation. It is mostly zoned for public uses. Development pressure is presently low, but may increase if port-related industry increases, particularly on the northern part.

AREA OF IMPORTANCE

LOCATION: (14) KING SALMON WETLANDS Total Acreage: 115

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Grassland	7.8	1.2	
Cordgrass marsh	1.8	3.2	
Pickleweed marsh	6.4	1.5	
Hairgrass marsh	22.6	28.3	Largest single parcel of brackish marshes within the Bay
Brackish rush marsh	17.9	22.1	
Fresh marsh	2.2	3.3	
Oenanthe marsh	1.4	3.3	
Fresh rush marsh	0.9	1.9	
Cattail marsh	7.2	25.7	
Tidal creek	5.1	0.7	
Intertidal flat	31.4	0.3	
Shrub	2.1	0.6	
Swamp	3.0	1.6	
Deciduous forest	3.8	1.8	
Jetty	1.3	7.2	

History of Area

The King Salmon area was originally platted as Humboldt, although little construction of a town took place. Between 1854 and 1891 the northwest shore was relatively stable and Buhne Spit was elongating southwestward at a steady rate. After construction of the jetties in 1890 there was a shoreline retreat of approximately 150-200 feet from 1891 to 1903; Buhne Spit retreated with the shoreline. The shoreline remained stable until 1926, although Buhne Spit did migrate southeastward about 700 feet between 1903 and 1926. During this period a levee was constructed along the approximately 1911 western shore of the King Salmon area reclaiming the area for agriculture (no evidence of that levee remains today). Between 1926 and 1946 the northwestern shore retreated another 800 feet, to approximately its present position, where it is stabilized by a seawall. Urban development of the area began in the 1950's and culminated with the present marina complex. The dike between King Salmon and Highway 101 was breached at the time of this study. The breach has since been repaired; the impacts of the repair on wetlands behind the dike are not yet known.

Natural Functional Importance

Highly productive cordgrass marshes are located immediately outside the dikes where tidal action will export production to adjacent intertidal flats. Many of the marshes behind the dike are also highly productive, especially hairgrass and cattail marshes. This production is only exported during flooding situations. Marshes are feeding grounds for herons and egrets; flats are used by shorebirds. The freshwater wetland system east

of the highway provides storm water storage and also filters upland runoff moving through it.

Ancillary Importance

As highly productive wetlands, the area falls under EO 11990, the Resource Agency's wetland policy, and general preservation policies of FWS, NMFS, EPA, SCS, CCNCR, and OPR. The Eureka General Plan shows part of the area as Agriculture or Open Space. The area is archaeologically sensitive. It has several recreational facilities nearby, but is not itself identified for such uses. It is part of an identified view.

Development Pressure

The area is open space surrounded by industrial, residential, and public service uses. It is accessible by road and is bordered by a major highway (101). It is within CSA #3, which provides sewer service. The area is designated service/commercial lands by the Harbor District. The Eureka General Plan shows the Fields Landing and PG&E areas and the southern part of the area west of Highway 101 as industrial. The wetlands east of Highway 101 are designated partly agriculture and partly residential in the Eureka General Plan. The area is mostly in private ownership, including the tidelands, and parts are zoned industrial and commercial. It is part of an area being considered by the City of Eureka for a wastewater marsh. Most of the area is not designated unsuitable for power plants. Development pressure is considered medium because of the proximity of the navigation channel, other development, and because of local and state policy.

AREA OF IMPORTANCE

LOCATION: (15) FIELDS LANDING WETLANDS Total Acreage: 26.2

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Pickleweed/saltgrass marsh	3.5	0.8	
Hairgrass marsh	1.0	1.3	
Fresh marsh	3.2	4.8	
Swamp	12.7	6.9	
Deciduous forest	3.1	1.4	
Grassland	2.7	0.4	

History of Area

In 1850, the entire area west of the present highway was wetland. By 1870 a small portion had been reclaimed for agriculture. The first dock facilities had been established in 1885, and were expanded in following years. Completion of the NWPRR in 1901 effectively diked most of Fields Landing from tidal influence. A significant realignment of the port facilities took place by 1927, probably in response to railroad construction. During this period, residential development began replacing agriculture. Since then, both port and residential activities have grown slowly. The present fresh wetlands are a result, in part, of low elevation, poor drainage, and upland runoff in diked areas not being used for urban activities; the salt marshes are tidal.

Natural Functional Importance

These marshes and swamplands exhibit moderate to high productivity which is usually only exported under high water (storm) conditions. The swamp and deciduous forest offer nesting and breeding habitat to a wide variety of small mammals and birds. Herons have been noted resting in the trees in winter and spring. Storm and floodwater runoff from the nearby hillsides is stored in these areas and slowly released, filtering particulates in the process.

Ancillary Importance

As a wetland habitat, the area falls under EO11990, the Resources Agency's wetland policy, and general preservation policies of FWS, EPA, SCS, CCNCR, and OPR. The area is archaeologically sensitive.

Development Pressure

The area is open space bordered by highway, residential and industrial areas, and pasture. It is accessible by road and is in CSA #3 for sewer service availability. The Eureka General Plan identifies the Fields Landing area for industry. The area is not specifically designated by the Harbor District, but it is adjacent to the Fields Landing Channel, designated as Development Water. The area is not designated unsuitable for power plants. The area is privately owned and is zoned for industry. Development pressure is considered high, particularly when navigation improvements to the Fields Landing Channel are completed.

AREA OF IMPORTANCE

LOCATION: (16) SOUTH BAY Total Acreage: ~5,070

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Urban	12.5	0.2	
Agriculture	812.0	5.8	
Shrub	14.3	4.2	
Evergreen forest	33.5	1.9	
Cordgrass marsh	111.0	19.9	90 acres sparse cordgrass reverting after a dike breach.
Pickleweed marsh	27.4	6.6	
Mixed brackish marsh	16.5	75.8	
Sedge marsh	10.2	36.4	
Brackish rush marsh	8.8	10.8	
Mixed fresh marsh	2.5	3.8	
Cattail marsh	3.4	12.1	
Fresh rush marsh	1.3	2.8	
Swamp	4.6	2.5	
Intertidal flats	3,240.0	33.0	~1,900 acres eelgrass
Tidal creek	10.7	15.4	
Deep tidal channel	520.0	15.0	
Shallow tidal channel	235.0	11.0	
Closed Ditch	9.5	5.7	

History of Area

South Bay is the least developed portion of the Humboldt Bay system. Small areas in the upper part of Beatrice Flats were developed for agriculture in the 1880's. Dredging of the Fields Landing Channel began in 1883. Construction of the jetty on South Spit in 1891 probably had some effect on flushing and sedimentation in South Bay. By 1927 most of Beatrice Flats and the wetlands at the base of South Spit had been diked, leaving only the Hookton Slough wetlands intact. These too were diked by 1936. Dikes on the island at the mouth of Hookton Slough have since been breached and the area is now reverting to salt marsh.

Natural Functional Importance

Most of the intertidal flats of South Bay support dense populations of eelgrass, a highly productive plant community. Eelgrass is a major food source for black brant and other waterfowl, provides cover for numerous juvenile fish, and eventually becomes detritus, a food source for numerous benthic organisms living in the mudflats. The benthic organisms include diverse populations of shellfish, and numerous small invertebrates which are fed upon by fish, waterfowl and shorebirds. Salt marshes surrounding the bay are also highly productive, exporting the production to the flats. Juvenile fish are common in shallow tidal channels of the Bay. Waterfowl feed throughout the Bay and nest in Beatrice Flats. A heron rookery has been identified on the hillside

above South Spit. Seal haulout and pupping areas are located on the flats. The candidate threatened species *Cordylanthus maritimus* ssp. *palustris* has been noted in the salt marshes of Humboldt Bay.

Ancillary Importance

South Bay is the portion of the study area about which there is the most general agreement that it should be preserved. As a wetland/tideflat/agricultural area extremely valuable to wildlife (including fish and waterfowl), it is under EO 11990, the Resources Agency's wetland policy, and general preservation policies of FWS, BLM, NMFS, EPA, HCRS, SCS, DFG, DPR, CCNCR, CEC, SLC, and OPR. It is designated unsuitable for power plants. It is an approved part of the FWS National Wildlife Refuge and has been proposed as a State park (DPR). It is a CNACC natural area. It is identified as a Class A area - restricted use - by the SLC. Together with the rest of the Bay, it is identified as a "premium waterway" and an "extraordinary wildlife waterway" by OPR. Local agencies also support preservation of South Bay; the Northern Humboldt County General Plan identifies it as public and agricultural lands, while the Harbor District identifies it as Conservation Water surrounded by Public Open Space/Agricultural lands. It is extensively used for education and research by HSU and College of the Redwoods. It is bordered by areas commonly used for hunting and the entire Bay is considered a public clamming area. It is considered part of several significant views, notably from Table Bluff.

Development Pressure

The area is tideflats, open space, and agricultural lands, surrounded by similar uses except for the Fields Landing Channel and the developed area of Fields Landing. The tideflats are accessible by boat and on foot from South Spit. The agricultural lands are not easily accessible. There are no urban services. The land areas are privately owned, but the FWS has an option on lands in the southwest corner for the wildlife refuge. Portions of the tidelands are privately owned. As noted above, it is identified as Wildlife Refuge and Agriculture in the General Plan. The portion of this area in Beatrice Flats is zoned Agriculture Exclusive; the rest is not zoned. Development pressure is considered negligible because of the overwhelming policy for preservation.

AREA OF IMPORTANCE

LOCATION: (17) JACOBY CREEK **Total Acreage:** 28.0

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Grass	4.7	0.7	
Swamp	5.9	3.2	
Deciduous forest	15.9	7.4	
Tidal creek	2.1	0.3	

History of Area

Jacoby Creek meandered through tidal wetlands in the Bayside area until completion of NWPRR in 1901 resulted in the diking of those wetlands. The shores of the creek were also diked to minimize overbank flooding. Since 1901, riparian vegetation has become established along Jacoby Creek. The bottom lands along the creek have been used for pasture probably since about 1901.

Natural Functional Importance

Jacoby Creek is an important steelhead and salmon stream; above the study area, it is also a major summer trout stream. Riparian habitat along the stream provides important shade and cover to migrating fish. Trees and shrubs in this habitat also contribute potential detrital material, in the form of leaves and twigs, to the intertidal flats of the Bay. Riparian habitat is also important nesting and feeding habitat for small mammals and birds. Some waterfowl also nest in these riparian areas. Carnivores and raptors nesting in riparian habitat feed on small mammals, such as mice and moles, which are found in adjacent agricultural areas. During high water situations, the floodplain of the creek provides floodwater storage.

Ancillary Importance

As tidal creek used by anadromous fish and riparian and wetland habitat, the area falls under EO 11990, the Resources Agency's wetland policy, and general preservation policies of FWS, NMFS, EPA, HCRS, SCS, DFG, CCNCR, CEC, and OPR. It is designated unsuitable for power plants. Jacoby Creek falls under both general and specific protection policies of the HC General Plan and LCP documents. Arcata's General Plan and LCP documents also specifically mention Jacoby Creek for protection and preservation of the resource. Minimum stream flow and protection of riparian habitat are issues of concern to the local jurisdictions, and minimum stream flow requirements have been established by the SWRCB to protect salmon and steelhead runs. The creek is in an archaeologically sensitive area. Downstream at the mouth is a commonly used hunting area (DFG) which is considered a potential public access point. However, hunting will no longer be allowed in the National Wildlife Refuge. Near the mouth of the creek is an identified viewpoint.

AREA OF IMPORTANCE - Continued
(17) JACOBY CREEK

Development Pressure

The area is open space creek and riparian habitat surrounded by agricultural uses. The area is accessible only on foot over private land. The southern boundary of the creek and riparian habitat is fenced. The entire area is privately owned. It is designated for agriculture in Arcata's General Plan and is mostly zoned Agriculture Exclusive. Development pressure is low except for continued agricultural use, and interest in improving the stream as anadromous fish habitat.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (18) NORTH BROADWAY POCKET MARSHES Total Acreage: 4.7

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Cordgrass marsh	0.8	0.1	Much of the area is degraded wetlands resulting from proximity to industrial activities.
Pickleweed marsh	0.3	<0.1	
Mixed brackish marsh	0.4	0.6	
Hairgrass marsh	1.0	1.3	
Mixed fresh marsh	0.4	0.6	
Cattail marsh	1.0	3.5	
Swamp	0.3	0.2	
Grassland	5.5	<0.1	

History of Area

Essentially the entire shoreline from Elk River to Eureka was wetland (probably salt marsh) in 1850. By 1870 most of the area south of Vigo Street was diked as agricultural land. In addition, a race track was constructed at the present location of the Murray Street Sewage Treatment Plant. The Northwest Pacific Railroad was completed along the shore of this area in 1901 but it did not eliminate tidal influence in the marsh. By 1927 the area west of the railroad had been filled and was being used for industrial activities. Since 1944 numerous small fills have slowly encroached on these wetlands, especially from the north and east. Only a few small areas of wetland habitat remain between Washington and 14th Streets; most of these have been degraded as a result of their proximity to industrial activities.

Natural Functional Importance

The cattail, hairgrass, and cordgrass marshes are highly productive and provide habitat for small birds and mammals. Several of these areas are tidally influenced and, therefore, readily export detritus to the Bay. The swamp offers nesting and feeding habitat for a wide variety of birds and mammals.

Ancillary Importance

As productive wetlands, the area falls under EO 11990, the Resources Agency's wetland policy, and general preservation policies of FWS, NMFS, EPA, SCS, CCNCR, and OPR. Their degraded character decreases their importance, however. They are in an archaeologically sensitive area.

Development Pressure

The small wetlands are all surrounded by intense industrial-type uses. The general area is easily accessible and has urban services. Eureka's General Plan and the Harbor District have the general area, including the wetlands, designated for industry. Part of the wetlands is privately

owned. The Schmidbauer pond is owned by the Coastal Conservancy by dedication as terms of a coastal permit. All the wetlands are zoned for industry. Development pressure is high because of local policy and the lack of alternative industrial sites in Eureka. These degraded wetlands could be restored as buffer or compensation areas.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (19) MAD RIVER Total Acreage: 607.5

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Agriculture	17.5	0.1	
Dune hollow	1.5	1.1	
Moving dune	125.8	16.7	
Dune swamp	7.0	8.1	
Sparse dune	64.2	7.2	
Vegetated dune	17.0	1.1	
Mixed forest	8.2	1.8	
Closed cone pine forest	4.2	0.7	
Riparian forest	29.7	51.2	
Shrub	38.0	11.1	
Urban	2.9	<0.1	
Mixed brackish	3.5	5.4	
Swamp	0.3	0.2	
Intertidal flats	76.4	0.8	
Gravel bar	6.2	29.4	
Tidal river	205.1	29.6	

History of Area

The mouth of the Mad River has migrated almost 2 miles northward since 1870. It has no doubt undergone several elongation and breaching episodes. Most of the upland in this unit is dune habitat; it has received little activity until recent years when ORV's became common. The river mouth has always been a high use fishing area.

Natural Functional Importance

Much of the dune habitat would be sparsely populated with rodents, small mammals, small birds and reptiles, even in a pristine state. In its present impacted state populations are probably even lower. The Mad River is an important spawning river for salmon, steelhead, and cutthroat. Shorebirds and wading birds feed in the shallow flats at the river mouth, small mammals and even occasional deer use the riparian shrub along the river.

Ancillary Importance

As an important salmon and trout stream and a coastal dune habitat, the area falls under general preservation policies of FWS, NMFS, EPA, HCRS, DFG, CCNCR, CEC, SLC, and OPR. It is designated unsuitable for power plants. The Mad River is designated a Class B (Limited Use) area by the SLC and a "premium waterway" by OPR. It is under general preservation policies of the HC General Plan and is mentioned for minimum stream flow monitoring in the HC LCP documents. Arcata's General Plan specifies its preservation as Open Space; the river banks are archaeologically sensitive. Humboldt County has a large park at the mouth of

Mad River; the park has a boat ramp and the area is extensively used by ORV's and horseback riders. The river is important for both commercial and sport fisheries and has a salmon and steelhead trout hatchery.

Development Pressure

The river is used for fishing and fish habitat, boating, and gravel mining and is surrounded by agricultural uses and some residential development in McKinleyville. The park is bordered by agriculture and open space. The park is accessible by road and the river by boat. McKinleyville has urban-type services and a sewage interceptor crosses the river along the section line between Section 12 and Section 17. The park is in public ownership. The Arcata General Plan calls for preservation of the river and a buffer strip along it. This plan also calls for preservation of sand dunes. The lands around the river are zoned Agriculture Exclusive. The river is valuable economically for commercial and sports fishing and for gravel mining. Pressure for development is low except for fish hatchery improvement and possibly expanded gravel mining.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (20) ARCATA BOTTOMS/MAD RIVER Total Acreage: 3,702

Habitat Types	Acreage of Location	% of Total type in Estuary	Remarks
Agriculture	3,624.0	26.0	
Grassland	4.9	0.7	
Shrub	18.2	5.3	
Deciduous forest	6.7	3.1	
Urban	35.8	0.4	
Oenanthe marsh	2.2	5.2	
Swamp	5.8	3.1	
Intertidal flat	0.4	<0.1	
Closed ditch	18.3	11.0	
Tidal slough	4.5	0.6	

History of Area

The southern portion of this unit was originally tidal wetland, the northern portion of Arcata Bottoms was coastal redwood forest, and the Mad River floodplain was deciduous forest (sitka spruce, willow, alder). The north portion was cleared by 1871. Only a small portion of the area was agriculture. Clearing of forests proceeded slowly, but with completion of the Arcata Bottoms Dikes by 1905, the entire area was utilized for pasture. There has been little change in land use use since then. The area is all in the 100 year floodplain.

Natural Functional Importance

Pastures may provide important resting and feeding habitat for shorebirds, wading birds, and waterfowl, especially during the winter. Upland game birds and other birds are more common in the summer. Rodents are usually present in pastures also. All of these are prey for raptors.

Ancillary Importance

As agriculture, the area falls under general preservation policies of FWS, SCS, CCNCR, CEC, and OPR. It is designated unsuitable for power plants. The HC General Plan has a preservation policy for Class I and II soils in the Mad River floodplain and Arcata Bottoms and it is mostly identified as prime agricultural lands in the HC LCP Agriculture Technical Study. Arcata's General Plan and LCP documents show the area as agriculture. The Harbor District designates all uplands in the Arcata Bottoms area adjacent to North Bay as public green space/agriculture. Parts of the area are archaeologically sensitive. The Arcata Bottoms area generally is used for education and research by HSU. The bottom lands are an important visual/aesthetic resource.

Development Pressure

The area and its surroundings are in agricultural use. It is accessible by road at various points and by boat from Mad River. Urban services are not generally available, although the sewer interceptor runs through part of the area. The parts of the area in the south of the City of Arcata have urban services. The Arcata General Plan designates the area as agriculture.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (21) ARCATA BOTTOMS WEST Total Acreage: 1,212

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Agriculture	1,156.0	8.2	
Urban	21.5	0.3	
Shrub	0.8	0.2	
Dune swamp	2.0	2.3	
Pickleweed marsh	1.7	0.4	
Brackish rush marsh	3.1	3.8	
Mixed fresh marsh	1.2	1.9	
Oenanthe marsh	0.5	1.1	
Closed ditch	25.5	15.4	

History of Area

This entire area was part of the Mad River Slough tidal wetland system until it was diked between 1903 and 1927. Since that time it has been used continuously as pasture. The eastern boundary of the area is formed by roads and by the old grade of the A&MRRR. Several old dikes along Liscom Slough, the old rail grade and Lanphere Road, Jackson Ranch Road and Foster Road all are potential dikes for use in defining compensation areas.

Natural Functional Importance

As pasture, the area offers winter resting and feeding habitat to shorebirds, wading birds, and waterfowl; in the summer it is used by other birds. Along with rodent populations these provide a major raptor food source. The area has been noted as duck nesting habitat. The area also serves as floodwater storage and is entirely within the 100 year floodplain. The area is a valuable buffer for the Mad River Dunes and Mad River Slough.

Ancillary Importance

As agriculture, the area falls under general preservation policies of FWS, SCS, CCNCR, CEC, and OPR. It is designated unsuitable for power plants. It is identified as prime agricultural lands in the HC LCP Agriculture Technical Study. Arcata's General Plan and LCP documents show it as agriculture. The Harbor District designates all uplands in the Arcata Bottoms area adjacent to North Bay as public open space/agriculture. The area has several commonly used hunting and fishing access points and several identified potential public access points. It i used by HSU for education and research. The bottom lands are an important visual/aesthetic resource.

Development Pressure

The area and its surrounding lands are in agricultural use. It is accessible by road at various points and by boat from Mad River Slough. There are no urban services, but the regional sewage system line runs down the Old A&MR RR grade. The area is all privately owned and is zoned Agriculture Exclusive. The General Plan designation is agriculture. Development pressure is low. The area is considered appropriate for wetland restoration as compensation/mitigation because of the number and location of dikes and cross dikes and the ease of selectively returning small parcels to tidal action (See Section V.D. for a discussion of compensation).

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (22) ARCATA BOTTOMS EAST Total Acreage: 1,195

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Agriculture	1,068.0	7.6	
Grassland	8.9	1.4	
Shrub	2.3	0.7	
Urban	113.5	1.4	
Mixed fresh marsh	2.5	3.8	

History of Area

The southern portions of this area were being intensely farmed before 1870. The northern portion was not used for agriculture until the evergreen forest occupying the bottoms was cleared by 1871. Since that time most of the area has been pasture. In recent years industrial and residential development has encroached on the area. The area is outside the 100 year floodplain.

Natural Functional Importance

As pasture, the land offers some habitat to small mammals and birds. Common egrets may prey on rodents; raptors will prey on small birds and rodents. Most of the soils have been designated as prime agricultural land.

Ancillary Importance

As agriculture, the area falls under general preservation policies of FWS, SCS, CCNCR, and OPR. Most of the area is unsuitable for power plant construction (CEC) and the HC LCP documents identify it as prime agricultural land. It is mostly identified as agriculture in Arcata's General Plan and LCP reports. The Harbor District designates all uplands in the Arcata Bottoms area adjacent to North Bay as public open space/agriculture. The Arcata Bottoms area generally is used by HSU for education and research. The bottom lands are an important visual resource.

Develpoment Pressure

The area is agriculture bordered by urban (residential, commercial, industrial) uses on the east and north and agricultural uses to the west and south. It is quite accessible by road along its eastern part and in the northern area around Highway 101. Urban services are available from the built-up area of Arcata. There is a sewer line running through the area from McKinleyville to Arcata. The area is all privately owned. It is mostly designated for agriculture in the General Plan, except for an industrial designation in an already developed area. It is zoned Agriculture Exclusive. Development pressure is considered medium because the area is above the 100 year floodplain and because it is adjacent to already developed urbanized areas, from which development extensions would be easy.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (23) McDANIEL SLOUGH Total Acreage: 20.7

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Agriculture	6.8	<0.1	
Shrub	0.3	<0.1	
Cattail marsh	8.0	28.5	Largest continuous cattail marsh in the Bay.
Oenanthe marsh	5.0	12.0	
Closed ditch	0.6	0.2	

History of Area

Prior to the diking of the Arcata Bottoms, this was a tidal creek meandering through tidal wetlands. Reclamation of the Arcata Bottoms between 1903 and 1927 included dikes on this creek from the mouth to at least the present Old Samoa Road. In 1904, a tide gate was installed in the Arcata Bottoms dike and the Slough was removed from tidal influence.

Natural Functional Importance

Because it is very shallow, much of the slough is effectively pasture and is impacted by grazing. Many of the fresh marshes along the creek are highly productive; much of the organic debris is exported to the intertidal flats as detritus, especially during high flow situations. Despite grazing, the area provides feeding and nesting habitat for small birds and waterfowl. These in turn are preyed upon by raptors. Herons and other wading birds feed on amphibians and small mammals found in these marshes. James Creek supports a native cutthroat population that used to extend into McDaniel Slough before the heavy growth of vegetation in the slough. The slough serrves as storm water storage during the winter.

Ancillary Importance

As wetland habitat (biologically productive shallows) and agriculture, the area falls under EO 11990, the Resources Agency's wetland policy, and general preservation policies of FWS, NMFS, EPA, SCS, CCNCR, CEC, and OPR. Most of the area is designated unsuitable for power plants. The Arcata General Plan calls for preservation of rivers, streams, and marshes and specifically shows a greenbelt park along McDaniel Slough. An issue of concern in Arcata's LCP is whether to restore tidal action to the slough. Most of the slough is in an archaeologically sensitive area.

Development Pressure

The area and its surroundings are in agriculture south of Samoa Boulevard. The slough itself is the southerly terminus of the drainage system for the north and west portion of the city of Arcata. North of Samoa Boulevard the slough is bounded by urban sues on all sides. Parts of the area are accessible by road and on foot across private land. Urban services

are generally available in Arcata. The Arcata LCP Technical Report on Agriculture recommends an urban expansion around the slough north of Samoa Boulevard; the southern part would remain as agriculture. The area is privately owned. Arcata's General Plan shows the area as a park. South of Samoa Boulevard, the zoning is Agriculture Exclusive west of the slough and Agriculture to the east. North of Samoa Boulevard, the area is zoned for agriculture and industry. Development pressure on the slough and its surroundings north of Samoa Boulevard is high; south of Samoa Boulevard it is low.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (24) ARCATA MARSH AND OXIDATION POND

Total Acreage: 159.1

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Urban	25.6	0.3	Note: areal determinations were completed prior to construction of the Arcata marsh.
Agriculture	12.2	<0.1	
Grassland	34.6	5.3	
Shrub	0.6	0.2	
Cordgrass marsh	0.3	<0.1	
Pickleweed marsh	1.6	0.4	
Hairgrass marsh	5.3	6.6	
Closed ditch	78.7	47.4	
Shallow tidal channel	0.2	<0.1	

History of Area

The entire area south of Arcata was wetland prior to completion of the NWPRR in 1901. The tracks of the NWP and the A&MR railroads effectively diked most of the wetlands directly south of Arcata except the small triangular portion that makes up most of this area. The sewage treatment lagoon was constructed in 1956. Construction of the sanitary landfill began in the 1960's. The site was about two-thirds filled when it was closed in 1973. Creation of a 63 acre freshwater marsh is underway in the unfilled portion of the area; there are hopes of using effluent from the local sewage treatment plant as a water source for the marsh in the future.

Natural Functional Importance

The western portion of the site is pasture land; as such its natural habitat functions are limited primarily to flood water storage and feeding habitat for shore and wading birds, particularly in the winter. Most of the fill is sparsely vegetated and offers little habitat, except for small mammals such as mice and voles. These are probably preyed on by raptors. The pond-like area south of the fill is a popular feeding and resting area for shorebirds. Flocks of hundreds of sandpipers, willets, and godwits can be seen resting and feeding in the shallows on this pond. Even more important to birds is the oxidation pond, which has been reported to provide feeding and resting habitat for almost 200 species of birds. The oxidation pond is also used for a fish rearing project; salmon are produced there. Some portions of the marsh area are highly productive. Although degraded by trash, the area still serves as habitat for small birds and mammals. A highly irregular topography, together with trash and debris in the channels, creates sill-like effects which impede the export of detritus from the marsh to the Bay. Construction activities for the freshwater marsh have eliminated much of the agriculture, grassland, shrub, and brackish marsh habitat. The marsh reclamation project is now in place.

(24) ARCATA MARSH AND OXIDATION POND

Ancillary Importance

As fish and wildlife habitat, in particular waterfowl habitat, the area is under general preservation policies of FWS, NMFS, EPA, HCRS, DFG, CCNCR, CEC, and OPR. The area is designated unsuitable for power plants. The Coastal Conservancy gave the City of Arcata a grant to create the freshwater marsh described above; this marsh will cover the landfill site. The SWRCB and RWQCB are very concerned about water quality around the oxidation ponds and in North Bay; the SWRCB recently agreed that the Arcata marsh project may enhance water quality in the Bay. The oxidation pond is used for education and research by HSU, College of the Redwoods, Humboldt County Schools, and the Audubon Society. At the southwest corner of the landfill, is the Arcata boat ramp, and the dikes around the oxidation pond are commonly used for hunting. The salmon ranching project in the oxidation pond is projected to become commercially important within a few years by the City of Arcata.

Development Pressure

The area is used for public services and is bordered by wetlands and by an industrial area around South G Street. It is accessible by road. The area is owned by the City of Arcata except for a small portion of the pasture land north of the landfill. The Arcata General Plan designates the oxidation pond as public area and the western part of the site as park, natural resource/wildlife habitat, and some industrial area. It is zoned partly for public use; the marshes are zoned for natural resource preservation. The pasture lands are zoned agriculture and industrial. The Coastal Conservancy grant will allow the City to move ahead with the marsh project. Development pressure for anything other than the marsh construction and maintenance of the oxidation pond is negligible.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (25) BAYSIDE BOTTOMS Total Acreage: 976.5

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Agriculture	926.6	6.6	
Wet agriculture	11.0	-	
Agriculture/wetland	1.2	-	
Mixed forest	3.2	.7	
Grassland	17.2	2.6	
Urban	5.1	<0.1	
Pickleweed marsh	1.0	2.3	
Cattail marsh	1.2	4.4	
Swamp	1.4	.8	
Intertidal flats	0.6	.2	
Closed ditches and ponds	6.0	3.6	
Tidal creeks and sloughs	2.0	.3	

History of Area

As with most of the bottom lands around North Bay, this area was tidal wetland prior to completion of NWPRR in 1901. Since then, diking and draining have reclaimed the area for agricultural purposes. In recent years a few urban developments, such as the CHP headquarters, have encroached on the area. The area is in the 100 year floodplain.

Natural Functional Importance

Although principally pasture land, the bottoms also serve as winter feeding and resting habitat for numerous shore and wading birds, especially when the lower areas are flooded. Waterfowl nesting has been noted in the area. Wet pastures and isolated wetlands are common in old tidal channels, providing year-round wetland habitat. Storm water runoff and overbank flows from Jacoby Creek are stored in the bottoms and slowly released to the Bay through tide gates.

Ancillary Importance

As agriculture, the area falls under general preservation policies of FWS, SCS, CCNCR, CEC, and OPR. The area is designated unsuitable for power plants. It is under general preservation policies of the HC and Arcata General Plans and LCP documents. It is mostly specified for agriculture in Arcata's General Plan and is designated public open space/ agricultural lands by the Harbor District. The area is identified as prime agricultural land in the HC LCP Agriculture Technical Study. It is archaeologically sensitive. The bottomlands are identified as a visual aesthetic resource; there are several viewpoints along the west boundary of the area.

Development Pressure

The area is in agricultural use and is surrounded by open space and residential uses. It is bordered by roads on the east and west and is generally accessible on foot. The northern parts of the area can receive urban services from Arcata. The Arcata General Plan designates the area as agriculture except for some residential and public areas around Old Arcata Road. It is all privately owned and is zoned Agriculture Exclusive except for several areas along Old Arcata Road. Development projects proposed in this area in the last five years include an auto sales area, a mini storage project, a construction storage site, a Holiday Inn, and a mobile home park. Pressure for residential subdivision and development around Old Arcata Road is increasing. Development pressure is medium.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (26) MANILA DUNES Total Acreage: 673.1

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Agriculture	4.1	<0.1	
Dune hollow	50.4	39.4	
Moving dunes	98.6	13.1	
Dune swamp	27.4	31.5	
Sparsely vegetated dune	154.8	17.3	
Vegetated dune	100.0	6.3	
Closed cone pine forest	225.4	38.5	
Grassland	3.9	.6	
Shrubland	3.8	1.1	
Urban	4.8	<0.1	

History of Area

The first intrusion into this area was the Samoa to Arcata Railroad completed in 1897. A second railroad, the Humboldt Northern, was completed from Arcata to Samoa in 1909. During the 1930's a road to Samoa was constructed. The next encroachment occurred in the 1950's with the founding of Manila. The growth of Manila has had a major impact on the dune area, with sand mining and easy beach access slowly impacting the habitat.

Natural Functional Importance

The diverse dune habitat supports a diverse faunal assemblage, including small mammals and birds, carnivores and reptiles. Swamps often provide feeding and nesting habitat for herons. Deer are found occasionally in the pine forest. Several raptors commonly nest in the forest and feed in the dunes. Specimens of the candidate threatened species *Erysimum mensiezii* have been reported from the area. Encroachment by urban development at Manila and by ORV's has resulted in significant impacts to dune habitats, particularly in the form of trails and sand mining activities.

Ancillary Importance

As coastal dune and forest habitat with a threatened species, the area falls under general preservation policies of FWS, NMFS, EPA, DFG, CCNCR, CEC, and OPR. The area is designated unsuitable for power plants. Part of the area is a CNACC natural area. It is shown as open space/forest in the Eureka General Plan. It is mentioned as needing protection in the HC General Plan and LCP documents. Dunes and dune forests are under general preservation policies of Arcata. It is designated public open space/agriculture by the Harbor District. It is archaeologically sensitive and is used for education and research by HSU, College of the Redwoods, and Humboldt County schools. The area is extensively used for active and passive recreation, including ORV's. Numerous potential public access

points border the area (from Manila). The coastal dunes are an aesthetic resource. The area is very similar to the coastal dunes north of it except that it has been significantly impacted by encroaching development.

Development Pressure

The area is open space bordered by residential development. It is easily accessible on foot and by ORV, and by vehicle from street ends. It has no sewers or sewage treatment at present, but Manila will have a small community system with a leach-field in the dunes. The area is in private ownership except for the tidelands and accreted areas. It is shown as natural resource/wildlife habitat/forest/open space in the General Plans of Eureka and Arcata. No zoning is shown on HC maps. The Corps of Engineers proposed a beach site for disposal of dredged material occupying the southern part of the beach on the ocean side of the foredunes. Development pressure is low except for possible expansion of the residential areas around Manila if suitable wastewater handling is available and except for pressure for heavier ORV and beach recreation uses.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (27) NORTH SPIT, BEACH, AND COAST GUARD STATION

Total Acreage: 1,077

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Agriculture	6.4	<0.1	
Dune hollow	30.9	24.1	
Moving sand	27.7	3.7	
Sparsely vegetated dune	86.7	9.7	
Vegetated dune	697.9	43.7	
Deciduous forest	1.4	.7	
Evergreen forest	2.3	.4	Mostly eucalyptus.
Closed cone pine forest	7.7	1.3	
Grassland	3.9	.6	
Jetty	3.3	18.4	
Shrubland	7.6	2.2	
Urban	194.3	2.3	
Pickleweed marsh	.6	.1	
Mixed brackish marsh	4.3	6.7	
Sedge marsh	.1	.3	
Brackish rush marsh	2.1	2.6	

History of Area

In 1850, the distal end of North Spit consisted of two recurved spits with a shallow lagoon between them. By 1858, both spits had eroded and the lagoon was gone; a single point jutted into the Bay. A lighthouse and life saving station were established by 1886. The jetty and a weather station were begun on North Spit in 1891; sedimentation began immediately, widening the spit at the jetty. Most of the jetty was eradicated during the winter of 1903; reconstruction began in 1912 and was completed in 1917. A railroad grade was extended to North Spit, probably to aid in jetty construction, about 1917. In 1914 the Coast Guard was established on North Spit. During World War II a seaplane ramp was constructed in the area. The ramp has recently been rebuilt and is used for boat launching. The airport was completed in the 1940's; at present, the site is used occassionally as an airport and also as a race track and drag strip. In recent years, several portions of the site have been used for dredged material disposal. ORV traffic is heavy in the area, creating numerous trails. Erosion is a problem in portions of the Bay shoreline (jeopardizing some low-use facilities, according to DBW).

Natural Functional Importance

The wetland habitats are highly productive and export the production to adjacent intertidal flats. The flats contain populations of shellfish with value for recreational uses. The vegetated dune habitat and the evergreen forest both provide a home for a variety of small mammals and birds. These in turn are preyed upon by a variety of raptors, which may nest in the evergreen forest. *Erysimum menziesii*, a candidate threatened

species, is widely distributed throughout the back dune area. Much of the area has been disturbed by military and ORV activities.

Ancillary Importance

As a dune habitat with an identified threatened species, a wildlife and shellfish habitat, and a recreational area, the area falls under general preservation policies of FWS, NMFS, HCRS, EPA, DFG, DPR, CCNCR, and OPR. The North Jetty itself is of concern to the Corps and the Coast Guard as a navigation improvement, and the Coast Guard Station is of obvious importance to that agency. The area is shown as partly industrial, partly public/semipublic lands, and partly open space in Eureka's General Plan. It is partly designated Public Open Space by the Harbor District. The Bayside portion of the area is archaeologically sensitive. The entire North Spit is used for educational and research purposes by HSU, College of the Redwoods, Humboldt County schools, and the Audubon Society. It is an existing recreation area, used for shore fishing, surfing, skindiving, ORV's, drag racing, beach access, public clamming, and passive recreation such as walking, birdwatching, and beachcombing. The area has several potential public access points, including the Samoa boat ramp. It is an identified viewpoint.

Development Pressure

The area is presently open space except for the Coast Guard Station, the boat ramp, and the airport. It is surrounded by ocean, navigation channels, and intertidal flats. The area is easily accessible by road and boat; no sewer service is available. There is water service to the Coast Guard Station. The area is not designated unsuitable for power plants. The area is partly designated for port and water-related industry by the Harbor District. The General Plan shows industrial uses along the Bay shore east of Navy Base Road just in the part of the area north of the Samoa Boat Ramp and west of Navy Base Road south of the airport and north of the Coast Guard Station. The area is in public ownership except for a small area south of Fairhaven east of Navy Base Road and except for the accreted beaches. The area is mostly in public zoning, with residential zoning in the area south of Fairhaven and some industrial zoning along north and west of Navy Base Road. The Coast Guard Station is not zoned and is owned by the U.S. Government. The Corps of Engineers has two sites for dredged material disposal in this area: one west of Navy Base Road adjacent to the airport, and the other a beach disposal site occupying the northern part of the beach on the ocean side of the foredunes. A pipeline route for surf zone disposal crosses the North Spit Beach. Development pressure is negligible for the Coast Guard Station, North Jetty, and ocean beaches; it is low to medium for the area around the airport and Navy Base Road and south of Fairhaven.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (28) EUREKA BOTTOMS Total Acreage: 2,290.1

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Urban	9.0	<0.1	
Agriculture	2,076.0	14.8	
Grassland	20.5	3.1	
Shrub	6.2	1.8	
Deciduous forest	22.0	10.2	
Evergreen forest	121.8	7.0	
Riparian forest	1.5	2.7	
Mixed forest	13.6	3.0	
Pickleweed marsh	0.2	<0.1	
Mixed fresh marsh	4.8	7.2	
Oenanthe marsh	6.3	15.0	
Swamp	7.0	3.8	
Closed ditch	1.2	0.7	

History of Area

Originally tidal wetlands, most of this area was diked with the completion of NWPRR in 1901. Since that time, it has been used almost exclusively as pasture.

Natural Functional Importance

These diked lowlands provide feeding and resting habitat for shore and wading birds during the winter months. Some birds, in particular the common egret, feed here throughout the year. These lowlands are noted as waterfowl nesting areas. These bottomlands also serve to store floodwaters and release them slowly into Eureka Slough and the Bay.

Ancillary Importance

As agriculture and seasonally flooded lands, the area falls under general preservation policies of FWS, SCS, CCNCR, CEC, and OPR. It is mostly designated unsuitable for power plants. The area is shown as open space/agriculture in Eureka's General Plan and is designated public open space/agriculture by the Harbor District. It is archaeologically sensitive and has several potential public access points along roads bordering it. As open bottomland, it is considered an important visual/aesthetic resource.

Development Pressure

The area is used for agriculture/open space and is bordered by residential development on the uplands and by the Murray Field airport and Highway 101. It is accessible by boat from the sloughs and from the roads bordering it. It is privately owned and is open space/agriculture in

Eureka's General Plan. No zoning is shown on HC maps. The area has several potential wetland restoration sites along the south side of Eureka Slough (see Section V-D). Development pressure is considered low except for agricultural uses and for residential or other urban development around Myrtle Avenue and Highway 101.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (29) EUREKA WATERFRONT **Total Acreage:** 3.1

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Cordgrass marsh	2.0	0.4	Degraded by trash, lumber, etc.
Cattail marsh	1.1	4.1	

History of Area

This entire area was salt marsh until the 1890s when the first small fill was placed along Eureka Channel, just west of Eureka Slough. Since then it has been slowly and continuously diked and filled. Recently about 10 acres of the area was used for dredge spoil disposal. As a result of all these activities, only 3 acres of marsh remain.

Natural Functional Importance

Both cordgrass and cattails are highly productive wetland species. In this area however the marshes have been somewhat degraded and their productivity is not known. The short slough providing water to this marsh may support a few juvenile fish if degradation and toxic discharges have not made it unsuitable.

Ancillary Importance

Though it is a small degraded wetland, the area still falls under EO11990, the Resources Agency's wetland policy, and general preservation policies of the FWS, NMFS, EPA, SCS, CCNCR, CEC, and OPR. It is in an area designated unsuitable for power plants. The Coastal Conservancy, the Coastal Act, and SCR No. 28 support restoration of such degraded wetlands (although its size is against it here). The wetland is in an archaeologically sensitive area and several potential public access points are located in its vicinity.

Development Pressure

The area itself is open space, bordered by navigation channels and urban development (industry and fill). It is easily accessible by road, and urban services are available to the general area. It is part of the area classified as industrial/commercial by the HC and Eureka General Plan and by the Harbor District. It is privately owned and is zoned for industry. The Harbor District is using part of the area as a dredge spoil disposal site, depositing dredged material on the existing adjacent fill and avoiding the marsh areas where possible. Development pressure is very high because of its location and the lack of alternative development sites.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (30) MARTIN SLOUGH/UPPER FOURTH GULCH

Total Acreage: 1,201.5

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Urban	17.0	0.2	
Agriculture	268.0	1.9	
Grassland	110.0	16.7	
Shrub	9.0	2.6	
Evergreen forest	666.0	38.4	Forested slopes offer an important buffer between wetland habitats and urban activities.
Mixed forest	74.8	16.4	
Deciduous forest	9.3	4.3	
Fresh marsh	9.1	13.7	
Oenanthe marsh	2.5	5.9	
Fresh rush marsh	2.5	5.4	
Swamp	32.3	17.4	
Closed ditch	1.0	0.6	

History of Area

Prior to 1850, the gulches were probably characterized by evergreen and mixed forests on the slopes, willow swamps in the bottoms, brackish and fresh marshes in the upper tidal areas and salt marshes in the lower tidal areas. In most places the redwoods were removed from the slopes before 1875 and large portions of the bottoms were diked and cleared as pasture. As the city grew through residential expansion, evergreen trees began to revegetate the slopes. Eventually agriculture became less profitable in many areas and they reverted to wetland. Recently, the municipal golf course was constructed on some abandoned agricultural land. In some areas the gulches have been filled for urban construction during the last 10 years.

Natural Functional Importance

Evergreen forests and swamps are highly productive, and a major source of detrital material exported by the streams. The diversity of habitat types in the gulches provides feeding and nesting areas for a wide range of birds and small-to-medium mammals. The gulches also serve to store storm water runoff and then filter it before discharging it into Eureka Slough or Elk River.

Ancillary Importance

As diverse wetland and forest habitat, the area falls under general preservation policies of FWS, NMFS, EPA, SCS, DFG, and DPR. It is outside the coastal zone and is not designated unsuitable for power plants. The wetlands themselves are under EO11990, the Resources Agency's wetland policy, and various Federal, state, and local preservation policies. Preservation of the Eureka gulches and steep slopes as greenbelts is specified in the Eureka General Plan. The areas are useful for recreation

(including the Eureka Municipal Golf Course) and are an aesthetic resource because of the visual transition between lowland and upland.

Development Pressure

The lowlands and slopes of the gulches are open space/agriculture, with residential development on the uplands. The gulches are accessible on foot from the top of slope. Urban services are available to development on the uplands. Except for the golf course and several small publicly-owned areas, the area is privately owned. Eureka's General Plan designates the area as gulches and greenways. It is mostly zoned residential, although part of Upper Fourth Gulch appears to be zoned agricultural. The steep slopes have low to moderate slope instability and liquefaction hazard potential. Pressure to develop is medium to high in the lowlands and on the surrounding uplands.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (31) PALCO MARSHES Total Acreage: 20.1

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Fresh marsh	4.0	6.5	
Fresh rush marsh	0.7	1.5	
Brackish rush marsh	4.5	5.6	
Pond (closed ditch)	0.2	0.1	
Shrub	1.2	0.4	
Grassland	9.2	1.4	

History of Area

This entire area was tidal wetland in 1850, but by 1870 it had been converted to agricultural uses. It remained pastureland until the mid-1940's when it was converted to industrial use as a part of the Pacific Lumber Co. facility. The marshes are low areas which were not filled or paved as part of the industrial activities, and which have been allowed to revert to wetland.

Natural Functional Importance

This collection of fresh marshes is adjacent to and ecologically contiguous with the North Broadway wetlands. Degradation as a result of industrial activities has impacted but not destroyed productivity and habitat functions. The shrub area is utilized by small birds and mammals. Waterfowl feed and may occasionally nest in these areas. Herons and egrets occasionally feed here. The area serves storm and floodwater storage functions. Restoration of the area could provide a valuable addition to the North Broadway wetlands ecosystem.

Ancillary Importance

As degraded wetland (marsh) habitat, the area falls under EO 11990, the Resources Agency's wetlands policy, and general preservation policies of FWS, SCS, CCNCR, and CEC. The area is designated unsuitable for power plants. The Coastal Conservancy has a part of its mandate to promote restoration of degraded areas, as called for in the Coastal Act and SCR No. 28. Policies of local agencies for this area do not favor preservation. The area is archaeologically sensitive. It has an identified potential public access point. It is one of the areas identified in this study as a potential compensation area through wetland restoration and enhancement.

Development Pressure

The area is open space surrounded by urban uses except for the large wetland area to the north. It is generally accessible by road and has available urban services. The area is designated for industrial development in the Eureka General Plan and for water and port-related industry by the Harbor District. The area is privately owned and is zoned for industry. Development pressure is considered high because of its location and the lack of alternative industrial sites.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (32) ELK RIVER SPIT Total Acreage: 150.6

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Agriculture	41.5	0.3	
Sparse dune	90.3	10.1	
Vegetated dune	18.8	1.2	

History of Area

Elk River Spit first became established about 1930. It has since extended northward almost 7,000 feet. Few activities have taken place on the spit since its formation.

Natural Functional Importance

Sparsely vegetated, Elk River Spit does not provide habitat for an abundance or diversity or organisms. The mice, rabbits, and reptiles which do inhabit the spit, however, are prey to a wide variety of raptors such as hawks and kites. The distal end of the spit offers a resting area for shorebirds. Numerous shellfish are found in the intertidal and subtidal areas west of the spit.

Ancillary Importance

As an accreting sand spit, the area falls under general preservation policies of FWS, NMFS, HCRS, EPA, DFG, DPR, CCNCR, CEC, and OPR. It is designated unsuitable for power plants. The HC General Plan and LCP documents call for the entire spit as park land; the spit is shown as Open Space and the waters around the spit, including Elk River, are designated Conservation waters by the Harbor District. The spit is used for research and education by HSU. A proposed recreation trail would improve access to the spit. The northern tip of the spit is a commonly used hunting area (DFG).

Development Pressure

The spit is open space, surrounded by water - navigation channels, intertidal flats, and the Elk River. The spit is presently rather inaccessible and has no urban services. General Plans designate the spit as park or open space. Ownership of the spit is not recorded on HC Assessor's maps and no zoning classification is shown. Development pressure is low.

LOCATION: (33) ELK RIVER BOTTOMS/ SPRUCE POINT

Total Acreage: 1,208

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Agriculture	1,084.0	7.7	
Wet agriculture	13.4	-	
Deciduous forest	1.3	.6	
Mixed forest	39.3	8.6	
Grassland	12.9	1.9	
Shrubland	19.7	5.8	
Urban	11.1	.1	
Mixed brackish marsh	8.2	12.8	
Brackish rush marsh	14.5	17.9	
Cattail marsh	.5	1.8	
Water parsley marsh	.2	.5	
Swamp	2.6	1.4	

History of Area

The lower portions of this floodplain were probably tidal wetlands in 1850, and the upper portions riparian bottomlands. By 1870 much of the area was being farmed. Construction of the NWPRR in 1901 provided a dike, and later a revetment, to protect the area from the high energy conditions in Entrance Bay. Since then, the river has been diked but few other changes have taken place.

Natural Functional Importance

Some of the pastureland has not been grazed for many years. It is poorly drained, and much of it is dominated by freshwater wetland species, especially in the old tidal sloughs. It supports small birds and mammals throughout the year. Herons and shorebirds feed throughout the area during the winter when it is flooded by storm water runoff. The area is noted for waterfowl feeding and may provide some nesting habitat.

Ancillary Importance

The area falls under general preservation policies of SCS, CCNCR, CEC, and OPR; part of the area is designated unsuitable for power plant construction. The HC LCP documents specify need to preserve agricultural lands. The Eureka General Plan designates it for agriculture. Part of the area is classified Public Open Space and part Agriculture by the Harbor District. Part of its shorelines area is archaeologically sensitive. The area contains a potential public access point and a proposed trail to the Elk River Spit. Bottomlands are considered an important visual resource in the study area. A 17-acre portion of the area is owned by Caltrans and will be ultimately reverted to wetlands as compensation for Caltrans projects.

Development Pressure

The area is generally in agriculture and open space and is bisected by a major highway. Development (industrial-energy, commercial) has occurred south along the shoreline and along Highway 101; residential development is beginning to increase on the uplands around the floodplain. The portion of the area west of the highway is generally accessible; the bottomlands upstream on the Elk River are mostly rather inaccessible except on foot across private lands. Urban services are available to the developed areas. The area is in private ownerships. It is designated agriculture in the Eureka General Plan. The southern part of the area west of the highway is zoned for industrial development; no zoning is shown for the remainder. The area north of Elk River is part of an area being considered by the City of Eureka as marsh areas for wastewater treatment. Wetland restoration is a possibility in the area, particularly around the Elk River. Development pressure for activities other than agriculture is low except around Highway 101 and in the industrially-zoned area near the PG&E plant, where it is low to medium.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (34) ENTRANCE BAY/BUHNE POINT Total Acreage: 1,350

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Intertidal flats	36.7	0.4	Highly exposed intertidal and subtidal habitats.
Shallow tidal channels	1,154.0	56.0	
Deep tidal channels	147.0	4.3	
Sparse dune	9.3	1.0	

History of Area

Construction of the jetties at the Bay mouth in 1891 and later, dredging of the entrance channel about 1930, have apparently resulted in major shoreline realignments around Entrance Bay. The shore at Buhne Point retreated over 1000 feet from 1890 to 1945. About 1930 the Elk River spit began forming, thus the northeastern shore of Entrance Bay was prograding while the southeastern shore was retreating. Prior to 1940 NWPRR constructed a major revetment to protect the tracks north of King Salmon.

Natural Functional Importance

The high energy conditions which resulted in the major shoreline reorientation of Entrance Bay also preclude the establishment of major vegetation communities in the area although algae are common on the revetment. Clams and flat fish are found there. Almost all water entering Humboldt Bay on a flood tide passes through Entrance Bay first, thus maintenance of water quality here is important.

Ancillary Importance

As an aquatic habitat for shellfish and flatfish, the area is under general preservation policies of FWS, NMFS, EPA, DFG, CCNCR, CEC, and OPR. It is designated unsuitable for power plants except for Buhne Point. The DBW is concerned about erosion at Buhne Point (as are the Corps and the County). The Harbor District designates the area Conservation Water. Much of the area is a clam reserve (DFG). The King Salmon/Buhne Point area is archaeologically sensitive and is used by HSU for education and research purposes. The Buhne Point area is commonly used for fishing (DFG) and there are several identified potential public access points. The area contains identified viewpoints. There is a commercial surfperch fishery off King Salmon.

Development Pressure

The area is water, tideflats, and open space bordered by residential, industrial, and agricultural uses. Buhne Point is accessible from King Salmon, but the Entrance Bay mudflats are relatively inaccessible. A considerable part of the tidelands is privately owned and portions are zoned industrial. Buhne Point has no General Plan designations. Development pressure is low to negligible in the portion of Entrance Bay near Elk River Spit, but higher in the King Salmon/Buhne Point area.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (35) SOUTH SPIT Total Acreage: 439.5

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Urban	22.2	0.3	
Sparse dune	243.2	27.2	
Vegetated dune	138.9	8.7	
Dune hollow	30.8	24.0	
Jetty	4.3	23.8	
Cordgrass marsh	0.5	<0.1	
Closed ditch	0.1	<0.1	

History of Area

Construction of the jetty in 1891 is the only major activity which has taken place on South Spit. The road to the north end of the spit was unpaved for many years and often washed out. It was paved in 1968.

Natural Functional Importance

Dune habitat types are used by a variety of small birds and mammals. These in turn are preyed upon by various raptors and small carnivores, in particular owls, kites, hawks, kestrels, foxes, and weasels.

Ancillary Importance

As a barrier sand spit and dune habitat adjacent to approved National Wildlife Refuge, the area falls under general preservation policies of FWS, NMFS, CCNCR, CEC, and OPR. The Northern Humboldt County General Plan shows it as public and semi-public land, and the Harbor District designates it for Public Open Space/Agricultural lands. It is archaeologically sensitive. The Spit is commonly used for recreational hunting and for educational and research purposes by HSU, College of the Redwoods, Humboldt County schools, and the Audubon Society. The Spit is part of the dramatic view from Table Bluff and is an aesthetic resource. It has two potential public access points.

Development Pressure

The South Spit is an isolated open space area with South Bay to the east and the ocean to the west. It is accessible by road along its entire length, but the roads are narrow. There are no urban services. It is mostly in private ownership, with two areas near its north end publicly owned. It is designated public/semi-public in the General Plan. It does not have a zoning classification. Development pressure is negligible except for heavier recreational use.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (36) BEATRICE FLATS Total Acreage: 1,139.2

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Agriculture	1,016.0	7.2	
Urban	77.5	0.9	
Pickleweed marsh	0.7	0.2	
Tidal slough	1.6	0.2	
Closed ditch	6.7	4.0	
Evergreen forest	23.3	1.3	Eucalyptus forest
Deciduous forest	0.8	0.4	
Shrub	12.6	3.7	

History of Area

Small areas in the upper reaches of the flats were used for agriculture as early as 1870. The NWPRR was completed through the area about 1901. By 1927 most of the flats had been diked. Farming has been the principal activity in the area ever since.

Natural Functional Importance

Most of these low pasture lands serve as important winter feeding habitat for a variety of shorebirds and wading birds. Whistling swans winter here also. Many of the fields remain saturated or inundated for much of the winter, thus serving both as wetland habitat and storm water storage.

Ancillary Importance

As active agriculture, the area falls under general preservation policies of SCS, CCNCR, CEC, and OPR. It is designated unsuitable for power plants except for the southeast portion east and west of Highway 101. It is identified as agriculture in the Northern Humboldt County General Plan and as Prime I agricultural lands is identified for preservation of agriculture in the HC LCP Technical Reports. It is classified as Public Open Space/ Agriculture by the Harbor District. It has an identified potential public access point. It is an aesthetic resource forming part of several identified views.

Development Pressure

The entire area is in agriculture and is surrounded by agriculture and open space uses. Although it is bisected by Highway 101, much of the area is only accessible on foot across private land. The nearest wastewater facilities are at College of the Redwoods to the north; however, the College has a proposal to locate wastewater treatment ponds in the flats. The area is all privately owned except for a small part owned by College of the Redwoods. It is shown as agriculture in the General Plan. Almost the whole area is zoned Agriculture Exclusive (AE). Development pressure is considered low in the area itself, but high on the bluffs overlooking the area and Fields Landing.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (37) TABLE BLUFF Total Acreage: 702.2

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
Agriculture	527.0	3.7	
Urban	40.6	0.5	
Shrub	31.0	9.1	
Mixed forest	32.7	7.2	
Evergreen forest	63.9	3.7	
Deciduous forest	5.1	2.3	
Swamp	31.0	1.0	

History of Area

Much of Table Bluff was cleared for farming early in the area's development. Agriculture is still the dominant activity. The only recent activities were a sanitary landfill and several natural gas wells (presently not in production).

Natural Functional Importance

The forested areas of Table Bluff are important habitat for a wide diversity of mammals and birds. Little study has been carried out to determine either abundance or diversity of wildlife in the area. The proposed endangered *Lilium occidentale* has been identified on Table Bluff. Parts of Table Bluff are prime agricultural soils.

Ancillary Importance

As active agriculture, the area falls under general preservation policies of SCS, CCNCR, ERCDC, and OPR. It is designated as Public Open Space/ Agriculture by the Harbor District. The entire area is archaeologically sensitive. It is used for education and research purposes by HSU, College of the Redwoods, Humboldt County Schools, and the Aubudon Society. It contains a County park and has several identified potential public access points. It has three viewpoints identified by the CCNCR. The County sanitary landfill in this area has been closed.

Development Pressure

The area is agriculture and open space surrounded by similar uses and bordered by South Bay on the north. It is accessible by road but has no urban services (water or sewer). The entire area, except the County park and landfill site, is privately owned. It is designated as agriculture in the Northern Humboldt County General Plan. It has no zoning classification. It is a high bluff lacking navigation access. Development pressure is generally low, although the Coastal Commission has received a number of inquiries about rural residential land divisions in this area.

GENERAL USE AREAS

As can be seen on Plate 2, there are a number of areas which are designated appropriate for general use in the study area. General use areas are areas in which the effects of permit activities on wetlands and other valuable habitat types would generally be minimal; such areas include developed urban and industrial areas and settlements. Some relatively undeveloped areas are designated as General Use areas because of the recognized need to allow future development and possible expansion of port and water-related industry in particular. The General Use areas shown on Plate 2 are discussed in three development categories: (1) principally industrial/commercial; (2) principally residential; (3) mixed development.

(1) Principally Industrial/Commercial Areas

This category includes the following areas:

- That part of the City of Arcata around South G Street south of Samoa Boulevard.
- The Brainard and Bracut areas, the Indianola Road - Highway 101 intersection, and the already developed land adjacent to Highway 101.
- The north bank of Eureka Slough south of Highway 101 including Murray Field.
- The Eureka waterfront and Broadway area north and west of Highway 101 from Eureka Slough to the northern limit of the Broadway wetlands, excepting areas designated AOI or AEC.
- The Bucksport strip west of Highway 101 from Elk River to the southern limit of the Broadway wetlands, excepting areas designated AOI or AEC.
- North Spit east of Navy Base Road from the Eureka-Samoa Bridge to south of Fairhaven.
- The area around the PG&E facilities, not including the residential parts of King Salmon.
- The waterfront area in Fields Landing, west of the railroad tracks.
- The navigation channels and the Middle Bay Area, including the main channel, the Eureka and Samoa Channels to the Eureka-Samoa Bridge, and the Fields Landing Channel to south of Fields Landing.

Of these areas, those under heaviest development pressure are the Eureka waterfront, Broadway strip, and the Bucksport area.

Pressure to develop the North Spit is also high. Many of these areas are already mostly developed; those with developable space (under heavy development pressure) would experience even more significant development pressure were the economy of the Humboldt Bay area an expanding or growing economy.

(2) Principally Residential Areas

This category includes the following areas:

- Parts of the Cities of Eureka and Arcata which are already zoned for residential development; in both cities the mixed downtown area is excluded from this category. The areas around the Eureka gulches are principally in this category.
- The residential areas of McKinleyville.
- The area along Old Arcata Road in Bayside Bottoms.
- The residential area on the highlands around Indianola Road.
- North Spit around Manila, from Mad River Slough south to the Eureka-Samoa Bridge.
- King Salmon.
- The residential part of Fields Landing east of the railroad tracks.
- The Humboldt Hill area, except the steep slopes.

Of these areas, the most significant pressure for new development is presently in McKinleyville, followed by the Jacoby Creek-Bayside Bottoms area along old Arcata Road, Humboldt Hill, Indianola, Pigeon Point, Eureka, and Arcata. Pressure for residential development on North Spit is lower, partly because of the lack of adequate wastewater treatment facilities in and around Manila.

(3) Mixed Development Areas

This category includes the downtown areas of Eureka and Arcata: the central business districts where commerce, light industry, and residential facilities all occur.

C. ACTIVITIES AND THEIR IMPACTS

This section discusses major types of activities occurring in the Humboldt Bay study area, as identified by the Corps of Engineers and from Corps permit applications and planning documents of the Coastal Commission, North Coast Region (CCNCR), and local agencies. The major types of activities considered are as follows:

- Dredging
- Dredged Material Disposal, Fill, and Levees
- Piers and Docks, Pilings, Dolphins
- Shoreline Stabilization Structures
- Breakwaters
- Marinas
- Aquaculture
- Canals and Ditches
- Overhead Cables/Aerial Crossings
- Cables and Pipelines
- Outfall Structures
- Urban Development
- Agriculture
- Bridges and Roads

Of these activities, not all are Corps permit activities; for example, agriculture, urban development, and roads are generally not under Corps regulation. Each activity type is discussed in the format of Template 3. The activity is defined and described, and its associated activities and potential activity conflicts are listed. Environmental impacts and significant concerns about the activity are summarized in terms of physical, chemical, biological, and socioeconomic effects. Environmental impacts may be related to construction and/or operation of the use or activity. The impacts may be short-term or long-term. There may be secondary activities, such as increased commercial growth induced by new industrial development on a filled area or increased boating activity associated with the placement of mooring buoys. Secondary activities will have environmental impacts which must be considered at least qualitatively in the evaluation of the primary activity. As a result of the discussion of environmental impacts, a judgment of impact potential is made. The legal and administrative processes by which the activity is regulated are briefly described.

The following abbreviations are used in the template descriptions of various activities:

FWS	U.S. Fish and Wildlife Service
NMFS	National Marine Fisheries Service
EPA	U.S. Environmental Protection Agency
EDA	Economic Development Administration
FDA	Food and Drug Administration
DFG	California Department of Fish and Game
DBW	California Department of Boating and Waterways
CCNCR	California Coastal Commission, North Coast Region

CEQA California Environmental Quality Act
SLC California State Lands Commission
SWRCB California State Water Resources Control Board
RWQCB Regional Water Quality Control Board, North Coast Region
Harbor District - Humboldt Bay Harbor, Recreation, and Conservation District
HBWA Humboldt Bay Wastewater Authority
MHW Mean high water

The purpose of this section is three-fold:

- To provide general information on the types of impacts associated with particular activities.

- To list the agencies with regulatory control over or policies on particular activities, so that permit applicants can be better informed about regulatory processes.

- To provide sufficient information to allow the Corps and other planning and regulatory agencies to determine easily if an Environmental Statement or Environmental Impact Report is required.

An issue of great importance in evaluation of permit applications is that of cumulative impacts of permit activities on the study area. Cumulative impacts can be defined as those impacts resulting from the implementation of pending or future permit applications and activities in the study area. *More specifically*, the term "cumulative impact" may have either or both of the following meanings:

- The continued loss of or encroachment on wetlands in the study area and consequent loss of a valuable resource.

- The environmental degradation of the study area resulting from the additive effects of activities of the same type or of activities with the same types of impacts.

The first meaning may be amplified as follows: If there are five pending permit applications which contain requests to fill wetland areas in the estuary, what will be the total loss of wetlands in the estuary and what will be the loss in wetland acreage by type if these permits are granted? What is the value of these wetlands in terms of natural functional characteristics and ancillary issues of the public interest? How much of the wetlands resource will remain? The second meaning may be amplified as follows: How much activity (for example, boat slips) can the area support without significant degradation of water quality, air quality, the ambient noise environment, and so on? If there are five pending permit applications for marinas, what will this mean in terms of additive water pollutant loading, for example? In review of any permit application or proposed project in the study area, regulatory and planning agencies should make every effort to evaluate cumulative impacts under both of the above definitions.

Template 3 (sample format)

ACTIVITIES AND THEIR IMPACTS

NAME OF ACTIVITY

Description

What is the activity? What does it entail; how is it carried out? Where is it located in the study area?

Associated Activities and Activity Conflicts

Listed here are other activities in the coastal area with which the activity is generally associated. This is a cross-reference to indicate that the other activity guidelines may be helpful. Secondary activities resulting from or facilitated by the primary activity will be listed here. This section also indicates what activities may conflict with the activity or be preempted by it. This heading may include a general statement or specific uses. The purpose is to allow consideration of multiple uses of an area.

Impacts and Significant Concerns

Shown here are the types of impact and the important issues or concerns about the activity. Impacts will generally be discussed as physical, chemical, biological, and social/economic effects. A general assessment of the impact potential of the activity will be made.

Legal/Administrative Processes

Here are listed the legal and administrative processes by which the activity is managed. This includes agencies with jurisdiction or review and approval authority over the activity, regulatory programs, and permits required by the activity. Agencies with specific guidelines, standards, or criteria for the activity will be listed here. (For example, the U.S. Fish and Wildlife Service has specific guidelines for marinas, bulkheads, and other Corps permit activities (40 CFR 230).) If there are legal or administrative questions about control of the activity, it will be noted here.

GENERAL REGULATORY POLICIES

The following regulatory policies apply to all activities affecting the Humboldt Bay study area which are under the jurisdiction of the U.S. Army Corps of Engineers. These policies reflect requirements of Corps regulations 33 CFR 320-329 and the regulations of other federal, state, and local agencies. Please note that these general policies are designed to apply to Corps permit applications, although other agencies may choose to use the general policies.

1. Permits for activities in navigable waters, waters of the United States, and adjacent wetlands will only be granted if the permit issuance is found to be in the public interest as defined in 33 CFR 320.4. Factors of the public interest which must be considered include:

   > *...conservation, economics, aesthetics general environmental concerns, historic values, fish and wildlife values, flood damage prevention, land use, navigation, recreation, water supply, water quality, energy needs, safety, food production, and, in general, the needs and welfare of the people.* 33 CFR 320.4(a)(1)

2. Permit applications in areas, particularly wetlands, designated Areas of Importance will receive special scrutiny to be certain that the following criteria are met:

   > *...the benefits of the proposed alteration outweigh the damage to the wetlands resource and the proposed alteration is necessary to realize those benefits. In evaluation whether a particular alteration is necessary, the District Engineer shall consider whether the proposed activity is primarily dependent on being located in, or in close proximity to, the aquatic environment and whether feasible alternative sites are available. The applicant must provide sufficient information on the need to locate the proposed activity in the wetland and must provide data on the basis of which the availability of feasible alternative sites can be evaluated.* 33 CFR 320.4(b)(4)

3. All permit applications will be reviewed by the Coastal Commission, North Coast Region (CCNCR). No permit which is viewed by the CCNCR or the State Coastal Commission to be in conflict with Coastal Act policies will be issued without resolution of the conflict, nor should any permit be issued with conditions less stringent than those recommended by the CCNCR or the State Commission. Corps requ-

lations 33 CFR 320.4(h) on consistency under the Coastal Zone Management Act of 1972 will apply.

4. Great weight will be given to conservation of fish and wildlife resources and prevention of damage to such resources in evaluating permit applications. As required by several federal statutes, evaluation of permit applications for effects on fish and wildlife resources and habitat will be coordinated with other agencies, including the U.S. Fish and Wildlife Service, the National Marine Fisheries Service (as appropriate) and the California Department of Fish and Game.

5. Activities will be permitted only if applicable state or federal water quality statutes, rules and standards will not be violated. For any activity which may affect water quality, the Regional Water Quality Control Board, North Coast Region, must be consulted as to the suitability of the activity. The applicant must provide information on any waste discharge characteristics, including type and amount of pollutant loading in the discharge, for use by the RWQCB and other agencies in evaluating the application.

6. Where applicable, activities will be permitted only if state and federal air quality standards, rules, and statutes will not be violated. For any stationary source activity which may affect air quality, the Humboldt County Air Pollution Control District (HCAPCD) and the State Air Resources Board (ARB) must be consulted as to the suitability of the activity. The applicant must provide information on any emissions, including type and amount of pollutant emitted (especially particulates) for use by the HCAPCD and other agencies in evaluating the application. If a significant potential problem with vehicle emissions exists, then the ARB must be consulted.

7. Permit applications in areas having historic, archaeologic, cultural, scenic, recreational, and research/educational values will be carefully evaluated to ensure that to the greatest extent possible, the proposed activity is consistent with, and avoids adverse effects on, such values and resources. In the evaluation, interagency coordination shall be necessary. Public development projects must have an archaeological clearance as required by CEQA. Humboldt County Planning Department may initiate archaeological clearance procedures through Sonoma State Archaeological Clearing House.

8. All permit applications will be reviewed for consistency with state and federal policies and regulations applying

to the land and water areas in which activities are proposed. (Volume I, Section V-F, identifies and summarizes identified policies and regulations.) Where any required federal or state authorization or certification is denied, the Corps permit will also be denied (33 CFR 320.4(j)).

9. All permit applications will be evaluated for consistency with General Plans, zoning, Local Coastal Programs, and ordinances and regulations of Humboldt County, Eureka, and Arcata. Permit applications will also be evaluated for consistency with Ordinance No. 7 of the Humboldt Bay Harbor, Recreation, and Conservation District. The applicant should furnish sufficient information that these evaluations can be made by reviewers of the Corps and these other agencies.

10. Permit applications will be reviewed for consistency with Seismic Safety and Public Safety Elements of the local General Plans, in particular for critical facilities (emergency services, major utility lines, industrial facilities using or storing hazardous or toxic substances, etc.). Critical facilities are defined in the Alquist-Priolo Special Studies Zone Act of 1972.

DREDGING

Description

Dredging is the removal from a water body of either original or recently deposited bottom material. From Corps regulations (33 CFR 323.2), dredged material is defined as material that is excavated or dredged from waters of the United States. New dredging is usually associated with construction of moorages, marinas, and piers. Maintenance dredging is done to keep navigation channels and mooring areas open for navigation and to keep creeks, sloughs, and drainage ditches flowing freely. In the study area maintenance dredging is done by the Corps in the Eureka, Samoa, and Fields Landing channels for navigation and by the City of Arcata in stretches of Janes Creek in the urban areas for drainage and flood control purposes. Once an area has been dredged, it usually must be periodically dredged to maintain it. Dredging is also done to provide materials for dike maintenance.

Dredging is most frequently done by clamshell (bucket) dredge, hopper, or hydraulic pipeline dredge; however, Hoffman (1978) describes seven less well-known methods which may be useful in circumstances requiring particular environmental controls or dredging techniques. In the design studies for navigation improvements (Corps, 1976), the agency evaluated hopper dredges, hydraulic pipeline dredges, and clamshell dredging with barge hauling to an ocean disposal site. The Corps concluded that hydraulic pipeline dredging was the most cost effective and feasible approach.

The gravel mining operations in the Mad River may be considered a form of dredging for purposes of this study, since they involve removal of gravel from bars in the river bed.

Associated Activities and Activity Conflicts

Associated activities include dredged material disposal and fill, navigation and placement of navigational aids, marina construction and operation, and port development and expansion. Conflicting activities include commercial and recreational shellfishing and maintenance of fish and wildlife habitat.

Impacts and Significant Concerns

Physical Effects. The primary (but not necessarily the most important) physical effects of dredging are the creation of deep holes or channels which change the hydraulics in the vicinity, and the temporary suspension of clouds of sediments, causing turbidity in the water body. The finer the sediment, the higher the resulting turbidity. In the study area finer grained sediments (silts and clays) are found in the parts of the tidal channels farthest from the Bay entrance, in the higher tide flats of North Bay, and in the lower tide flats of South Bay. The navigation channels themselves have rather coarse grained sediments, and dredging

in these channels probably does not create much turbidity. Different methods of dredging result in more or less turbidity; a hydraulic pipeline dredge stirs sediment at one location (the cutterhead) during dredging, while the hopper dredge stirs sediment at three locations (the prop wash, the suction heads, and the hopper overflow ports). The sediments suspended in the water column may settle out downstream, creating a new sediment layer on the bottom.

A potential adverse effect of the gravel mining in the Mad River is that removal of riverbed materials may create continuous bed load movement and substrate shifting and may leave pits or pockets in the banks. If these pits trap flood waters, the downstream hydraulic regime may be changed.

Chemical Effects. Dredging breaks through the thin oxidized layer of the submerged soil and exposes the unoxidized layer. The sediments placed in suspension are also chemically reduced. The exposure of these reduced sediments creates a high chemical and biological oxygen demand. In the Humboldt Bay area dissolved oxygen (DO) levels appears to be unrelated to concentrations in the incoming water and the mixing process in the Bay. The DO levels vary most at the entrance; the most stable DO values are in the northeast part of Arcata Bay. DO varies through the tidal cycle.

If the dredging is done in an area where dissolved oxygen concentration is low and flushing is poor, or where there is a very high concentration of oxidizable substance in the exposed materials, dissolved oxygen concentrations may be significantly reduced. In the Humboldt Bay study area, however, dissolved oxygen levels have been found to be generally within standards.

Dredging may expose toxic materials such as hydrogen sulfide, organic compounds, and heavy metals which have been discharged as industrial wastes and absorbed and buried in the sediments.

Biological Effects: Dredging may destroy or adversely affect flora and fauna in the water and aquatic lands habitats of the study area. The water and aquatic lands habitats contain a variety of flora, including phytoplankton, algae, eelgrass, and marsh plants. The rivers and sloughs are spawning and juvenile nursery areas for salmon and other fish. Clams, oysters, and other sediment dwellers (worms and crustaceans) are all found in the mudflats of the Bay. Insect larvae are found in all marsh and swamp habitats. Dredging destroys the benthic habitat and with it the associated eelgrass, algae, and the benthic organisms such as clams, worms, and crustaceans. Recovery time will be dependent on season, sediment composition, and rate of deposition and numerous other factors.

An excellent general discussion of the biological effects of suspended sediments, increased turbidity, sedimentation, changes in oxygen concentrations, and toxic materials is contained in Darnell (1976, pp. 234-270). More detailed information on the effects of maintenance dredging (and

disposal) on aquatic vegetation, fish, avian and mammalian fauna, ecological relationships, juvenile salmonids, and other benthic organisms may be obtained from the Corps of Engineers Dredged Material Research Program (Corps, 1973-1978). In general, turbidity and suspended sediments can interfere with primary productivity (photosynthesis), respiration, feeding and nutrition, and migration and spawning. Sedimentation may smother eggs, larvae and adult forms of benthic fauna and fish. Changes in dissolved oxygen may suffocate aquatic plants and animals, and toxic materials may kill or be absorbed by flora and fauna.

If the gravel mining in the Mad River induces bed load shifting and bank erosion, salmon and trout migration, nesting, and rearing may be disturbed. Resident fish or juvenile fry may become trapped in holes left from the excavations, especially during flood conditions.

Socioeconomic Effects. Dredging for new construction will result in secondary socioeconomic effects from the activity made possible by the dredging; for example, dredging to create a marina will ultimately mean water and land traffic, noise, and other marina impacts. The dredging itself may be noisy and may have temporary visual impacts.

Impact Potential. Medium, particularly in the navigation channels and other areas which are routinely dredged.

Legal/Administrative Processes

Dredging requires a Corps Section 10 permit (and a 404 (or 103) permit if disposal in waters or wetlands is involved), a CCNCR permit, and a Harbor District or other local agency permit in areas under the agency's jurisdiction. Dredging in streams and creeks would require a stream alteration permit from DFG. Various agencies, such as FWS and EPA, have guidelines and criteria for dredging. The SWRCB, EPA, and Corps of Engineers regulate dredging, disposal, and mining wastes through adoption of waste discharge requirements. The SLC has policies for regulating dredging in areas under their jurisdiction.

DREDGED MATERIAL DISPOSAL, FILL, AND LEVEES

Description

From Corps regulations (33 CFR 323.2), dredged material disposal, or the discharge of dredged material, means any addition of dredged material into the waters of the United States. The term includes, without limitation, the addition of dredged material to a specified disposal site located in waters of the United States and the runoff or overflow from a contained land or water disposal area. In the Humboldt Bay study area, no disposal of dredged material is done within the open water of the Bay; there is a deep water disposal site which is located southwest of the Bay entrance. Most dredged material disposal in the study area is on uplands; there are two approved upland sites for dredge material disposal on the North Spit near the airport and a beach disposal site on North Spit near the Eureka-Samoa Bridge (see Volume II, Section VIII.C). Fill material is material used for the primary purpose of replacing an aquatic area with dry land or of changing the bottom elevation of a water body. Discharge (placement) of fill material is the addition of fill material to waters of the United States, including adjacent wetlands (33 CFR 323.2). Sometimes an area may be filled primarily to dispose of the material (for example, the closed Humboldt County landfill on Table Bluff). For purposes of discussing environmental impacts, levees may be considered a form of fill in that they are placed on and around wetlands to prevent continued water intrusion. The protected area (and the levee) are then useful for other purposes. Fill materials used in the study area are principally sand and gravel dredged from the Bay.

Associated Activities and Activity Conflicts

In filled areas, associated activities may include industrial, commercial, residential, or any other form of intensive development. In areas behind levees, land uses such as agriculture are often in the protected area. In general, fills and levees serve to create land which may be used for development of various types. However, fills and levees remove the area from whatever its past use was; for example, pastureland may be lost.

Impacts and Significant Concerns

Physical Effects. Fills and levees interfere with surface flow through a wetland by blocking it off (or covering it) from water interaction. This may change flow characteristics of the area. A result of levees along rivers and creeks is reduced areas for floodwater storage and perhaps higher flood heights downstream. Fill banks may tend to erode and in some cases need to be protected. The area filled is raised above its former elevation, and this will induce biological changes. Storm runoff may be different (faster) and may result in short-term salinity fluctuations in the area around the fill.

Chemical Effects. Fill materials may produce water quality problems if leachate from the fill enters the creeks and sloughs or the Bay. Fills composed of municipal wastes (sanitary landfills) produce leachate containing substances which may be toxic to aquatic organisms. Depending on the composition of dredged materials, their disposal may result in leachate problems if they are used for fill. Sand, gravel, and clean earth do not produce toxic leachate. Dissolved oxygen levels may be temporarily lowered at the site where discharge of dredged or fill material occurs. Salt extrusion from Bay sand occurs with rainfall and chloride groundwater contamination may occur.

Biological Effects. The immediate biological effect is the loss of the existing habitat at the fill site. If it is a marsh or swamp habitat, filling it will mean the loss of a highly productive area. All vegetation and soil or sediment dwellers in the filled area will be lost. Vegetation may ultimately regrow in the filled area, but it will be different from the original vegetation because of the difference in levation and drainage characteristics. There is considerable interest in the use of dredged material to create new marsh habitats by placing it as fill on intertidal areas (Beeman and Benkendorf, 1978; Reimold, 1978; Eckert, 1978; Smith, 1978).

Levee construction will mean loss of the existing habitat behind the levees, but over a longer time. The interruption of tidal inundation will mean loss of productive wetland vegetation, as was the case when all the bottomlands of the study area were diked in the early part of the century. Levees convert the protected area from wetland to upland type habitat with some trade-off value in the creation of the habitat. Unlike filled areas, leveed areas may revert to the original wetland habitat if the levees are allowed to degenerate through lack of maintenance.

Any habitat will usually be at its carrying capacity for the species using it. If a significant amount of the habitat is lost by fills or levees, there may be a resulting loss in the numbers of fauna in the area, unless they can use the newly created habitat as well. If the habitat is specialized, particular species may be eliminated.

If the filled area produces toxic leachates, flora and fauna may be killed. Changes in salinity from increased runoff may affect flora and fauna around the fill.

Socioeconomic Effects. Both filling and levees allow the development of urban-type uses in the protected area. Examples of this in the study area include the Brainard and Bracut fills and developments along the Eureka waterfront, among others. Urban-type development in reclaimed floodplain and bottomlands has not occured extensively in the study area; most of the reclaimed bottomlands are still actively used for agriculture. However, socioeconomic effects of levees and filling could include a conversion of the economy from agriculture to other sectors. If urban-

type development occurs as a result of levees and filling, then traffic, noise, etc., could result.

Impact Potential. High.

Legal/Administrative Processes

The activity would require a Corps Section 10, 404, and/or 103 permit, and permits from the CCNCR, the Harbor District, and other agencies with jurisdiction. Levee construction in a creek or stream would require a DFG stream alteration permit. The SWRCB regulates dredged material disposal through the adoption of waste discharge requirements. Various agencies, such as FWS and EPA, have guidelines and criteria for dredged material disposal and fill. The SLC has policies for regulating dredged material disposal, levees, and filling in areas under their jurisdiction.

PIERS AND DOCKS, PILINGS, DOLPHINS

Description

A pier or dock is a structure, usually of open construction, extending from the shore out into the water, designed to serve as a mooring place for boats. Pilings are long, heavy timbers driven into the bottom and protruding above the water surface. Pilings are included in the Coastal Act definition of fill (CCC, 1979). A dolphin is a cluster of piles bound together. Pilings in the study area are principally located along the Eureka-Broadway waterfront and in the King Salmon mudflats and along North Spit. Remnants of pilings are found in various places; for example, in North Bay near the site of the old Arcata wharf.

Piers and docks may be either on pilings or floating; sometimes a dock is on pilings with a floating part attached. Piers and docks in the study area are mainly located along the Eureka-Broadway waterfront, along the North Spit with access to the channels, and in King Salmon and Fields Landing.

Associated Activities and Activity Conflicts

Associated activities include various types of development (industrial, commercial, residential) depending upon the size and ownership of the pier or dock, vessel moorage and all types of boat traffic, and recreational uses such as fishing. Shore protection structures, in particular bulkheads and breakwaters, may be built to protect and enhance dock use. Dredging and dredged material disposal may also occur. The various uses of piers, docks, and pilings may conflict with each other; e.g., recreational versus commercial or industrial boat traffic.

Impacts and Significant Concerns

Physical Effects. The placing of pier supports or pilings may cause some temporary turbidity if the bottom sediment is time-limited, as is the case in North and South Bays and in the parts of the tidal channels farthest from the Bay entrance. A very small area of bottom for each piling or support would be affected. Floating docks would tend to create smooth water and so protect or shelter areas behind them, as do piling structures where the pilings are close together.

Chemical Effects. None of these structures has any significant effect on water quality; however, activities such as commercial, industrial, or recreational boat traffic which use the structures may adversely affect water quality (secondary impact). Creosote piles may temporarily leach pollutants into receiving waters.

Biological Effects. Pilings have minimal effects in and of themselves on the biological environment. Both pilings and pier supports, if not chemically treated, can provide a suitable substrate for algae and at-

tachment sites for invertebrates. They also provide cover and feeding sites for fish and sites for perching birds.

Piers can have more major effects on biological systems, primarily because of shading effects. Growth of wetland or tideland vegetation (algae, eelgrass, marsh vegetation) may be impeded or eliminated because of decreased light. Local turbidity and sedimentation may be increased because of changes in local currents, affecting fish and benthic fauna. If floating docks ground at low tide, they will damage benthic organisms.

Socioeconomic Effects. Such effects are principally related to the activities and uses associated with the piers and/or pilings. Activity on-shore could include traffic, noise, and other effects of industrial and commercial development. A real proliferation of piers and docks may give a very cluttered appearance to the shoreline.

Impact Potential. Low, although significant impacts may result from associated activities.

Legal/Administrative Processes

The construction of piers and docks and the placement of pilings require a Corps Section 10 permit, and permits from the CCNCR, the Harbor District and other local agencies. Various agencies, such as FWS and DBW, have guidelines and criteria for piers and docks.

SHORELINE STABILIZATION STRUCTURES

Description

This activity includes bulkheads, revetments, seawalls, riprap, groins, and jetties.

> *Seawalls, bulkheads, and revetments are structures placed parallel, or nearly parallel, to the shoreline, to separate a land area from a water area. The primary purpose of a bulkhead is to retain or prevent sliding of the land, with the secondary purpose of affording protection to the upland against damage by wave action. The primary purpose of a seawall or revetment is to protect the land and upland property from damage by waves, with incidental functions as a retaining [illegible] bulkhead. There are no precise distinctions between the three structures, and often the same type of structure in different localities bears a different name.* (U.S. Army Corps of Engineers, 1973)

These structures may be constructed of timber, steel, concrete, or large stones/riprap. Riprap is stone of various sizes (broken rock, cobbles, boulders). Seawalls are designed to take the full force of waves; a most notable example of a seawall in the study area is along the shoreline from the south end of the Elk River Spit to the south end of King Salmon. Bulkheads are smaller and are generally exposed to less severe wave action; examples in the study area include the wood and steel bulkheads along the Eureka Channel in Eureka. Revetments are the lightest of these three structures, because they are designed to protect shorelines against erosion by currents or light wave action.

Groins are usually structures of stone, concrete, or wood constructed perpendicular to the shore extending both inshore and offshore to retard shore erosion by trapping littoral drift. Jetties are structures extending into the water to direct and confine tidal flow, prevent or reduce shoaling in the channel and stabilize the inlet location through barrier beaches. The North and South Jetties were completed 30 August 1899.

Associated Activities and Activity Conflicts

Since the principal purpose of these structures is to protect and stabilize shore and channel areas, associated activities can include any development on land, port facilities, navigation, and any harbor uses including private boat moorage. The structures do not conflict with man's activities but are designed to enhance and protect them.

Impacts and Significant Concerns

Physical Effects. Turbidity in the water column will be temporarily increased during construction of any of these structures, particularly in fine-grained areas (see Dredging for effects of increased turbidity). If the structure is an abrupt vertical wall which extends into relatively deep water to allow boat mooring (as in the case with bulkheads), the vertical face will create reflection waves in shallow water which may further disturb sediments and/or erode the foreshore. This would be a minor problem in sheltered areas with low wave action. Seawalls, revetments, and bulkheads all exhibit this problem. Jetties at a bay mouth alter the rate of tidal currents and can change the tidal prism; in the study area, such impacts have long since occurred and the situation has stabilized. Groins may accelerate downdrift beach erosion by reducing the amount of sand transported. Jetties may also significantly change downdrift beaches and may cause erosion and accretion locally in patterns quite different from those previously existing.

Chemical Effects. Water quality effects from resuspension of bottom sediments and possible release of toxic substances may occur.

Biological Effects. The construction of these structures permanently buries established terrestrial and intertidal vegetation. If they are constructed in a wetland, they will eliminate the natural habitat there; if they are constructed landward of the wetland growth, the fringe marsh area will be preserved but may be impacted by increased freshwater runoff or erosion. All fauna using the wetland may be affected, including birds and mammals. For mammals, bulkheads, seawalls, and revetments may eliminate access from the aquatic area to the upland, thus limiting use of the seaward habitat.

The newly created deep water zone in front of a vertical bulkhead may have a lower concentration of detritus, lower phytoplankton production, and fewer benthic organisms than unbulkheaded areas. Turbulence from reflected wave action may prohibit vegetation growth. Bulkheads cause an abrupt habitat change, eliminating shallow water areas. Salmon fry may go into deeper water when confronted with a bulkhead or congregate near the bulkhead, not going around it. Both circumstances make the fry vulnerable to predation.

The rougher, more irregular material of seawalls and revetments, and their shallower slope, show a greater ability to support marine life than do vertical bulkheads.

The accretion of sand behind groins and jetties may bury sessile benthic organisms; however, the surfaces of these structures may provide attachment sites for sessile organisms. Both groins and jetties attract fish. On the channel side of jetties, the organisms tend to be those with tolerance for rapid salinity change, strong tidal currents, and periods of low water clarity, while those on the outside are tolerant of surf conditions.

Socioeconomic Effects. As with breakwaters, such effects are related to the activities which are allowed and protected by these structures.

Impact Potential. High, until a stabilized situation is reached.

Legal/Administrative Processes. All these structures require a Corps Section 10 and Section 404 permit, a CCNCR permit, and permits from the Harbor District or other local agency with jurisdiction. The FWS, DFG, DBW, and SLC all have policies on these structures. It is notable that the Resources Agency has a shoreline erosion protection policy which emphasizes beach nourishment (sand replenishment) as an alternative to construction of breakwaters, groins, and seawalls.

BREAKWATERS

Description

A breakwater is a structure offering wave protection to a shore area, harbor, or basin. Breakwaters may be fixed or floating, shore connected or detached. A fixed breakwater could be built on fill (as for example a rubble mound breakwater) but they are generally not, according to a representative of DBW. There area no breakwaters per se in the study area. The only structures resembling a breakwater are the North and South jetties, the riprapped dike east of King Salmon along the edge of the King Salmon mudflats and a small breakwater in load repair near the Coast Guard Station.

Associated Activities and Activity Conflicts

When a breakwater is used to create a protected harbor, then marinas, port facilities, and small boat harbors would be associated uses. Breakwaters could conflict with navigation; however, they are usually built to enhance vessel safety, maneuverability, and access.

Impacts and Significant Concerns

Physical Effects. Construction of a fixed breakwater is much like filling in its effects. Temporary turbidity, destruction of habitat, flora and fauna, and sedimentation are all effects of breakwater construction.

Breakwaters reduce wave energy in the area behind them. Solid breakwaters can decrease or change circulation, interfere with tides and currents, and obstruct littoral drift. Toe scour can cause local turbidity and damage to the structure. Sediment compositions in the area inside the breakwater may change.

Chemical Effects. If circulation and flushing are impaired by the breakwater, adverse impacts on water quality may result.

Biological Effects. If sediment composition changes behind the breakwater, the benthic population may change in species distribution, diversity, and numbers. Breakwaters may affect fish migration routes; this has been documented in the Columbia River and Coastal Bays in a study by the Washington State Department of Fisheries. If migration route change, fish may be subject to increased predation. Other biological effects are similar to those of groins and jetties (see Shoreline Stabilization Structures).

Floating breakwaters generally have less severe environmental effects than fixed ones, and the Washington State Department of Fisheries generally recommends their use to protect fish resources (Washington Department of Fisheries, 1971). However, their use is limited to low wave energy situations (DBW, 1979, personal communication).

Socioeconomic Effects. For breakwaters, such effects are secondary, resulting from the activities they are designed to permit. Sports fishing from breakwaters in California requires no license and is popular but dangerous (Harbor District, 1979, personal communication).

Impact Potential. High, particularly for fixed construction.

Legal/Administrative Processes. Breakwaters will require a Corps Section 10 and/or Section 404 permit, and permits from CCNCR, the Harbor District, and other agencies with jurisdiction. Other agencies such as FWS, DBW, and SLC have policies on breakwater placement and construction.

MARINAS

Description

Marinas are areas providing docking space, water access, and harbor area for small recreational and commercial fishing boats. In the study area, marinas are located on the Eureka waterfront and in King Salmon. A large marina on Woodley Island is approved and EDA funded for construction by the Harbor District. Marinas include piers and docks, launching ramps, boat storage, and on-shore facilities (restaurants, parking lots, etc.) and may include fuel pumps (although the Woodley Island Marina will not have fuel pumps).

Associated Activities and Activity Conflicts

Associated activities may include dredging and dredged material disposal, fill, and shore protection structures. Water-related industrial and commercial uses will complete for the available waterfront area.

Impacts and Significant Concerns

[Note: Several detailed studies of the possible impacts of the Woodley Island Marina are available and provide much more specific information than can be presented here. However, there is only one valid Environmental Impact Report.]

Physical Effects. If an artificial harbor is created, maintenance dredging must often be done (see Dredging above). The construction of breakwaters and other shore protection structures for marina protection may change hydraulic characteristics of the area.

Chemical Effects. The buildup of fouling communities (growth of mussels, amphipods, barnacles, etc. on floats and pilings) exerts a significant oxygen demand on marina areas. If circulation and flushing are poor, the low dissolved oxygen levels may result in problems for aquatic fauna and buildup of any water pollutants may occur. Without proper control over waste discharge, marinas may produce sewage type wastes, oil and grease, and litter. Commercial shellfish beds located near marinas may be unfit for certification by the State Department of Health. Fish may also be affected by water quality degradation.

Biologic Effects. Nixon et al, 1973, compared a marina area and a salt marsh cove to evaluate marsh grass productivity, suspended particulates, phytoplankton, nutrients, bacteria, dissolved organics, copper levels, fish abundance, and diversity and sediments. Interestingly, little difference between the marsh cove and the marina cove was found for the following parameters: marsh grass production, concentrations of suspended particulate matter, nutrients, bacteria, dissolved organics, infauna, or sediment metabolism. Fish species reached the same levels of diversity in the two coves. Dissolved oxygen levels were lower in the

marina cove, and bioassays showed some toxicity due to outboard motor exhaust water. The marina cove had higher copper levels, while the marsh cove had a greater abundance of fish (Nixon et al, 1973).

Socioeconomic Effects. Small boat harbors may result in significant on-shore development - restaurants and other commercial establishments, parking lots, etc. These will mean traffic, noise, and other impacts of development. Large marinas may be significant attractions for tourists and out-of-area recreational boaters and may thus benefit the local economy.

Impact Potential. Medium to high, depending on extent of dredging and shore protection required and on extent of discharge control and control of on-shore development.

Legal/Administrative Processes. Marina and small boat harbor development requires a Corps Section 10 permit (and a 404 permit if fill or dredged material disposal is required), and permits from CCNCR, the Harbor District, or other local agencies with jurisdiction. Agencies such as FWS, NMFS, EDA, DBW, and SLC all have policies on and interests in marinas, small boat harbors, and recreational boating in the study area.

AQUACULTURE

Description

Aquaculture is the controlled culture of any aquatic species for purposes of commercial harvest. The State Interpretive Guidelines (CCC, 1979) define aquaculture as "the culture and husbandry of aquatic organisms, including, but not limited to, fish, shellfish, mollusks, crustaceans, kelp and algae. It is a major industry in the study area, with three types of commercial oyster culture and salmon ranching projects in the Bay itself. Two salmon and steelhead hatcheries are located outside but near the study area, one at Humboldt State University in Arcata and the other on the Mad River at Blue Lake. A salmon ranching project is part of Arcata's wastewater treatment and marsh reclamation effort, located at the northeast end of North Bay. A second salmon ranching facility has been proposed, but so far it is in abeyance. Oyster culture in North Bay involves growing oysters on productive beds (ground culture) with no transfer and mechanical dredge harvesting. In Mad River Slough, oyster culture is in trays and lantern nets suspended from floats; no substrate disturbance is necessary during harvesting.

Associated Activities and Activity Conflicts

Associated activities include commercial fishing, seafood processing, off-loading, and canning facilities, and navigation and boat traffic. Aquaculture conflicts with waste discharge outfalls; a major controversy in the study area involves the possible adverse effects of improperly treated wastewater discharge near oyster beds, because of possible bacterial and pathogen contamination. If the use of the water surface is preempted, then aquaculture would conflict with navigation and boating. If much of the area were in aquaculture, then there could be conflicts with recreational and commercial harvest of native species. In areas such as periodically flooded pasture lands, existing lowlying areas already protected by levees (e.g., abandoned log ponds) and in the King Salmon oxidation ponds, aquaculture may be an appropriate use. Changes from marginally agricultural use or from degraded wetlands to aquaculture may be beneficial.

Impacts and Significant Concerns

Physical Effects. The physical effects of aquaculture depend on the methods used. In the case of harvest by mechanical dredging of oysters located in the substrate, there is clearly major disturbance of the substrate, with resulting turbidity (see Dredging). The amount of dredging is not enough to create large holes or significant hydraulic changes. The tray and rack technique would have little physical effect except for the need for anchor points.

Chemical Effects. For techniques involving dredging, any of the effects listed for dredging are polssible. In addition, intensive aquaculture could result in water quality problems such as change in biochemical oxygen demand (BOD) and dissolved oxygen (DO), increased nutrients and suspended solids, and waste discharges. However, water quality problems associated with aquaculture are a lesser consideration in open water culture systems such as Humboldt Bay. In closed systems, increased BOD, decreased DO, and increased nutrients can be problems.

Biological Effects. In the case of dredging, the disruption of the substrate destroys any aquatic vegetation in the area; in North Bay eelgrass beds are disrupted and the plants uprooted (the circular dredging patterns are very obvious in aerial photographs). After hydraulic dredging, subsurface rhizomes remain. Intensive ground culture of one species will tend to preempt the area and preclude the growth of other benthic fauna. The introduction of new commercial species may significantly change the local ecosystem.

Socioeconomic Effects. As mentioned above, aquaculture is a major sector of the Humboldt Bay economy. It might adversely affect commercial fishing if too much area were reserved for it. The activity generates boat traffic and may also generate land traffic and noise.

Impact Potential. Medium for techniques involving dredging; low for raft and tray techniques; however, the area should be well flushed to prevent water quality impacts.

Legal/Administrative Processes. Aquaculture requires permits from CCNCR, the Harbor District, and other local agencies with jurisdiction. Depending on the exact techniques used, Corps Section 10 (and perhaps Section 404) permits may be required. The DFG has active programs for salmon and trout hatcheries, evaluation of mussel culture potential, and inland fishery development in the study area. The FDA, State Department of Health, and SWRCB (and RWQCB) are all concerned about the relationship between water quality and shellfish production. The Health Department has regulatory authority over growing areas and times when harvesting is allowed. A permit from EPA and SWRCB is required to use pollutant discharges from a point source (such as a sewage treatment plant) to enhance aquaculture projects.

CANALS AND DITCHES

Description

Canals and ditches are linear, excavated water bodies constructed for drainage or navigation access. Under the State Interpretive Guidelines (CCC, 1979), drainage ditches are defined as narrow (usually less than 5 feet wide) man-made non-tidal ditches excavated from dry land. In the study area, canals and ditches have been constructed for drainage and as artificial waterways in King Salmon. Canals and ditches often have poor water quality because of poor circulation and flushing. Canals and ditches may require periodic cleaning or dredging so that they can continue to drain an area efficiently. An old ditch or canal may establish a riparian habitat along its banks if the water level does not fluctuate too much. Ditches in wetlands are sometimes constructed for mosquito control.

Associated Activities and Activity Conflicts

Since the principal purpose of this activity in the study is drainage, associated activities include any development or activity which needs a well-drained area, such as urban development or agriculture. Canals and ditches are built as support for man's activities generally. Conflicts might occur if drainage ditches are constructed to allow urban-type development in agricultural areas.

Impacts and Significant Concerns

Physical Effects. The major physical effect is, of course, the interruption of existing water patterns. Both surface and ground water may be affected. The construction and maintenance of canals and ditches may mean turbidity in downstream waters. In wetlands the retention time of water is reduced.

Chemical Effects. These include the effects of turbidity on downstream waters - increased suspended solids. If a wetland has been serving a water purification function, then this function will be lessened and water quality may be affected. If the ditches are draining areas in urban development, then receiving waters could be affected by urban-type pollutants in the runoff. Drainage ditches in agricultural areas will mean faster addition of agricultural pollutants (coliforms, fertilizer wastes) to receiving waters.

Biological Effects. Interruption of water flow patterns may mean destruction of the wetland habitat because of drainage. The actual construction will destroy marsh vegetation in the paths of the ditch or canal and the equipment used for digging. If the ditch connects a fresh marsh to salt water (without a tide gate) then salt water intrusion will occur and the character of the wetland will change. If significant changes in type or amount of habitat occur, then there will be corresponding changes in faunal population characteristics.

Socioeconomic Effects. The principal effect is in making more area usable or developable by man; specific effects depend on the type of development which may occur. Construction and maintenance will mean traffic and noise impacts.

Impact Potential. Low to medium in and of the ditches themselves. Otherwise dependent on the type of development or use they allow.

Legal/Administrative Processes. Construction and maintenance of drainage ditches and canals in wetlands would require a Corps Section 404 permit. Permits from the Harbor District or other local agency are required. The FWS has policies about ditches and canals in wetlands. If a creek or stream is affected, then a DFG stream alteration permit would be required. A Coastal Commission permit is necessary.

ACTIVITIES AND THEIR IMPACTS

OVERHEAD CABLES/AERIAL CROSSINGS

Description

Aerial crossings include power lines and poles which cross streams, creeks, sloughs, and wetlands. Depending on the size of the cables, the size and number of towers may vary. Placement of the supporting poles is typically on-shore in stable areas wherever possible. Two Corps permit applications for overhead cables in the Eureka Slough area have been recorded, together with a few in Humboldt Bay and Harbor and Mad River Slough.

Associated Activities and Activity Conflicts

Associated activities include on-shore placement of support towers and development of activities using the overhead cables. Overhead cables may conflict with navigation if they are not placed high enough.

Impacts and Significant Concerns

Physical, Chemical and Biological Effects. Construction and placement impacts include any destruction of on-shore habitats from tracked vehicles and trampling and installation of piles. If the support poles are installed in a wetland, productive wetland vegetation will be destroyed, and, if large ruts are created, then water circulation and drainage patterns may be altered. If support poles are installed in the water, then the impacts would be similar to those associated with pilings. Power lines and towers present hazards to birds, particularly large birds and migratory waterfowl.

Socioeconomic Effects. Such effects would be associated with on-shore activities using the overhead cables. The aerial crossings will be visible and this may be considered an adverse impact.

Impact Potential. Low, except for effects of pole installation.

Legal/Administrative Processes. Aerial crossings will require a Corps Section 10 permit and a Section 404 permit if work in wetlands is involved. They also require permits from the Harbor District or other local agencies with [illegible]. The FWS has policies for aerial crossings. Cables and aerial crossings require a Coastal permit.

CABLES AND PIPELINES

Description

Included in this activity are cables and pipelines which are submerged (underwater) or buried (on land). Cables and pipelines are used for transmission of oil, gas, electricity, water, sewage, and communications. Buried cables and pipelines on land may cross uplands and wetlands. Submerged cables and pipelines may be either on the bottom or buried in the substrate. Pipes placed on the bottom are subject to changes in bottom shape which may undercut the pipe. Cables and pipes lying on the bottom may be at risk of being cut or hooked by anchors or other objects dragged from ships. Burying the cables and pipelines will protect them from these problems. In the study area there are four areas where submerged cables cross the Bay, one just north of the Eureka-Samoa Bridge and the others across the Middle Bay and near King Salmon. Submarine pipeline/cable crossing has been one of the more frequently proposed activities in Eureka Slough (from Corps permit applications).

Associated Activities and Activity Conflicts

Associated activities include industrial and community development. In the study area, outer continental shelf (OCS) related oil and gas development is likely as an associated activity. Lands in which pipelines are buried are pre-empted from any development over the pipeline itself; however, pipelines and cables may be (and often are) laid in road rights-of-way. Submerged cables and pipelines could conflict with navigation, dredging, and water uses such as commercial fishing.

Impacts and Significant Concerns

Physical Effects. Underwater burying of pipe or cable requires dredging or jetting a trench, placing the pipe or cable, and backfilling; turbidity in the water column will result during construction. On firm upland areas, the routine trench and backfill method is used for laying the pipeline; impacts may include erosion (particularly in sloped areas). Depending on the soil type, there may be more excavated soil than required for backfill, and mounds of earth may alter topography. Where cables or pipelines are placed underground in a wetland, they may be "pushed" in rather than laid in by digging or cutting the wetlands (the "push-ditch" method). This method results in the least disturbance to the wetland by heavy machinery and canal or road building; the corridor affected is much narrower than with other techniques (8-10 feet as compared to 40-50 feet for the "flotation canal" or lay barge techniques. (FWS, 1978) Large pipes may inhibit water movement in wetlands. Disruption of wetland soils may cause greater erosion and sedimentation down stream.

Chemical Effects. Underwater burying of pipes and cables may have temporary water quality impacts from exposure of toxic sediments and addition of suspended solids during construction if dredging is used. Accidental damage to an underwater pipeline (i.e., by an anchor) could lead to the release of potentially harmful substances. Water quality in wetlands could also be affected by pipeline construction and operation. Long-term modifications in water quality and water table levels could result if water-holding properties of soil layers in wetlands were not restored to pre-construction conditions.

Biological Effects. Underwater burial will result in destruction of benthic organisms along the route of the cable or pipeline. On firm dry uplands and in wetlands, vegetation and habitat along the route of the cable or pipeline will be destroyed. For upland areas, the width of land affected may be 50 to 60 feet; this area would have to be maintained free of trees and large shrubs to permit maintenance vehicle access and leakage surveillance. In wetland areas, the amount of vegetation destroyed depends on the firmness of the soil and the construction technique used; the push-ditch method causes a loss of approximately one acre per mile of pipeline construction (assuming a trench 8 feet wide) while for the flotation method the loss is about 6 acres per mile (trench 50 feet wide). Cables and pipes in wetlands may act as barriers for some wetland organisms. If water movement in the wetland is interrupted by the pipeline or by ruts from construction, both flora and fauna may be adversely affected.

Socioeconomic Effects. Such effects would be associated with activities using the cables and pipelines; for example, extending cables and pipelines to new areas may allow new development to occur there.

Impact Potential. For submerged cables and pipelines, low; even during construction the effects will be slight and temporary. For such facilities on land, high to medium, depending on what habitats are crossed by the route.

Legal/Administrative Processes. Submerged cables or pipelines will require a Corps Section 10 permit, and perhaps a Section 404 permit if fill or dredged material disposal in wetlands is involved. The Harbor District has granted several permits for submerged pipelines. The FWS has policies for placement of cables and pipelines. If the cable or pipeline placement involves a streambed, a stream alteration permit from DFG will be required. A Coastal Commission permit is necessary for any cables or pipelines, submerged or on land, in the coastal zone.

OUTFALL STRUCTURES

Description

An outfall is a pipe extending into a body of water to discharge wastes such as storm water runoff, treated sewage effluent, or industrial wastes. In the study area, all three types of wastes are discharged. There are eight sewage effluent point source discharge points located in Humboldt Bay: Arcata Bay at the foot of I Street; Eureka Slough (Hill Street); Eureka Channel (Murray and McCullen Streets); and South Bay (King Salmon, Sea View Manor, South Bay, and Whites Slough [College of the Redwoods]). There are a few remaining industrial discharges in the Bay; a representative of the RWQCB indicates that serious efforts to comply with discharge requirements have been made by all industries. Industrial discharges in the past have included lumber and pulp mills (discharging sulfite waste liquors). The PG&E power plant has a thermal discharge into the Bay near King Salmon.

Associated Activities and Activity Conflicts

Outfall structures carry discharges from various types of on-shore development: industrial, commercial, and residential (through sewage treatment plants). Discharges may conflict with commercial and recreational fishing, in particular shell-fishing and aquaculture, with recreational use of the water area, and with other uses of the Bay requiring good water quality.

Impacts and Significant Concerns

Physical Effects. The physical act of discharge may cause local turbidity and changes in substrate. The outfall construction would cause temporary effects. Mounding or buildup of sediments at the end of the pipe could change the hydrodynamics of the local area.

Chemical Effects. The major effect of an outfall is the impact of the discharge on water quality. Urban storm water runoff contains oil and grease, coliform bacteria, heavy metals, suspended solids, and other pollutants. Sewer lagoon and treatment plant effluent can contain coliform bacteria unless properly chlorinated. Industrial waste discharges may contain sulfites, organics, calcium, and other organic and inorganic substances. The level of impact depends on the type of discharge and the quality of receiving waters.

Biological Effects. The effects of the discharge depend [illegible] of material discharged. Industrial waste discharges such [illegible] effluent contain toxic substances. Improperly treated [illegible] discharges affect shellfish, making them unfit for human [illegible] because of high coliform levels; however, properly treated [illegible] discharges can provide the benefit of sustained [illegible] mal discharges attract fish and are not harmful if [illegible] controlled so that temperature in the receiving water [illegible]

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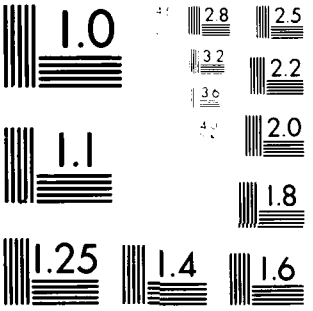

MICROCOPY RESOLUTION TEST CHART

above a certain level. Discharges into poorly-flushed areas or into wetlands may induce the production of undesirable flora and fauna. The City of Arcata will be creating and treating a marsh in North Bay using secondarily-treated domestic wastes and will be developing data to examine this concern.

Storm water outfalls on tidal flats and in wetland areas would affect flora and fauna. The discharges would have different temperature and dissolved gas content, and different salinity depending on location in the estuary. Organisms may suffer from the discharge load of urban type pollutants.

An outfall structure placed in a wetland will destroy the vegetation on which it is placed. The act of discharge may affect vegetation in the flow path. This is a minor impact. If the pipe blocks water interaction throughout the wetland, this would be a major impact.

Socioeconomic Effects. The principal effects would be due to degradation of water quality, which might result in decline of beneficial uses of the Bay waters; for example, the commercial oyster industry is adversely affected by high coliform levels from discharges during certain times of the year. Outfall structures in wetlands might have a visual impact.

Impact Potential. High. However, in the study area, the Bays and Estuaries policy will ultimately result in the phasing out of all municipal wastewater and industrial discharges unless such discharges can be shown to enhance Bay waters or their uses; thus the impact potential is lower in this specific case.

Legal/Administrative Processes. Outfall structures require a Corps Section 10 permit if located below MHW and a Corps Section 404 permit if fill or discharge of dredged material is located in wetlands. Permits would also be required from the Harbor District or other local agency. The major regulatory agency for discharges, however, is the SWRCB (and RWQCB); these boards establish specific waste discharge requirements on a case-by-case basis and have authority to reject a proposed activity if the discharge cannot meet their requirements. A Coastal Commission permit is required. For discharges of treated wastewater to aquaculture projects, permits from EPA and SWRCB are necessary.

URBAN DEVELOPMENT

Description

Urban development includes all industrial, commercial, residential, and public development in the study area. Urban development encompasses all the developed areas of Eureka, Arcata, King Salmon, Fields Landing, Manila, Samoa, Fairhaven, Indianola, Bayside, Humboldt Hill, and other communities in the study area. Characteristics of urban development include large impermeable areas (either paving or buildings) and rapid storm water runoff characteristics. The areas designated General Use Areas (Section V-B) are, generally speaking, areas with heavy urban development; specific locations for the different types of urban development are discussed in Section V-B. For purposes of this report, industrial development will be discussed separately from commercial, residential, and public development where impacts and standards differ significantly.

Industrial. Industrial development involves port facilities, forest products industries, facilities for the commercial fishing industry, oil terminals, energy facilities, and all other industrial development. Industrial facilities associated with development of outer continental shelf (OCS) oil and gas resources are projected for the study area, with four development scenarios based on various levels of resource find. Support facilities for OCS development will include docks, pipelines, service bases (shoreline harbor and dock areas), gas processing plants, and other such development. No refineries or marine terminals are projected to be necessary.

Commercial, Residential, Public. Commercial development includes restaurants, motels/hotels, shops, and general commercial and service establishments which cater to the tourist trade or support the local economy. Residential development includes subdivisions, single and multifamily housing, apartments and residences in densely developed areas; it does not include single family residences or large parcels in areas zoned agriculture exclusive or scattered homes in rural areas. Public facilities include highways, railroads, airports, schools, hospitals, power plants, and other public service developments.

Associated Activities and Activity Conflicts

Associated activities include dredging, fill, dikes, piers, shoreline protection, cables, roads, pipelines, outfall structures, and all other activities which are designed to support and allow urban-type development. Urban development conflicts with agriculture and other non-intensive land and water uses. Port facilities may conflict with commercial fishing and aquaculture. If activities which are not water-dependent (in the physical sense of needing a location on the water or shore at the water line to function at all) are located on the waterfront, space necessary for water-dependent activities may be irretrievably committed to other uses.

Impacts and Significant Concerns

Physical Effects. Urban-type development generally requires grading of building pads and roads and may require cuts and fills and drainage modifications. Thus the topography, soils, and hydrology of the developed areas are all changed. Storm water runoff rates and volumes are significantly increased by the construction of large areas of impermeable surface. Both surface and groundwater regimes may be significantly changed. Where urban development is on shorelines, shore protection structures may be required with all concomitant impacts. For port, OCS facilities, or energy facilities, such activities as dredging, disposal, outfall structures, and piers/docks may be necessary; they will have impacts as listed under each activity.

Chemical Effects. Water quality may be affected by pollutants such as oil, grease, heavy metals, suspended solids, and coliform bacteria in the general urban runoff. Industrial developments may cause addition of specialized pollutants to receiving waters, either through waste discharges or through accidents such as oil or chemical spills. Residential runoff includes fertilizers and pesticides. Public facilities in the study area include sewage treatment plants which discharge treated wastewater to the Bay.

Biological Effects. Where urban-type development occurs, the native flora and fauna are displaced and usually destroyed. Although wildlife may try to migrate to adjoining habitats, most habitats will be at or near carrying capacity, so some wildlife will inevitably perish. Exotic species may be introduced, upsetting the ecosystem balance on a local, and perhaps areal, basis. Industrial uses of the water areas such as port or OCS facilities may impact aquatic vegetation, benthic organisms, and fish if dredging or in-water construction are necessary. Any adverse effects on water quality can adversely impact aquatic fauna.

Socioeconomic Effects. Urban development has major social and economic effects. Traffic, noise, and air quality impacts will all result; traffic and industry will be sources of air pollution and if any significant sources of particulates are developed, they will contribute to the non-attainment of particulate standards in the area. Increased urban development will cause impacts on public services (roads, sewer, water, police, fire, schools, hospitals, energy, etc.); the demand for services may exceed capacity, and the costs of services to the developments may not be covered by development revenues to the service agencies. Pressure for urban development may cause changes in zoning and general plans. The commitment of land to urban development forecloses any option to use the land for other purposes, essentially irretrievably.

Impact Potential. Extreme in undeveloped areas. In partly urbanized areas, the impact potential is less, and impacts can be controlled to some extent through permit conditions.

Legal/Administrative Processes. Port facilities will require a Corps Section 10 permit and a Section 404 permit if work in wetlands is involved. Port facilities would also require a permit from the Harbor District in areas under its jurisdiction. The Corps has no authority over urban development on land; the same is true for the Harbor District. Other local agencies have numerous specific development regulations and controls; these include zoning, building codes, grading requirements, etc. Permits from local agencies are required at several stages in the urban development process. The CCNCR has regulatory authority over all development in the coastal zone; this agency has taken steps to protect sites for power plant and industrial development and expansion and to maintain and develop low and moderate cost housing in the coastal zone. The CCNCR has approved some restaurants and motels in or adjacent to areas already developed in these uses (CCNCR permit review).

ACTIVITIES AND THEIR IMPACTS

AGRICULTURE

Description

Agriculture has historically been one of the major sectors of the Humboldt Bay economy. Dairying, livestock and poultry production, field and row crops, and fruit crops are all part of the County's agricultural industry. In the Humboldt Bay area itself, dairying and livestock (beef) are the most important agricultural activities. Virtually all of the bottom lands around the Bay are diked and used mainly for pasture. The importance of agriculture is recognized by all Federal, state, and local agencies, and many steps have been and are being taken to preserve it, including special zoning, special tax advantages, establishment of minimum parcel sizes, special restrictions on uses of prime agricultural lands, and proposed establishment of an urban/rural line to prevent encroachment of other uses on agricultural lands.

Associated Activities and Activity Conflicts

Associated activities include meat, dairy, and other food processing, non-intensive residential development, and construction and repair of protective levees. Agriculture may conflict with or impact commercial and recreational shellfishing, although a representative of a local commercial oyster company has stated that agricultural runoff increases Bay productivity by nutrient enrichment. This statement is supported by the results of a year-long Bay nutrient study conducted by the Department of Oceanography at Humboldt State University and by data in reports submitted to the SWQCB by the Cities of Eureka and Arcata. Agriculture may also come into conflict with pressure for urban-type development in very rapidly growing areas (which Humboldt Bay is not).

Impacts and Significant Concerns

Physical Effects. Agriculture itself has little permanent physical effect on areas in which it is conducted; however, the dikes and drainage ditches which support it cause major changes in water circulation and flow, habitat type, and useability of the area. The ground surface in areas heavily used by livestock may be quite cut up; however, if the livestock are removed, natural repair will eventually occur.

Chemical Effects. The major effect is adverse impacts to water quality from agricultural runoff. Fertilizer residues, insecticides, and large amounts of animal fecal material containing coliform bacteria may all be added to receiving waters. This problem falls under Section 208 of FWPCA and is being studied by the RWQCB in developing the 208 plan for the area.

Biological Effects. Nutrient enrichment, high coliform levels, and other agricultural wastes may adversely affect downstream flora and fauna. Diking of wetlands for agricultural purposes destroys the wetland habitat and will change (and reduce) the populations of wetland

flora and fauna. However, many of the agricultural lands in the study area are seasonally flooded and act as wetlands; they are heavily used by waterfowl and other birds. Grazing livestock may seriously damage wetlands and riparian habitat.

Socioeconomic Effects. As stated above, agriculture is a major factor in the Humboldt Bay economy. In and of itself, it does not have significant adverse socioeconomic effects; if the viability of agriculture were reduced by significant conversion of agricultural land to other uses, there would be major adverse effects on the area unless those other uses could make up the economic losses.

Impact Potential. Low once the initial diking and drainage modifications are completed and the area has stabilized. However, agricultural runoff may be a significant water quality problem.

Legal/Administrative Processes. Any agricultural support work in wetlands will require a Corps Section 404 permit. Agricultural uses are controlled at the local level, except if a feed lot waste discharge permit is required from the RWQCB. Continuation of agricultural activities is actively encouraged and supported by the CCNCR, the Harbor District and other local agencies. New agricultural development in wetlands requires a Coastal Commission permit.

BRIDGES, ROADS, CAUSEWAYS

Description

A bridge is a structure spanning natural (or artificial) obstacles such as rivers or railways; it is usually supported by piers or towers and cables, but may be floating. A causeway is a continuous solid fill embankment. Sometimes causeways will be used over a portion of the water body to be crossed, with the remainder spanned by a bridge. Roads, if located in wetland or lowland areas, are often on fill also. Shore defense structures may be necessary to protect bridges and roads.

Associated Activities and Activity Conflicts. Associated activities include on-shore development which requires crossing the water body. Bridges may conflict with vessel traffic by preventing vessels of a certain size from entering or leaving an area.

Impacts and Significant Concerns

Physical Effects. Bridge and causeway construction, can cause alterations in current, velocity, and water circulation patterns. The construction may cause turbidity in the water column. If fill is required, there will be adverse impacts (see Fill). Construction of roads and causeways in wetlands may cause severe alteration of surface and subsurface water level and water flow patterns.

Chemical Effects. Water quality may be adversely affected by leaching of foreign road fill and paving materials and by introduction of vehicle-related pollutants such as oil, grease, lead, or asbestos from tires.

Biological Effects. If water circulation is affected, the aquatic flora and fauna may be reduced or changed in type or distribution. Alteration of wetland flow patterns may result in eventual destruction of wetland habitat in addition to that directly affected by the road or causeway. Impoundment of water behind a roadbed or causeway may result in the death of marsh vegetation, thus reducing plant biomass. Wetland habitats may be divided by physical barriers, adversely affecting wildlife migration.

Socioeconomic Effects. Bridges, roads, and causeways will mean vehicle traffic and noise. They may significantly change the visual aspects of the area. They may induce growth and development in new areas.

Impact Potential. High, particularly in wetlands.

Legal/Administrative Processes. Construction of bridges over navigable waters requires a Coast Guard permit. A Corps Section 10 permit is required for any work such as shoreline structures which affects

NAVIGABLE WATERS. A Corps Section 404 permit will be required if the work involves fill or discharge of dredged material in wetlands. If a creek or stream is bridged, a DFG stream alteration permit may be necessary. A Coastal Commission permit is required for bridges and causeways.

D. DEVELOPMENT PRESSURE AND COMPENSATION/MITIGATION IN THE HUMBOLDT BAY STUDY AREA

Of the many factors influencing land development, the following are discussed here:

- Existing and historic land use
- Accessibility and availability of urban-level services
- Plans and policies
- Ownership patterns and zoning.

Each of the above factors is discussed for the study area as a whole. Population/employment projections and the general economic profile of the study area are used to project a general level of activity for the future. A summary describes general areas in which pressure for development is expected to be high, medium, or low. Reference is made to specific plates and sections of Volume II where detailed information can be found. Finally, compensation and mitigation is discussed with reference to specific sites in the estuary.

DEVELOPMENT PRESSURE

Existing and Historic Land Use (Land and Water Use, Volume II, Section VII)

In the 130 years since development began in the Humboldt Bay study area, many changes have occurred. The lowlands around the Bay have been diked and converted to agricultural use. The 26,000 acres of open space and wetlands which existing in the study area in 1871 have been diminished to about 9500 acres in 1978; only 15% of the 1871 wetlands acreage was still wetland. Industrial, commercial, and residential uses have expanded in and around Eureka, Arcata, Bucksport, and Fields Landing and have developed on the North Spit. Land use in 1977 is shown on Plate 14 (see Volume I, Section V.F).

Figure V-2, in Section V.F, Volume I, derived from aerial photo interpretation and analysis of historical maps, shows the historical trends in land use in the study area for wetlands, open space, agriculture, and urban development (residential, commercial, industrial). The decline in wetlands and open space is balanced by the increase in agricultural acreage to a high of 17,000 acres in 1948. Agricultural use declined by about 3,000 acres between 1948 and 1978, while urban development increased by about 3,000 acres, as shown by aerial photo interpretation.

Since the early years of development in the area, industrial or heavily urbanized uses have encroached on the bottom lands only to a limited extent. The railroad along the east side of the Bay was established between 1903 and 1927, according to historic maps; the east side of the Bay thus became the major north-south transportation corridor and now includes Highway 101. This corridor effectively served to dike the Bayside Bottoms and Eureka Slough areas. The corridor has not

been heavily developed in urban uses; such uses have instead tended to expand around the urban centers of Arcata and Eureka and to concentrate near Fields Landing, on the North Spit, and in the uplands east of the Bay. However, the highway corridor is viewed by residents of the area as potentially inducing new development. Industrial uses have concentrated on the eastern shore of the North Spit south of the Samoa Bridge and in the Eureka Bucksport Strip.

Accessibility and Availability of Urban Services (Volume II; Governmental Profile, Section VII-C; Economic Profile, Section VIII-C.)

In the study area accessibility from both land and water is important. Most of the study area lands are generally accessible by public road and are therefore considered generally developable based on this criterion. Deep-draft shipping channels are maintained from the Bay entrance to Fairhaven and Samoa on the North Spit to Eureka and the Bucksport area. A shallower channel goes south to Fields Landing, and the Corps is evaluating plans to deepen this channel and construct a turning basin. This would allow deep-draft shipping to reach Fields Landing. Although land and water accessibility to various parts of the study area is fair, the study area as a whole is generally inaccessible. It is about 300 miles from any large urban center and has only minimal air and railroad service. It does not have a major east-west highway corridor. Water service is generally available in the study area except for the Beatrice Flats, Table Bluff, and South Spit areas. Sewer service areas at present include the areas around Arcata, Eureka, Fields Landing, King Salmon, portions of Humboldt Hill, and College of the Redwoods. The North Spit, Arcata Bottoms, and Bayside Bottoms areas, and much of the Eureka Slough area, do not have sewer service; residents there are on septic tanks. A regional sewage treatment system was proposed; it would include interceptors from McKinleyville and Arcata to an interceptor down the North Spit to a treatment plant located on the ocean side south of the Samoa Bridge. A trans-bay interceptor would pick up wastewater from Eureka and the areas south of the city and transport them to the treatment plant. This proposed system will probably not be built (Government Profile, Section VII-C, Humboldt Bay Wastewater Authority and State Water Resources Control Board). In summary, most parts of the study area have sufficient accessibility and availability of urban services to allow development to occur.

Plans and Policies (Volume II, Governmental Profile, Section VII-C)

The local (city and county) plans have policy statements referring to specific parts of the study area in which development should be encouraged or which should be preserved free from development (Government Profile, Section VII-C, Local Governments).

Preservation of agriculture, wildlife habitat, and environmentally sensitive areas is a general policy of all local governments. Humboldt County's General Plan generally specifies the following areas as public and semi-public lands: South Spit and South Bay, Indian Island, the Coast Guard Station, the North Spit and coastal dunes north of the Samoa Bridge, Elk River Spit, and the Eureka gulches. The Arcata Bottoms (north of Samoa Boulevard), Beatrice Flats, and Elk River Bottoms are specified as agriculture, while the Eureka-Bucksport strip and the North Spit south of Samoa Bridge and west of Navy Base Road are for industry. Arcata's General Plan shows agriculture in Arcata and Bayside Bottoms; the area planned for industrial development is around South G Street west of Highway 101 and south of Samoa Boulevard. Eureka's General Plan shows industrial and commercial uses on the North Spit south of the Samoa Bridge and along the entire waterfront from Eureka Slough to the Elk River. The islands (Indian, Woodley, and Daby) and the Eureka Slough and Elk River Bottoms areas are shown as agriculture/open space. The Local Coastal Programs (LCP's) being prepared by Humboldt County and Arcata generally call for preservation and of agriculture, water and marine resources, visual/aesthetic resources, archaeologic/historic resources, and environmentally sensitive habitats, including wetlands and riparian habitat, coastal dunes, Mad River Slough, and tidal flats. The LCP's also generally call for new urban and residentail development to be located around existing centers, rather than starting new nodes. The Humboldt Bay Harbor, Recreation, and Conservation District designates the Middle Bay waters from the Bay entrance along Hookton Channel to south of Fields Landing and north along the channels to the Eureka-Samoa Bridge as Development Waters; all other waters of the Bay are designated Conservation Waters (use limited to natural resources habitat, wildlife refuges, mariculture, public access, and scenic vistas). The Harbor District further designates as lands appropriate for service, commercial, and industrial uses the following: King Salmon, the north side of Eureka Slough west of Fay Slough including Murray Field, the Eureka-Bucksport strip, and North Spit from the Samoa Boat Ramp to the Eureka-Samoa Bridge (for a more specific description, see Section VII-C, Harbor District). Other lands in the study area are generally designated for public open space and agricultural uses.

Federal, state, and regional agencies with interest and/or jurisdiction in the study area have general policies calling for the preservation of biologically important, productive, valuable wetlands, agricultural and floodplain lands, archaeologic and historic sites, and educational, scientific and recreational areas (Section VIII-A, Cultural Profile).

Ownership and Zoning (Volume II, Sections VII-B and C)

Land and tideland ownership patterns in the study area are shown in Plate 15, Section VII. Most of the land in the study area

is privately owned; in the Table Bluff, Beatrice Flats, and Arcata Bottoms areas, the ownerships are generally quite large (over 100 acres). Significant public-owned parcels include the portion of the Manila dunes owned by the Bureau of Land Management, the Mad River Slough Wetlands (Humboldt State University), the Coast Guard station, Indian Island (City of Eureka), the National Wildlife Refuge areas in North Bay (see also Plate 23), and the Arcata landfill and oxidation ponds. The College of the Redwoods, the Eureka Golf Course, Murray Field, and several county and city parks are also publically owned. The U.S. Fish and Wildlife Service has an option on a parcel in the southwest corner of South Bay for the Humboldt Bay National Wildlife Refuge, a significant and expanding public ownership.

Substantial portions of the tidelands are in private ownerships. Although no more tidelands are being sold by the State, they are leased to various users, notably commercial oyster growers in North Bay. A portion of the Eureka waterfront is in litigation because of ownership questions originating from the original tideland grant to Eureka in 1857 (Section VII-B); parts of the North Spit and Fields Landing shorelines are also in litigation.

Plate 18 shows composite zoning for the three local governments in the study area. Beatrice Flats, Arcata Bottoms, and Bayside Bottoms are virtually entirely zoned Agriculture Exclusive, with a minimum lot size of 20 acres; the purpose of this zone is to protect viable agricultural operations and prime agricultural soils. Parts of the Arcata Bottoms in Arcata are zoned Agriculture, as is part of the Eureka Slough area; this zone permits much smaller minimum lot sizes (2.5 acres). Residential zones occur in Arcata and Eureka, on Humboldt Hill east of Fields Landing, and in various scattered small parts of the study area. Industrial zoning is found on the North Spit from the Coast Guard station to the Eureka-Samoa Bridge, in King Salmon and Fields Landing, in the entire Eureka-Bucksport strip, and on both sides of Eureka Slough around Highway 101. Arcata's industrial zones are north of the landfill and oxidation pond and east of Highway 101. Arcata has zoned the North Bay fringe marshes as Natural Resource Preservation to protect wetland and wildlife resources. Parts of the study area, including the northern part of North Spit and the coastal dunes, Table Bluff, South Spit, Elk River, and parts of Eureka Slough and Bayside Bottoms, are not shown in any zoning classification on Humboldt County Zoning maps.

General Growth Projections (Volume II, Section VIII A and C)

In the period 1970 to 1977, the population of Humboldt County increased only 7% over the 1970 population. Population projections made in 1974 for the planning and design of the proposed regional sewage system showed an expected increase of 44% over the 1970 population by 1995; however, this projection is not supported by the actual change between 1970 and 1977.

The Humboldt region has had continuing economic problems, partly because of its remote location and partly because of its resource-based economy. The resource base includes timber and wood products, agriculture, and fishing. The expansion of the Redwoods National Park was projected to hurt the Humboldt economy, creating even higher unemployment levels than the 14% seen in 1976. Employment in agriculture, forestry, and fisheries was projected to increase only 1% between 1980 and 1985. Tourism and recreation are another major sector of the Humboldt economy; employment in retail and tourism related sectors is projected to increase by 36% between 1976 and 1985. Economic development in Humboldt County is being actively pursued; grant money from the Economic Development Administration has been made available to make business loans and to fund new construction. It is possible that Outer Continental Shelf (OCC) dwvelopment (from Lease Sale #53 off the mouth of Humboldt Bay) may create a need for OCS support facilities in the Bay; however, the Bureau of Land Management currently projects that Lease Sale #53 would not be concluded before 1984.

In summary, the Humboldt Bay study area is not projected to grow rapidly in population or employment over the next few years. The general level development pressure should remain fairly low. However, certain parts of the study area will be under more pressure for development than others; these are summarized following.

Development Pressure in the Study Area

Portions of the study area in which development pressure is judged to be high include the following.

1. The entire Eureka-Bucksport strip, from the mouth of Eureka Slough to south of Bucksport, for continued industrial and port/shipping related development.

2. North Spit from the Coast Guard station to the Eureka-Samoa Bridge, west of Navy Base Road, also for industrial and port-related development.

Areas in which development pressure is judged to be medium include:

1. Fields Landing and King Salmon, particularly after the planned navigation improvements to the Fields Landing Channel are completed.

2. The Humboldt Hill area for continued residential development.

3. The north bank of Eureka Slough south of Highway 101, including Murray Field, for continued commercial development.

4. The area along Old Arcata Road in the Jacoby Creek/ Bayside Bottoms area and in Arcata for new residential development.

5. The main urban areas of Eureka and Arcata, for continued renewal.

6. McKinleyville, Indianola, and Pigeon Point for continued residential development.

7. The area around the mouth of Mad River Slough, and the waters of the Slough and North Bay, for increased aquaculture (oysters).

Areas in which development pressure is judged to be low include the following:

1. The coastal dunes along the North Spit west of Manila and Mad River Slough.

2. Arcata Bottoms and Bayside Bottoms (away from Old Arcata Road, because of significant pressure to maintain agriculture).

3. The Eureka Slough area north and east of Murray Field and in the Ryan and Freshwater Slough areas.

4. The Elk River Bottoms.

5. The steep slopes of Humboldt Hill east of Highway 101.

6. Beatrice Flats.

7. Table Bluff.

8. The Entrance Bay mudflats.

9. The portion of Woodley Island not included in the Habitat reserve associated with the Marina (beyond the Marina).

Development pressure is judged to be negligible in the following areas:

1. The North Bay fringe marshes in Arcata and in the National Wildlife Refuge.

2. The area designated for the Arcata marsh reclamation project - the old landfill site (except for sewage treatment facilities).

3. Indian and Daby Islands, and the part of Woodley Island reserved for the habitat associated with the marina.

4. The Elk River Spit.

5. The Coast Guard Station.

6. The entire South Spit and South Bay, because of inaccessibility and the approved National Wildlife Refuge.

COMPENSATION AND MITIGATION

Recent evaluations for implementing the National Environmental Policy Act (NEPA) require that consideration of alternatives to the proposed action *"shall include appropriate mitigation measures..."* (40 CFR 1502.14f). The regulations further state that when an *agency with jurisdiction...objects to or expresses reservations about the project on grounds or environmental impacts, the agency... shall specify the mitigation measures it considers necessary ..* (40 CFR 1503.2d).

Proposed regulations for implementation of the Fish and Wildlife Coordination Act (FWCA) require that all Federal agencies which propose, are authorized to undertake, or must approve any water control or modification project must give wildlife resource conservation equal consideration with other features of such projects (44 FR 29300-29313). In particular, the regulations are intended to

> *...ensure that planning for wildlife resource conservation measures addresses loss prevention, mitigation, compensation, and enhancement...* (50 CFR 410.2c)

The California Coastal Commission, North Coast Region (CCNCR), in reviewing permit applications, has been requiring compensation for wetlands lost by dike and fill; the compensation requirements have involved the creation of new wetlands. An example is the acquisition by the California Department of Transportation (Caltrans) of a 17-acre parcel of diked pasture on the west side of the Elk River at Elk River Corners to be used as compensation area for Caltrans projects which involve the loss of wetlands. Wetlands will be created on this parcel by breaching the dikes and allowing the area to revert.

Definitions

As defined in NEPA regulations, mitigation includes:

a. Avoiding the impact altogether by not taking a certain action or parts of an action.

b. Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

c. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.

d. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

e. Compensating for the impact by replacing or providing substitute resources or environments. (40 CFR 1508.20)

The proposed FWCA regulations offer definitions for compensation, conservation, enhancement, loss prevention and mitigation (50 CFR 410.3). Each definition is reproduced below with additional comments.

'*Compensation* means completely offsetting losses to wildlife resource values..' This is an acre for acre tradeoff, creating an acre of marsh for each acre lost. It can only be accomplished by sacrificing some other habitat type.

'*Conservation* means wildlife resource loss prevention, mitigation, compensation and enhancement.'

'*Enhancement* means development or improvement of wildlife resource values of the area affected by the project beyond that which would occur without the project.' There is no gain in wildlife habitat acreage, but improvement of some habitat quality, often for some particular species.

'*Loss prevention* means designing and implementing a project to avoid adverse impacts on wildlife resources.'

'*Mitigation* means (1) lessening wildlife resource losses to a project through use of loss prevention measures and (2) offsetting losses through use of other structural and non-structural methods.' This implies there will be some net loss of wildlife resources; the intent is to minimize the loss and the impact of that loss.

Restoration is not defined in either NEPA regulations, or the proposed FWCA regulations. It is the improvement of previously degraded wildlife resources through enhancement or other procedures. Sections 30230, 30231, and 30233 of the Coastal Act, and Senate Concurrent Resolution (SCR) No. 28, are the policies of the State en-

couraging wetlands restoration. In Section 30231, maintenance and restoration measures include:

> *...minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface waterflow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.* (Coastal Act, Section 30231)

SCR No. 28 authorizes the Department of Fish and Game to prepare a plan for the protection, preservation, restoration, acquisition, and management of wetlands, such plan to include:

> *...(3) The identification of sufficient additional potential wetland habitat sites to increase the amount of wetlands in California by 50 percent and a program for the public and private acquisition of such lands.*
>
> *(4) Potential sources of water to assure an adequate water supply for existing and newly-created wetlands,...* (SCR No. 28)

Approaches

The Coastal Commission has been requiring compensation for wetlands lost to dike and fill activities.* In determining compensation requirements, several important concepts have been recognized by the Commission:

- Not all habitat types have the same value for fish and wildlife resources.
- Replacement of a given habitat type can only be achieved through the loss of some other habitat type.
- Not all habitat types can be reasonably recreated.

With these concepts in mind, the Commission has developed an interim method for quantitatively determining habitat value (CCNCR, 1978). This method considers the numerous characteristics of habitats, such as productivity, species utilization, relative areal extent, and ease of replacement. Based on these characteristics, a point value is assigned to each of the major habitat types with which the Commission is most concerned. These point values are listed below:

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*Under the draft State Interpretive Guidelines (see Section V-C), the Coastal Commission will require the restoration of at least four units of habitat for every one unit altered or destroyed.

HUMBOLDT BAY HABITAT COMPARISON

Habitat	Habitat Value
Unvegetated subtidal	13.5
Vegetated subtidal (eelgrass)	15.8
Unvegetated intertidal	14.1
Vegetated intertidal (salt marsh)	14.7
Fresh water/brackish wetlands	14.4
Periodically flooded pasture land	10.1

Source: CCCNCR, 1978

With this point system it is possible for the Coastal Commission to make an assessment of the habitat value to be lost due to a specific activity, and to make recommendations concerning mitigation or compensation. The compensation point scheme will be revised based on the habitat statistics in this document, according to a Coastal Commission representative.

USFWS has also developed a method for assessing habitat value as a means of determining the impacts of proposed projects. The Habitat Evaluation Procedure (HEP) is a much more complex process than that used by the Coastal Commission. This process calculates habitat value as a function of wildlife. Utilization of the area HEP requires a detailed knowledge of habitat use by wildlife and is, therefore, more difficult to complete, but probably estimates more accurately the value of the habitat. HEP is an adopted methodology of USFWS and is often used to compare the impacts of alternative proposals.

Both of the methods outlined above are intended to assess the value of a habitat area, particularly one which may be subject to alteration or destruction as a result of development activities. The Coastal Commission method is perhaps overly simplistic, but it offers a quick and easy mechanism for comparing the values of habitat types. HEP may be more accurate in assessing habitat values, but "they involve a number of complex calculations" (USFWS, 1979, p. v) and, therefore, may be complicated to implement. Furthermore, HEP is not intended to equate values from different habitat types; it can be used, however, to identify "relative importance values" where compensation is being considered. Application of these two methods to a given habitat may not result in significantly different relative values.

Compensation activities should attempt to replace lost habitat types. But they should also aim to maintain certain physical characteristics of the ecosystem. Only in this way can they adequately compensate for habitat losses. Once the value of a given habitat type which may be lost has been assessed, it is necessary to determine what ecosystem characteristics the compensation efforts should attempt to maintain. Several suggestions have been made (La Roe, 1979):

- Surface area
- Depth and tidal prism
- Water quality
- Relative areal extent of the various habitat types

The surface area of the aquatic ecosystem is an important factor controlling the amount of solar radiation available to the system, and therefore the amount of primary production possible. Water depth and tidal prism are important to circulation, flushing and overall water quality of the estuary. In addition, water depth is an important factor controlling the distribution of a wide variety of organisms. Water quality refers both to direct impacts from the proposed activities and to the secondary impacts on circulation just mentioned. Finally, an ecosystem consists of a diverse mixture of habitat types; this diversity should be maintained.

Application

The purpose of this section is not to critique methods of habitat evaluation, but rather to suggest some mechanisms for implementation of compensation regulations. These suggestions include:

- Identification of areas where compensation might be both suitable and economically feasible.

- A compensation land bank which might be used be development agencies or organizations.

- A joint agency agreement on what ecosystem characteristic(s) should be maintained in the Humboldt Bay study area.

Each of these suggestions is explored in the following discussion.

Potential Compensation Areas. Compensation is the replacement or creation of habitat types lost due to development activities. The most common replacement technique has involved breaching levees surrounding diked pastures (most of which are in fact reclaimed wetlands). Such replacement has often been considered prohibitively expensive, due to not only the cost of the compensation land, but also the cost of creating new dikes. (Typically dikes surround large areas, therefore creating a small wetland would require constructing a new dike inside the old.)

As a part of the habitat mapping conducted during this project the location of dikes was mapped. (The dikes are depicted on the 1:6000 vegetation maps which accompany Volume III.) This included both dikes presently protecting pasture land from inundation and older dikes or railroad grades located inside the presently used dikes. It is these older dikes which increase the potential for compensation areas.

The older dikes present a situation in which returning tidal circulation to a reclaimed wetland would not entail construc-

tion of a new dike. The old dike would have to be investigated for suitable construction, elevation, etc., and new tide gates would have to be installed. However, these activities would be much less costly than construction of a new dike. In addition, the old dikes divide the potential compensation areas into units as small as a few acres. Finally, it should be noted that the pasture lands identified as potential compensation areas consist of low-lying, saturated Loleta, Bayside, and Ferndale soils of low agricultural capability (see Agricultural Soils, Section VI-F); such pasturelands are not generally considered prime agricultural land, although with very good hay values, they may qualify as prime under CGC 51201(c5). Use of such lands for compensation removes them from agricultural use.

The potential compensation areas identified during this study are delineated in Figure V-1 and listed below:

#16. South Bay, the portion of Beatrice Flats around Hookton Slough

#21. Arcata Bottoms West, around the Mad River Slough

#31. Palco Marshes, south of the Broadway wetlands

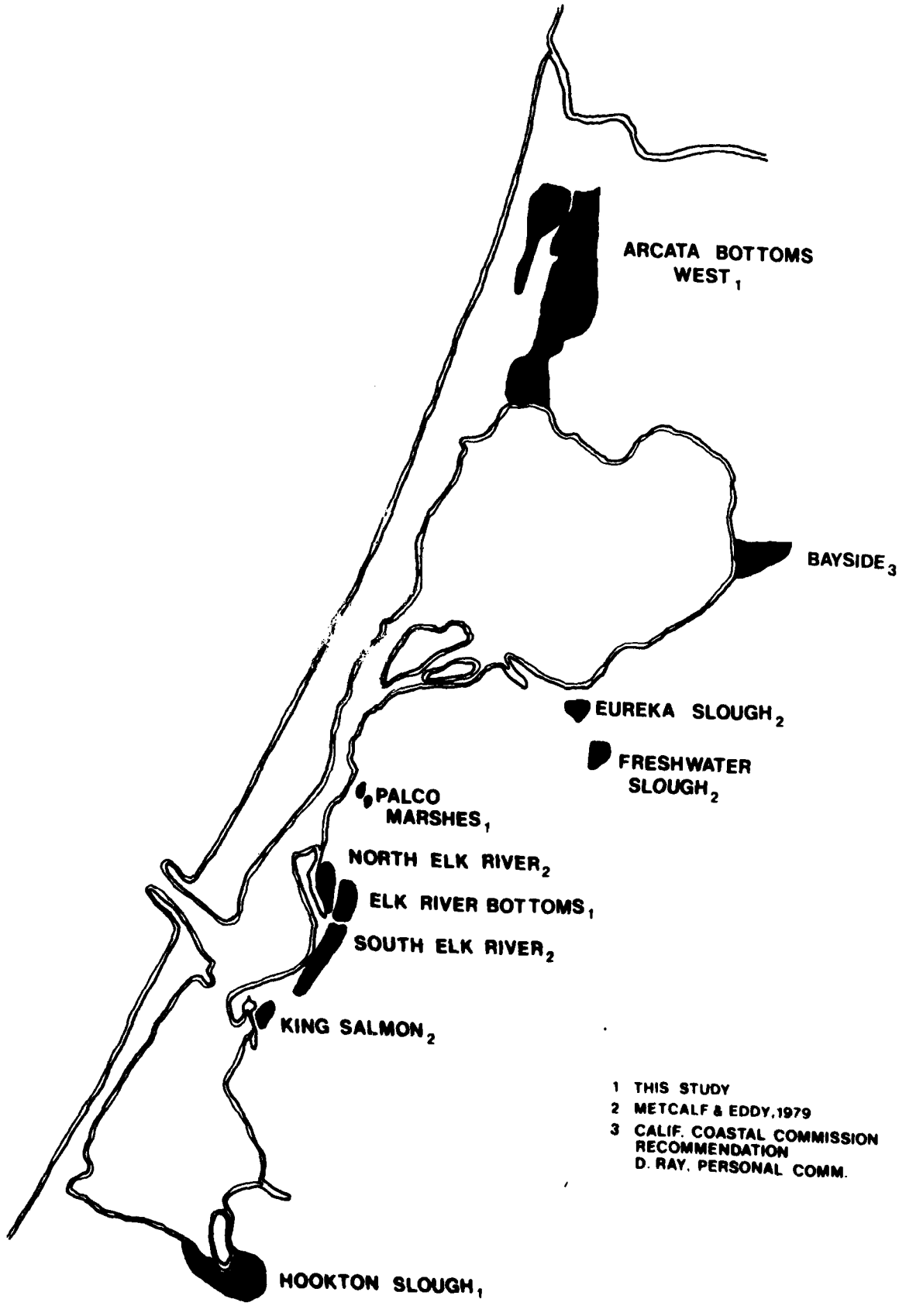
#33. Elk River Bottoms, near Highway 101

These areas are described in Findings, Section V-B, and shown on Plate 1A. The Hookton Slough and Arcata Bottoms West areas will require dike breaching and construction; the Palco Marshes are degraded wetlands and would be suitable for restoration or enhancement. Several locations within Elk River Bottoms would be suitable for compensation, with dike breaching and construction. Part of this area has already been acquired by Caltrans for that purpose.

Several "Potential Marsh Reclamation Sites" have been identified by Metcalf and Eddy (page VIII-58, 1979). Each of these sites will be discussed here. It should be noted, however, that the Metcalf and Eddy study was specifically concerned with appropriate sites to create freshwater marshes for wastewater enhancement, and not necessarily for compensation sites.

Both the Freshwater Slough and Eureka Slough Marsh sites are located in diked bottomlands adjacent to tidal sloughs. Creation of wetlands in these areas would entail construction of entirely new dikes as no old dikes are present. The soils here are Bayside series, and not generally considered prime agricultural land. Most likely, salt and/or brackish marshes would form if tidal influence was returned.

The Pacific Lumber site is already a broad expanse of salt, brackish and fresh marsh, and swamp habitat types. The area has been designated Area of Importance #10 in this study. The King Salmon site



POTENTIAL WETLANDS RESTORATION AND RECREATION SITES

Figure V-1

is also considered an Area of Importance (#14) in this study, due to the presence of salt and brackish marshes in the area (as mentioned in Section V.B., however, recent repair of the dike in this area may result in long-term changes to the character of the area).

As mentioned by Metcalf and Eddy (1979), much of the North Elk River site is stabilized dune, and therefore not appropriate for easy wetland creation through dike breaching activities. The wetlands on this site have been designated an Area of Importance (#11) in this study; the remainder of the site is an Area of Environmental Concern (#33) with some potential for wetlands creation through dike breaching.

The South Elk River site is also located within Area of Environmental Concern #33. The soils here are Bayside series, and generally not considered prime agricultural land. This site is mentioned above as a potential compensation site.

The Bayside site, located between Bayside cutoff and the Bayside wetlands, is an area of periodically flooded pasture which has been identified by the Coastal Commission as a potential wetland restoration site. It is described as low value pasture where levee maintenance is often needed (Dan Ray, personal communication). Although this 60-acre parcel has no internal levees that readily divide it, it is well confined by the cutoff road and closely associated with the Bayside wetlands.

Compensation Land Bank. To date, the acquisition of compensation areas has been somewhat haphazard, with development agencies (for example, Caltrans and the Harbor District) purchasing small isolated parcels to be reverted to wetland. Very few of such parcels are left at present in the study area.

A possible mechanism to make acquisition both easier and more cost effective is the formation of a compensation area land bank. The land bank would consist of development agencies and industries interested in purchasing compensation parcels. With the combination of efforts and resources the bank could acquire large parcels and assess each member according to its compensation needs. [This concept has already been started by Caltrans with the acquisition of 17 acres at Elk River Corners, part of which is to compensate for the loss of less than 2 acres near Mad River Slough. The remainder should serve as a compensation bank for future projects.]

Several advantages, both economic and environmental, would accrue from implementation of the compensation concept. First, a single large parcel allows for coordination of habitat evaluation and environmental impact assessment procedures. The result would be a single study and permit process rather than numerous smaller ones. Second, by consolidating compensation areas a larger ecosystem can

be created, offering habitat to a greater number and diversity of organisms than might several smaller, isolated areas of equal total area.

There will undoubtedly be numerous difficulties in setting up the compensation area land bank. The most immediate decision lies in setting up the appropriate agency structure for acquisition and management of banked lands. The California Coastal Conservancy may be the most appropriate agency to head the land bank, since it is already authorized to acquire sensitive coastal lands. Banked lands would be managed under Sections 30230, 30231, and 30233 of the Coastal Act, the State's policies for estuarine and wetland management. Whatever the difficulties, the compensation area land bank offers a mechanism for overcoming an increasingly difficult problem in both an economically and environmentally sound manner.

Maintenance of Ecosystem Characteristics. Finally, it is important for the various agencies involved in reviewing permit activities and formulating permit conditions in the study area to agree on which ecosystem characteristics are important to maintain. (This is particularly difficult since different agencies have different policies and responsibilities.) Management of the ecosystems to maximize primary productivity will necessarily be different from management to maximize waterfowl use, for example. The present systems for calculating compensation requirements emphasize replacing habitat value calculated on the basis of various ecosystem characteristics; agreement on required compensation could more easily be reached if all agencies were using the same basis for preservation.

E. INFORMATION NEEDS

This section lists and discusses the significant information gaps and problems identified during the course of this study. Recommendations for studies to fill information gaps and for procedures to deal more effectively with problems are included in this section.

The first recommendation made is procedural and deals with the problem of archaeological sensitivity in the study area. As shown on Plate 20, there are numerous areas of archaeological sensitivity within the study area; these areas were identified as such because they contain known archaeological sites. However, it is highly likely that the entire study area is archaeologically sensitive and that numerous sites as yet unidentified exist. This means that any decision to grant a Corps (or other) permit for a proposed activity has good potential for causing adverse impacts to archaeological resources. The most effective way to ensure that archaeological resources are protected to the greatest extent possible from impacts of development activities is to establish an advisory committee with ready access to the most complete information on the location and status of such resources. The following is recommended: That the Corps of Engineers create a statewide archaeological/historical resources advisory committee to review all Corps projects and permit applications. The committee would be composed of representatives of the following agencies: the Heritage, Conservation, and Recreation Service, the State Historic Preservation Office, the Northwest Indian Cemetery Protective Association, and authorized regional centers (Sonoma State University Anthropological Study Center Cultural Resources Facility is the Northwest Regional Center for the California Archaeological Survey and covers Humboldt County). The committee would serve an advisory role on whether archaeological/historical resources were in danger and how such resources could be protected. A similar approach is being used by other Federal agencies, including the Bureau of Land Management and the U.S. Fish and Wildlife Service.

The second recommendation is also procedural and deals with wetland mitigation and restoration policies. As discussed in the compensation and mitigation section (Volume I, Section V-D), several agencies have compensation policies, but there has been little coordinated implementation of these policies. The following recommendations should facilitate implementation and minimize procedural difficulties in compensation/mitigation decisions:

1. Develop a compensation land bank program, with an agency such as the Coastal Conservancy or a local agency acting as the "lead agency." Participants should include all federal, state, and local regulatory and development agencies and major industries.

2. Organize a committee of resource and development agency representatives to develop and support a universally accepted set of compensation policies for the study area.

The committee could also include representatives of major industries and the public. In any event, the committee should seek input from the private and public sectors.

3. Develop a restoration/compensation program specifically oriented toward small isolated wetlands surrounded by urban activities. The Coastal Commission has already developed draft guidelines which allow fill in such wetlands as a special limited exception to the restrictions of Section 30233(a) of the Coastal Act. (California Coastal Commission, 1979, Draft Statewide Interpretive Guidelines for Wetlands and Other Environmentally Sensitive Areas)

Planning and implementation of recommendations 1 and 3 may best be done by the committee described in recommendation 2.

The following list identifies information gaps and recomments studies to remedy data deficiencies. The list is in order of importance, with Number 1 being first priority.

1. Determination of the mean high water line (MHW), the mean higher high water line (MHHW), and the highest estimated tide

Each of the various agencies with jurisdiction and regulatory authority in the Humboldt Bay study area has a different jurisdictional boundary. Several of these agencies have regulatory authority over both land and water areas. Agencies such as the Coastal Commission, Humboldt County, and the Cities of Eureka and Arcata have well-defined boundaries both on land and in the water (for example, the coastal zone boundary, or the tideland grant limits of Eureka and Arcata). Two major regulatory agencies have jurisdictions limited principally to water parts of the study area; these are the Corps of Engineers and the Harbor District. The Corps of Engineers has two jurisdictional boundaries for permitting purposes: MHW under the Section 10 authority* and the limit of adjacent wetlands under the Section 404 authority (see Section I, Volume I, and Volume III). In unvegetated areas the Section 404 boundary has been defined as the limit of the "highest estimated tide." The Harbor District is limited to areas "subject to tidal action;" the District interprets this phrase to signify MHHW (except for Indian, Woodley, and Daby Islands where MHW is the Harbor District's jurisdictional boundary, which is an ecological or botanical boundary (see Volume III). However, the Corps Section 10 boundary (MHW) and the Harbor District's boundary (MHHW) are not exactly known around the Bay. During the course of this study, the need for an exact and legal determination of MHW and MHHW

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*Historically, the Corps had interpreted its Section 10 boundary to be MHHW on the Pacific Coast; however, in the Leslie Salt case (Leslie Salt Co. v. Froehlke, 578 F.2d 742,753 (1978), the court definitively determined that the Corps' Section 10 boundary is only to MHW.

was mentioned by numerous persons. Clearly, such a determination would clarify jurisdictional limits. The accurate mapping of MHW and MHHW will require good and complete tide data and careful surveying. The recently established National Ocean Survey tide gauges provide good information for most of the Bay except the South Spit area and the area near Jacoby Creek and the Arcata oxidation ponds. It is strongly recommended that a study to determine MHW, MHHW, and the "highest estimated tide" around the entire Bay be undertaken.

2. Physical oceanography: a numerical model of circulation in the Bay

There is and has been considerable controversy about circulation and flushing in Humboldt Bay. This is particularly true in North Bay where sewage outfalls and apparent poor flushing are in conflict with the harvesting of shellfish, in particular the commercial harvesting of oysters. To date no comprehensive long-term study of circulation, including current measurements, has been carried out in Humboldt Bay. Many of the smaller studies available offer conflicting results and conclusions. The small scale physical model developed as part of this study has offered some interesting, albeit controversial, interpretations of circulation within the Bay. A numerical model of Bay circulation, including adequate data on current velocity, tidal height, and water characteristics, would help resolve many of the conflicts. Such a model would provide a view of water mixing and movement, flushing rates, and other physical characteristics of Bay waters. It might also be useful in predicting maintenance dredging requirements because the model results would feed into a sediment budget for the Bay and would help to predict where and how rapidly sedimentation might occur. The model would be very useful to agencies such as EPA, the State Water Resources Control Board, and the Regional Water Quality Control Board which are concerned with water quality and discharge requirements and permits and agencies concerned with protection of shellfish resources (FDA, the Department of Health and the Department of Fish and Game, for example); it would assist these agencies in predicting effects of various activities using the same information base. The model would address circulation in the Bay itself, with water flows, freshwater input, and tidal prisms in the creeks and sloughs serving as input data to the model.

Preliminary planning for the development of a numerical circulation model has already begun. In a meeting in November 1978 representatives of the San Francisco District Corps of Engineers and the Waterways Experiment Station met to discuss the recognized need for a numerical circulation model of the Bay. Several oceanographers at Humboldt State University would constitute an advisory committee for the development of such a model. The City of Arcata Departments of Public Works and Planning are strongly in support of preparation of the circulation model as soon as possible.

It is strongly recommended that this work be undertaken and that sufficient field work to adequately define model input parameters be part of the formulation of the model.

3. Determination of the historic limit of wetlands around Humboldt Bay

The court's opinion in the Leslie Salt case (see #1 above) suggested that the Corps of Engineers may have jurisdiction over "historic" intertidal lands. While this opinion is by no means as definitive as the court's finding on MHW as the limit of Section 10 jurisdiction, it is sufficiently strong to lend credence to the concept of Corps jurisdiction over historic tidelands which are today diked agricultural lands. Litigation over ownership of waterfront lands (and former tidelands) in the City of Eureka indicates that the state may have some ownership rights to "historic tidelands" around the Bay (this same issue is being hotly debated in other parts of California, notably the Sacramento Valley and Bolsa Chica). It may soon be essential to know, as closely as possible, the "historic" upper limit of wetlands around the Bay. A comprehensive collection of sediment cores around the Bay would provide information on the pre-settlement location of wetlands, thus assisting in determining old jurisdictional and ownership boundaries. The information would be useful to scientists interested in successional changes in soils and wetlands. The study would require numerous transects around the Bay, with several cores along each transect. Transects should be run in particular in the lowlands of Arcata Bottoms, Bayside Bottoms, Eureka Slough, Elk River, and Beatrice Flats. Core samples would be looking for evidence of historic marshes, principally the presence of certain types of peat and pollen.

4. The relationship between wetland types and tidal elevations; sea level fluctuations

Compensation, or the replacement of lost habitat value by creating or enhancing new habitats, has become an important concept in mitigating the impacts of development activities. A popular method of compensation is to return diked pasture lands to tidal influence and thus ultimately create a salt marsh. However, the problem with this method is that to date there has been little or no data with which decision makers can predict whether, when, or how much salt marsh will actually result. Salt marshes only flourish in a very narrow range of tidal inundation. If there is too much inundation, the marsh plants cannot survive; if there is too little, then some upland species can tolerate the conditions and may overcome or crowd out marsh vegetation. If the relationship between tidal inundation and type and amount of vegetation is understood, then a potential compensation site could be surveyed for elevation and the vegetation resulting from tidal flooding could be predicted. The result would be a much more accurate set of compensation requirements. Such a study would involve sampling various salt and brackish marshes

in the study area for vegetation characteristics (species, abundance, distribution in the marsh) and for elevation across the marsh (by survey). The correlation between elevation, tidal inundation, and vegetation would be established using this data for the study area. The results would have to be field tested in study area marshes not used for primary data collection.

The type of information generated in this study is particularly important in view of sea level fluctuations which may have occurred since diking took place. Measurable fluctuations in sea level have occurred along the North Coast of California in the last 60 years. Recent geologic theory offers tectonic mechanisms to explain some of these fluctuations. Theory also suggests that the degree and perhaps the direction of sea level fluctuation may vary with location along the coast line. All assumptions about sea level fluctuations in Humboldt Bay are based on data from Crescent City or San Francisco, far too distant for accurate extrapolation in light of today's tectonic theories. Detailed investigation of historical and present tide records, core sediment samples (see #3 above) and historical survey records will provide insight into the extent and type of sea level fluctuation in the study area. This information will be important and useful for comparing present and historic wetlands (see #3 above), in identifying potential compensation sites, and in assessing height requirements for dikes and roads. The information will also be important in predicting changes in MHW/MHHW (see #1 above). Investigation of vegetation/tidal inundation/elevation and sea level fluctuation need not be undertaken as a single study; two separate studies can be done.

5. Invertebrate sampling

There are significant gaps in knowledge about invertebrate species, abundance, and distribution in Humboldt Bay. Little or no information on invertebrate populations has been gathered for the Broadway mudflats, and the bottoms of creeks and sloughs around the study area. Very few systematic studies to determine the distribution, abundance, and location of invertebrates in specific Humboldt Bay habitat types have been conducted (see Volume II, Section VI.P) those that have been done have been limited to particular parts of the Bay. A study to expand the work of Carrin and of Boyd, et. al. (Volume II, Section VI.P) in relating invertebrate populations to Bay habitats, including substrate type, should be undertaken. Invertebrate sampling should include at a minimum all the major groups identified as present in Humboldt Bay (Volume II, Section VI.P). The study should be designed to cover first the areas for which little or no data exists, in particular the Broadway mudflats which are under heavy development pressure, and the bottoms of creeks and sloughs. Sampling parameters should cover habitat characteristics including substrate type and salinity.

6. A study of shipping and harbor (port) facilities and the need for expansion of such facilities in the Bay

As available information on economics, navigation, and port facilities was reviewed, it became apparent there is inadequate data on vessel traffic, existing harbor facilities and their capacity, and the demand for the expansion of improvement of harbor facilities. Although the studies conducted by the San Francisco District in planning navigation improvement projects provide some general information, they do not address the specifics of navigation and harbor needs in the Bay. Several persons engaged in coastal planning for Humboldt Bay have mentioned the need for a more definitive study of vessel traffic and harbor expansion possibilities, particularly in relation to possible OCS development. Such a study is especially important in planning where future development can occur. It is recommended that a port study similar to the Port Series by the Board of Engineers for Rivers and Harbors be done; such a study should particularly address the following:

- Vessel traffic - numbers, types, and characteristics of vessels using Humboldt Bay channels and harbor facilities. Any navigational or docking problems experienced.

- Existing harbor facilities - number, type, characteristics, vessels served, use level (whether below, at, or over capacity) improvements needed.

- Need for new harbor facilities - special facilities such as fishing or OCS support facilities, possible locations, general time frame within which needed.

7. A survey of public opinion on Bay issues and appropriate use of Bay resources

It has become evident during the Local Coastal Program (LCP) efforts being conducted by the various local agencies and during the controversy over the proposed regional sewage system that there is significant interest on the part of both individuals and special interest groups as to how the resources of the Humboldt Bay should be used. Public meetings and hearings have been held by the various agencies concerned with coastal planning, but it is well-known that such meetings tend to attract a biased sample, that is, those persons or groups with a particular interest in specific issues. There has been no systematic investigation of what public opinion really is. It is recommended that a survey to determine public opinion on the use and management of resources of the Humboldt Bay study area be conducted. The survey sample should be sufficiently large to be statistically valid and should be selected using random-sampling techniques. The survey instrument(s) should be pretested to ensure valid (non-biased) results. In short, the survey should be conducted using generally accepted and valid survey methods. It should be a

joint effort of several agencies, including the Corps of Engineers, the Coastal Commission, North Coast Region, and the local agencies involved in LCP planning and in permit and development activities (e.g., the Harbor District). The results will be useful to all these agencies in both their project planning and their permit granting roles.

8. Mapping of all known sitings of endangered and threatened species within the Bay area

Endangered and threatened species, particularly fauna, are often difficult to locate, and yet knowledge of their real or potential presence is important to management and development decisions. To date, records of such information are incomplete and scattered [although the California Native Plant Society has a comprehensive list of plants known to them (CNPS, 1974)]. A comprehensive and consolidated record of all known observations of endangered and threatened species in the Humboldt Bay area, including date and location of observation and species observed, should be made. Both flora and fauna should be included, and the record should be in both list and map form. Copies of the record should be distributed to all federal, state, and local agencies with interest or jurisdiction in the study area. Such a data base would prevent destruction of unique habitat due to lack of information and might assist compensation and mitigation decisions where habitat loss is unavoidable.

9. An economic study of the Humboldt Bay area

At the public workshop on 13 May 1980, considerable support for an economic study of the Humboldt Bay area was expressed by the public. It was felt that while the Humboldt Bay Wetlands Report and Baylands Analysis provides a very good description of natural resources and existing land use/habitat areas, the study did not deal with the economic needs of the area in sufficient detail. An economic study to supplement the recommended harbor facilities study (No. 6 above) should address the projected need for land for activities such as industrial, commercial, and residential development. Such land needs could then be compared and balanced against the need to preserve and protect important wetlands and habitats. It was felt by the public that supplementing the Humboldt Bay Wetlands Report and Baylands Analysis would result in a more balanced picture of the land use needs of the Humboldt Bay area.

10. Additional study of the mudflat habitat (recommended by the U.S. Fish and Wildlife Service)

The mudflat habitat includes the eelgrass beds in the Bay. Eelgrass comprises the largest habitat type in the Bay and it may be a useful indicator of changing water quality and other environmental

conditions. It is an important food for black brant and widgeon and other ducks. Eelgrass beds should be mapped, changes in distribution of the beds should be monitored, and the causes for any decline should be determined.

11. Further study of the impacts of gravel mining in the Mad River (recommended by U.S. Fish and Wildlife Service)

Gravel mining in rivers may have substantial impacts on the river or estuarine environments and may adversely affect the fish populations (see Dredging, Section V.C). Studies to define more clearly such impacts should be carried out.

Note: The U.S. Fish and Wildlife Service, in a letter dated 10 April 1980, to the District Engineer, San Francisco District, Corps of Engineers, specifically supported the recommendations on wetland mitigation and restoration and recommended studies Nos. 1, 3, 4, 5, 10, and 11.

F. SUMMARY OF BASE INFORMATION

This section presents a very brief summary of the data contained in Volume II, Base Information. In Volume II, Section VI, is the environmental profile of the study area, covering physical characteristics (geography, geology and soils, geologic hazards, tidal characteristics, hydrology, physical oceanography, bottom sediments, and water quality) and biological characteristics (habitat types, fauna, ecological processes). Section VII covers land and tideland use, ownerships, and governmental agencies with interest or jurisdiction and their policies. Section VIII covers cultural characteristics (historical/archaeological resources, community structure, recreation, educational/scientific uses, refuges/reserves), aesthetics and economics.

In this summary, plates referred to are generally to be found in Volume II.

PHYSICAL AND BIOLOGICAL PROFILES

Detailed descriptions of the physical and biological characteristics of habitat types found in the Humboldt Bay study area are given in Section VI of the Volume II. Classification and mapping of the habitat types is described in Volume III. Habitat type mapping was done at a scale of one inch to 500 feet (1:6000). A summary of that mapping is presented on Plate 10, at a scale of one inch to 2000 feet (1:24000). Table V-1 is a summary of the biological features of each habitat type and the areal extent of each type within the Humboldt Bay study area.

The physical factors discussed in Volume II include geography, climatology, soils, geology, geologic hazards, hydraulics, and water quality. The biological profiles include discussions of flora, fauna, productivity, food webs and nutrient cycling. The information presented in the Volume II was used to assess the relative value and importance of various areas within the estuary (see Section V.B).

Certain terms in Table V-1 are defined below. "Flora" designates the dominant vegetation found in each habitat type. "Fauna" identifies the principal animal species which use a habitat for breeding and feeding. "Primary Productivity" relates to energy production in plants (vegetation); "Aquatic Interaction" describes the degree of water movement through an area. "Wetland" designates whether a habitat type is so defined under EO11990 and 33 CFR 323.2(c) and "Corps Jurisdiction" identifies which habitat types would probably require individual Corps permits under Section 404 of FWPCA (1972) or Section 10 of the Rivers and Harbors Act of 1899.

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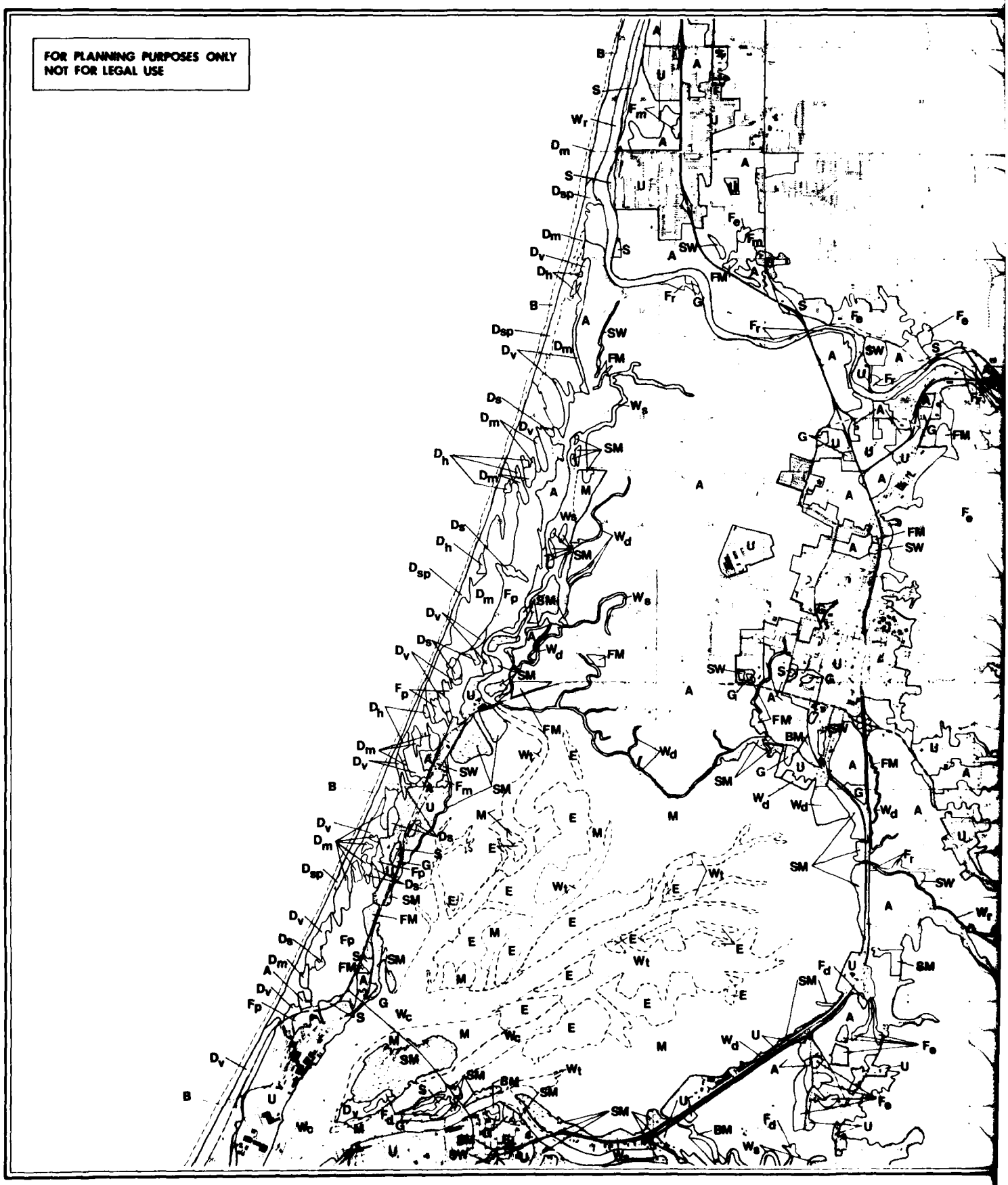

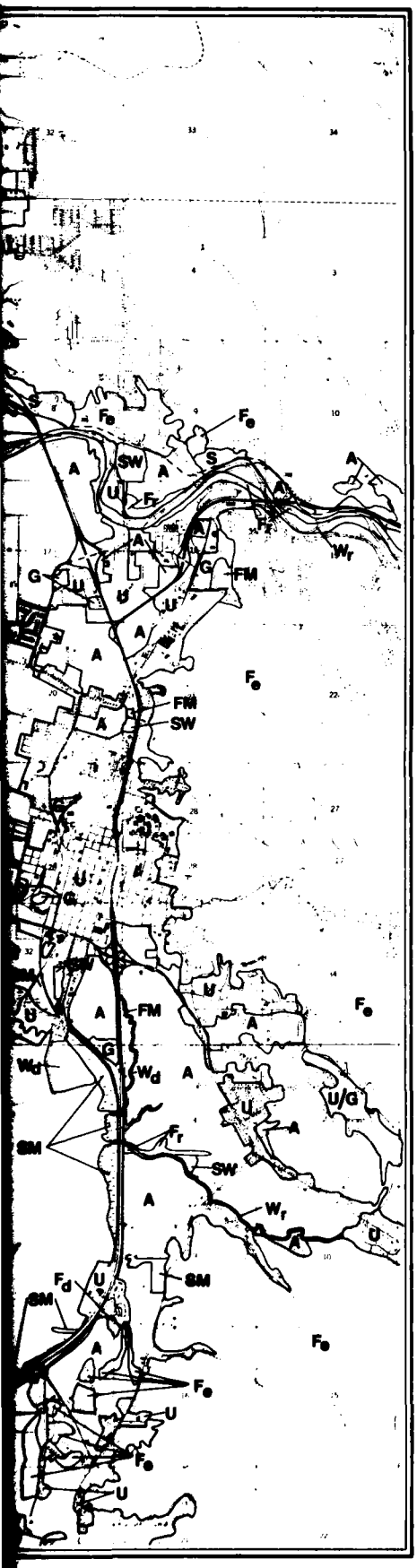

HABITAT TYPES
1978

PLATE NO 10 NORTH

LEGEND

A	Agriculture
B	Beach
D_h	Dune Hollow
D_m	Moving Dune
D_s	Dune Swamp
D_{sp}	Sparsely Vegetated Dune
D_v	Vegetated Dune
F_d	Deciduous Forest
F_e	Evergreen Forest
F_m	Mixed Forest
F_p	Pine Forest
F_r	Riparian Forest
G	Grassland
J	Jetties and Reefs
S	Shrub
U	Urban
Wetlands	
SM	Salt Marsh
BM	Brackish Marsh
FM	Freshwater Marsh
SW	Swamp
E	Eelgrass *
M	Intertidal Flat
W_c	Deep Tidal Channels
W_d	Ditches and Closed Channels
W_r	Creeks and Rivers
W_s	Tidal Creeks and Sloughs **
W_t	Shallow Tidal Channel

* As interpreted from Dec 1978 aerial photos

** Upstream limits of tidal influence are approximate

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HUMBOLDT BAY WETLANDS REVIEW
&
BAYLANDS ANALYSIS

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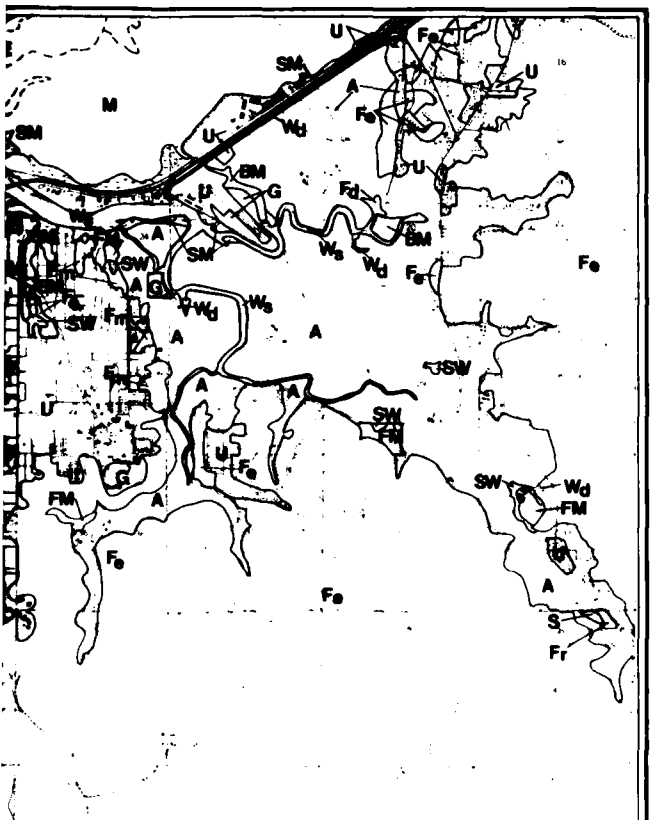

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HABITAT TYPES 1978

PLATE NO 10 SOUTH

LEGEND

A	Agriculture
B	Beach
D_h	Dune Hollow
D_m	Moving Dune
D_s	Dune Swamp
D_{sp}	Sparsely Vegetated Dune
D_v	Vegetated Dune
F_d	Deciduous Forest
F_e	Evergreen Forest
F_m	Mixed Forest
F_p	Pine Forest
F_r	Riparian Forest
G	Grassland
J	Jetties & Reefs
S	Shrub
U	Urban
Wetlands	
SM	Salt Marsh
BM	Brackish Marsh
FM	Freshwater Marsh
SW	Swamp
E	Eelgrass
M	Mudflat
W_c	Deep Tidal Channels
W_d	Ditches & Closed Channels
W_r	Creeks & Rivers
W_s	Tidal Creeks & Sloughs
W_t	Shallow Tidal Channels

* As interpreted from Dec 1978 aerial photos

** Upstream limits of tidal influence are approximate

HUMBOLDT BAY WETLANDS REVIEW
&
BAYLANDS ANALYSIS

Table V-1

BIOLOGICAL CHARACTERISTICS OF HABITAT TYPES

[illegible]	[illegible]	[illegible]	Fauna[illegible]				Primary Productivity	Aquatic Interaction	Wetland[4]	Corps juris-diction[5]
			Mammal[illegible]	Bird	Fish	Invertebrates				
[illegible]	[illegible]	[illegible]	[illegible] primarily rabbits, [illegible] weasels, [illegible]	[illegible] rail, [illegible] shorebirds, [illegible]		insects	low-medium	very low	no	no
[illegible]	[illegible]	[illegible]		[illegible] sandpipers, plover, [illegible]	surf smelt, sand-lances, surfperch	rocky [illegible], mole crabs, polychaete worms	low	very high	yes	yes
[illegible]	[illegible]	[illegible]	[illegible]	[illegible] tanager, short-eared owl, barn owl, [illegible] owls, [illegible] swifts, [illegible]		[illegible]	low-medium	low	no	no
[illegible]	[illegible]	[illegible]	[illegible] rabbits, [illegible]	[illegible] hawks, [illegible] woodpecker, [illegible]		insects, snails, [illegible]	medium-high	low	no	some areas
[illegible]	[illegible]	[illegible]	[illegible] rabbits, [illegible] fox, weasel, [illegible]	hawks, [illegible] shorebirds, terns, swifts, swallows, upland game birds, sparrows		insects	low-medium	low	no	no
[illegible]	[illegible]	[illegible]		surfbird, [illegible]	juvenile jile perch, striped perch, silver perch, rainbow perch, rockfish, wolf eel	limpets, mussels, barnacles	medium-very high	very high	no	yes
[illegible]	[illegible]	[illegible]	[illegible] rabbits, [illegible]	[illegible] hawks, [illegible] hummingbird, [illegible] warbler, [illegible] sparrows		insects	low-medium	low	no	no
[illegible]	[illegible]	[illegible]	[illegible]	[illegible] rail, [illegible] wren, [illegible]		[illegible]	low	low	no	no
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	medium-[illegible]	medium-high	[illegible]	[illegible]

Table V-1

BIOLOGICAL CHARACTERISTICS OF HABITAT TYPES

Habitat Type	Areal Extent[1]	Flora	Fauna[2]				Primary Productivity	Aquatic Interaction	Wetland[4]	Corps jurisdiction[5]
			Mammals	Birds	Fish	Invertebrates				
[illegible] Marsh	[illegible]	[illegible] sedges, [illegible], [illegible], waterparsley	[illegible], shrews, [illegible], skunk, muskrat, weasel, mink, [illegible], deer	waterfowl, wading birds, shorebirds, phalaropes, marsh-hawk, swallows, marsh-wren, blackbirds	juvenile trout and salmon	insects, snails	medium-high	low	yes	often
[illegible]		willow, alder, dogwood, spiraea, sedge, cattails, water-parsley	rodents, mink, weasel, muskrat, raccoon, beaver, otter, deer	bitterns, egrets, herons, hawks, woodpeckers, swallows, wrens, chickadees, warblers		insects, snails	medium-high	low-medium	yes	often
[illegible]	[illegible]	phytoplankton, algae, benthic diatoms	harbor seals	herons, shorebirds, gulls, water pipit, swift		clams, oysters, many sediment dwellers	low	very high	no	yes
[illegible]	[illegible]	eelgrass		ducks, geese	herring, bay pipefish, juvenile salmon, trout, larval and juvenile bottomfish	shrimp, clams, polycheate worms, sediment dwellers	low-medium	very high	yes	yes
[illegible]	[illegible]	phytoplankton	beaver, otter, muskrat, harbor seals	loons, grebes, waterfowl, gulls, osprey, swallows, swift, kingfisher	salmon, surfperch, anchovy, bottomfish, sculpin	clams, crabs, zooplankton	low	very high	no	yes

Footnotes:

[1] Acreage within study area from habitat mapping (Volume III). Mudflats, eelgrass, and water habitats measured from 1:24000 scale map.

[2] Principal species; not every species found in every example of habitat.

[3] Indicates principal habitat; does not include occasional visitors.

[4] As defined in EO 11990 and 33 CFR 323.2(c).

[5] Under Section 404 of FWPCA (1972) or Section 10 of Rivers and Harbors Act of 1899.

[illegible] Appendix E-7, there are numerous potential problems in precise and accurate measurements of land use from aerial photographs. [illegible] agricultural lands and open space will not be identified; open space and agriculture are often difficult [illegible] in land use acreage (Table V-1) and habitat tpe acreage (Table V-3).

LAND USE, POLICY, AND CULTURAL PROFILES

Land and Water Use and Ownerships (Volume II, Section VII A & B

Plate 14 shows the relative size and location of 1978 land uses in the study area, mapped from color IR aerial photographs at 1:24000. The land use categories delineated are described in Table V-2. Agriculture is a major land use in Arcata Bottoms, Bayside Bottoms, Eureka Slough, Elk River, Table Bluff, and Beatrice Flats. The entire South Spit and much of the North Spit are open space, as are the Eureka gulches and Martin Slough. The North Spit coastal dunes are all open space. Wetlands occur principally in the Mad River Slough, along the North Bay shoreline near Manila, and from Arcata to Eureka, on the Islands, and scattered through the Broadway area, Elk River, and Beatrice Flats. Industrial uses are concentrated in Arcata, the Eureka waterfront, the Eureka-Bucksport strip, and Fields Landing and on the North Spit south of the Eureka-Samoa Bridge. Residential uses occur in cities and small communities around the Bay.

Trends in land and water use were determined by aerial photo interpretation for the years 1871, 1903, 1926, 1948, 1958, 1967, and 1978. Table V-3 summarizes some of the trends for the years 1871, 1948, 1958, 1969, and 1978 (1926 and 1903 are not included because about 6,500 acres of the study area in the Arcata Bottoms subarea had no map coverage for those years. The totals do not include Mad River subarea because map and photocoverage was only available for 1871, 1969, and 1978). In 1871 most of the study area lands (about 80%) were in open space and wetlands, with agriculture using about 3,000 acres. By 1948, agriculture had increased in land area over five times to a high of about 17,000 acres. Only about 50% of the open space and 15% of the wetlands remained.

Table V-3

LAND USE SUMMARY (ACRES)

Year	Open Space	Agri-culture	Wetland	Commercial & Industrial	Resi-dential
1871	17,269	3,049	8,738	0*	250
1948	8,573	17,302	1,337	1,048	2,332
1958	8,467	14,905	1,136	1,595	3,616
1969	8,650	13,657	1,128	2,265	3,977
1978	8,372	13,750	1,108	2,239	4,171

Source: Interpretation of Aerial Photos and Maps, Shapiro & Associates, Inc., 1979.

*There were probably some mills in existance in 1871, but none are identified on the 1871 map.

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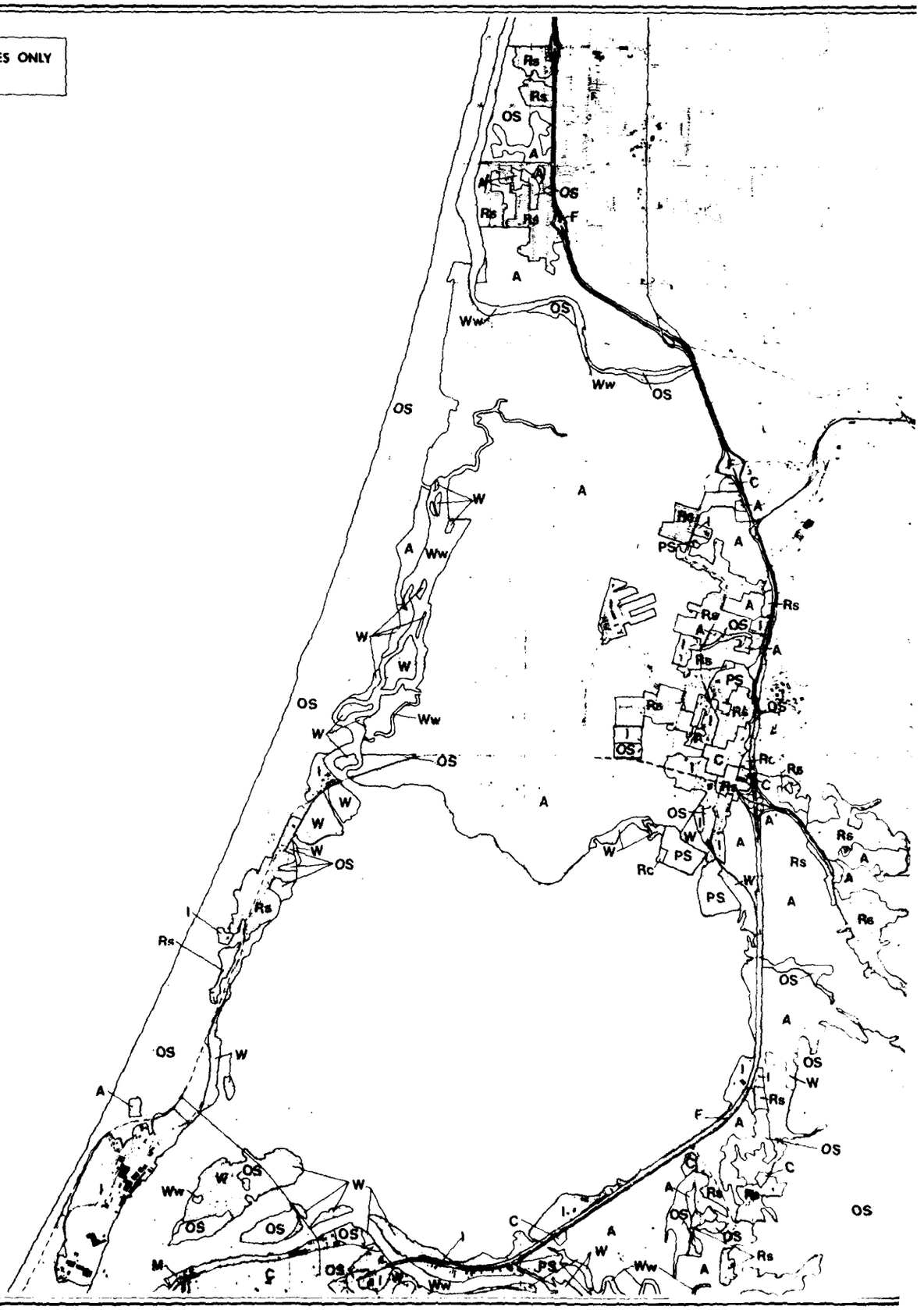

LAND USE 1978

PLATE NO 14 NORTH

LEGEND

A	Agriculture
C	Commercial
F	Freeway
I	Industry
M	Marina
OS	Open Space
PS	Public Service
Rc	Recreation
Rs	Residential
W	Wetland
Ww	Waterway

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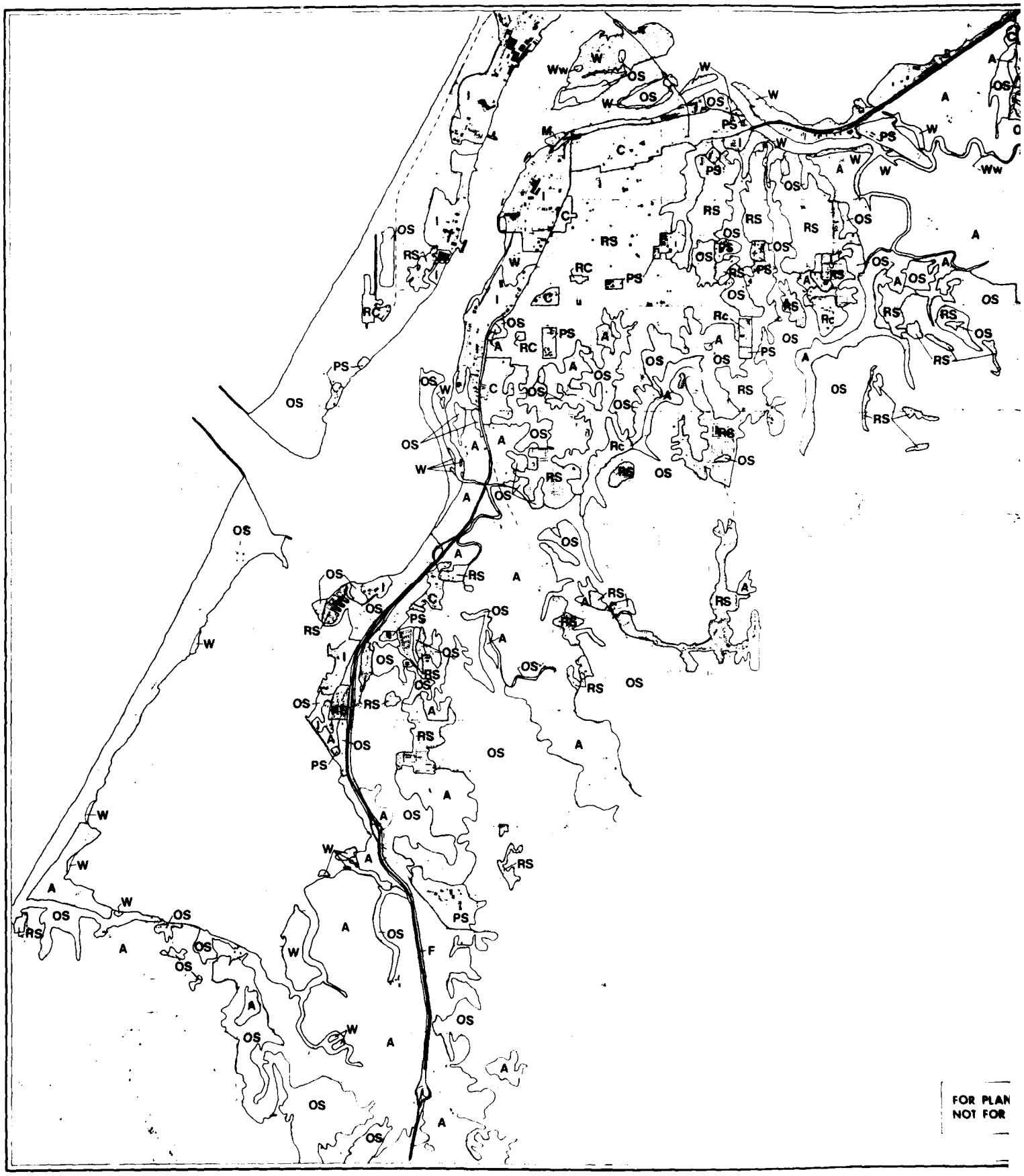
&
BAYLANDS ANALYSIS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LAND USE 1978

PLATE NO 14 SOUTH

LEGEND

A	Agriculture
C	Commercial
F	Freeway
I	Industry
M	Marina
OS	Open Space
PS	Public Service
Rc	Recreation
Rs	Residential
W	Wetland
Ww	Waterway

N

HUMBOLDT BAY WETLANDS REVIEW
&
BAYLANDS ANALYSIS

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Table V-2

LAND USE CATEGORIES

Open Space (OS)	Any woodland, or any grassland which was not agriculture. May include occasional houses in sparsely populated areas.
Wetland (W)	Any marsh or swamp.
Agriculture (A)	Any areas used for pasture or row crops. May include occasional houses in sparsely populated areas.
Commercial (C)	Urban non-industrial and non-residential development, downtown areas of cities, neighborhood business.
Industry (I)	Any manufacturing business, includes port facilities, lumber mills, boat building, and parking areas associated directly with a specific business.
Residential (Rs)	Single family or multiple family dwellings, density greater than 1 unit per acre.
Waterways (Ww)	All natural water bodies in the area such as sloughs, creeks and ponds. The Bay waters are not included; the category Ws stops at the mouth of the creek or slough.
Public Services (PS)	Sewage treatment ponds, pipeline corridors, power line corridors, military installations, schools, hospitals, cemetaries, airports.
Recreation (Rc)	Parks and boat launch ramps. Marinas were identified separately.
Marina (M)	Areas for mooring or storing boats.
Freeway (F)	Major locak, state, and federal highways.
Log Rafting (LR)	In-water log storage areas, including sloughs and mill ponds.
Log Storage (LS)	Log storage areas on land.
Railroad (RR)	Railroad tracks, switching yards and maintenance facilities.
Gravel Bar (GB)	Deposits of gravel exposed during low water along the Mad River.
Mudflat (MF)	Intertidal areas of mud and sand, generally located adjacent to the Bay shore.
Fill	Sanitary landfill.
Unknown	Areas for which no map or photo coverage was available.

Urban-type development (commercial, industrial, residential) had shown a 13-fold increase in land area. Over the period 1948-1978, urban-type uses continued to increase, leveling off somewhat after 1969. During this period, agricultural uses declined. There was some loss of wetlands (about 200 acres) between 1948 and 1958, but wetland acreage has remained fairly constant since 1958. Figure V-2 shows the trends in Table V-3 graphically.

Table V-4 shows wetland changes over time for each subarea. The Arcata Bottoms, Eureka Slough, Beatrice Flats, and Bayside Bottoms ahd large amounts of wetlands in 1871; by 1926 significant losses had already occurred because of diking to allow agricultural uses. In 1978, the following percentages of the 1871 wetlands in the lowland areas remained: Arcata Bottoms, 8%; Bayside Bottoms, 6%; Eureka Slough, 11%; Beatrice Flats, 6%.

Table V-4

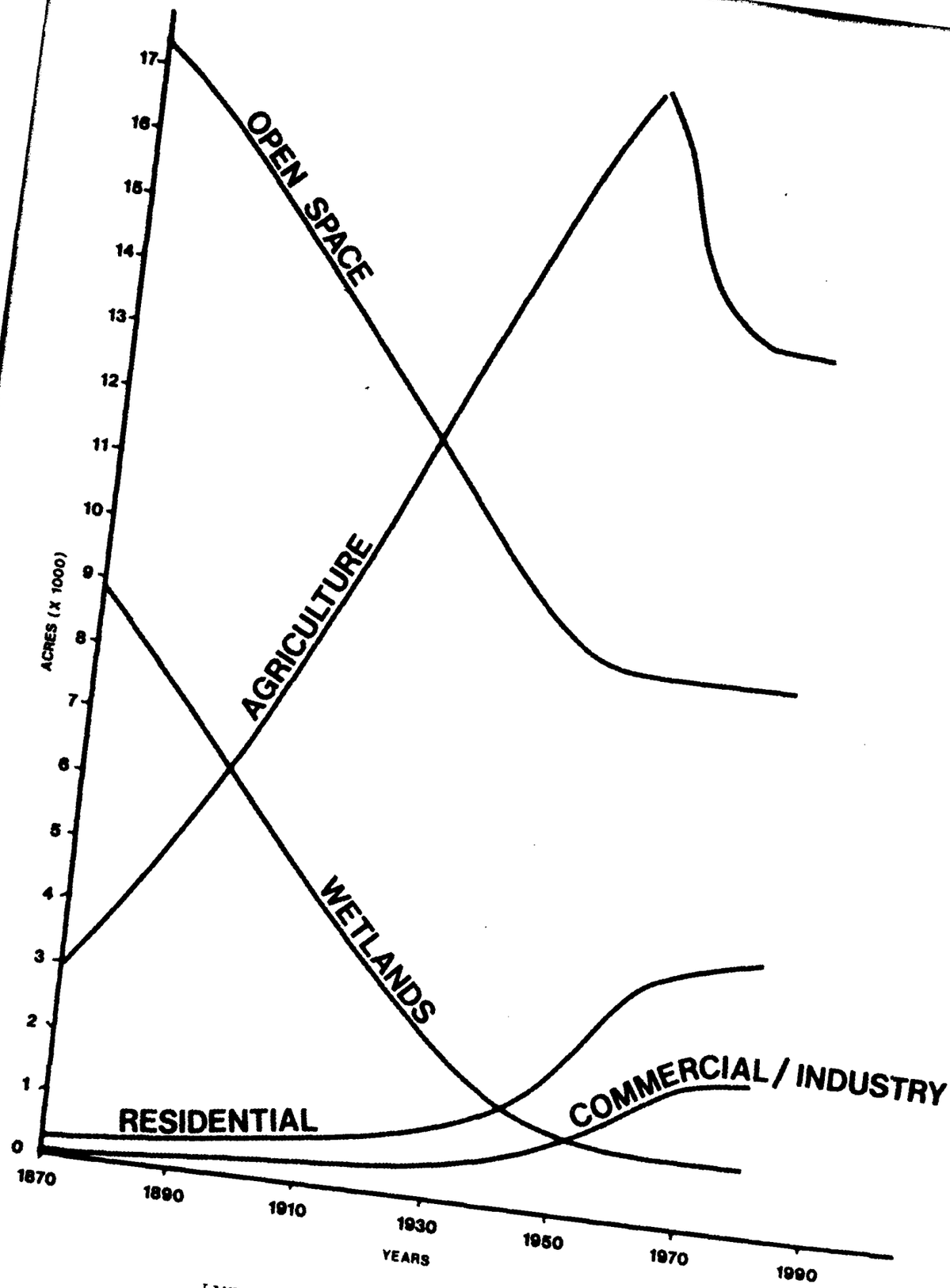
WETLANDS CHANGES BY SUBAREA OVER TIME
(area in acres)

	Year						
Subarea	1871	1903	1926	1948	1958	1969	1978
Mad River[1]	0	N/A	N/A	N/A	N/A	0	0
Arcata Bottoms[2]	2,982	N/A	N/A	440	282	229	246
North Spit	217	284	36	172	150	111	149
Bayside Bottoms	825	827	96	47	99	0	55
Eureka Slough	1,795	2,531	655	153	147	235	194
Eureka	488	415	401	77	31	77	6
Islands	257	291	239	264	267	266	255
Elk River	245	193	24	50	17	22	30
Beatrice Flats	1,929	1,965	525	115	136	18	122
Table Bluff	0	18	17	0	2	0	0
South Spit	0	105	83	19	5	40	51

[1]N/A means no map or photo coverage available
[2]N/A means only partial map coverage available

Source: Interpretation of Aerial Photos and Maps, Shapiro & Associates, Inc., 1979.

Most of the lands in the study area are in private ownership; the public aprcels are owned by federal agencies (Bureau of Land Management, Coast Guard, U.S. Fish and Wildlife Service), state



LAND USE CHANGES OVER TIME

Figure V-2

agencies (e.g., the State Lands Commission, Humboldt State University) and local agencies such as Humboldt County, the local cities, and local special districts. Much of the tideland acreage is privately owned. Large amounts of public tidelands are leased for such purposes as commercial oyster culture. All publicly-owned tidelands in the study area have been granted by the state to either the City of Eureka, the City of Arcata, or the Humboldt Bay Harbor, Recreation, and Conservation District. Ownership is shown in Plate 15, Volume II.

Governmental Policy (Volume II, Section VII-C)

This section discusses the plans and policies of the various governmental interests that interact with the Corps of Engineers during the permit process and/or that have planning or construction interests in the study area. Some of these governmental entities are specific to the Humboldt Bay study area; others, including federal and state agencies, have review responsibility for Corps permit applications throughout the San Francisco District.

Corps permit regulations (33 CFR 320-329) require an evaluation of the extent to which a proposed permit activity is in the public interest. This is the most important criterion applied in the decision to issue a permit. For any permit application, the Corps must consider all applicable official state, regional, or local land use plans and/or policies as reflecting local factors of the public interest (33 CFR 320.4(j)(2)); thus, the Corps will request review of permit applications in the study area by local governments. In addition, the Corps is required by permit regulations to coordinate and consult with certain federal and state agencies (33 CFR 320.4) so that permit decisions will reflect factors of the national and statewide public interest. In addition to permit review, federal, state, and local agencies have plans or projects in the study area which may be of interest to the Corps. In the Humboldt Bay study area, plans, policies, and proposed activities are of mutual interest to the Corps and the following principal federal agencies:

1. U.S. Department of the Interior (DOI)

   Fish and Wildlife Service
   Bureau of Land Management
   National Park Service
   Heritage, Conservation, and Recreation Service

2. U.S. Department of Commerce (DOC)

   Office of Coastal Zone Management
   National Oceanic and Atmospheric Administration/
      National Marine Fisheries Service/National
      Ocean Survey
   Economic Development Administration

3. U.S. Environmental Protection Agency (EPA)

$. U.S. Department of Transportation

U.S. Coast Guard
Federal Highway Administration

5. Advisory Council on Historic Preservation

6. U.S. Department of Agriculture (USDA)

Soil Conservation Service
Agricultural Stabilization and Conservation Service

7. U.S. Council on Environmental Quality

In addition, the following principal state and local agencies are interested in Corps plans, policies, and permit activities in the Humboldt Bay study area:

1. California State Agencies

The Resources Agency
Department of Conservation
Department of Fish and Game
Department of Forestry
Department of Boating and Waterways
Department of Parks and Recreation
Department of Water Resources
California Coastal Commission, North Coast Region
Coastal Conservancy
Energy Resources Conservation and Development Commission
State Lands Commission
Air Resources Board
State Water Resources Control Board
Department of Transportation
Office of Planning and Research
State Historic Preservation Office
Department of Health

2. Humboldt County Council of Governments

3. Local Government

Humboldt County
City of Arcata
City of Eureka
Zoning

4. Local Special Agencies and Districts

Humboldt Bay Harbor, Recreation, and Conservation District
North Humboldt Park and Recreation District
Humboldt Bay Wastewater Authority
Redwood Region Economic Development Commission
Humboldt County Local Agency Formation Commission
Humboldt County Air Pollution Control District
Other Special Purpose Districts (community service, water, sewer, fire, etc.)

For this study, the most important policies of these agencies are as follows:

- General preservation policies, referring to the preservation or conservation of wetlands or habitats in general.

- Specific area policies, referring specifically to the preservation or conservation of particular parts of the study area (what is meant here is a specific statement or policy such as the need to preserve Indian Island or South Bay). Other specific agency concerns, such as the Arcata Marsh project or erosion at Buhne Point, are also noted.

- Specific standards for or interest in the various types of activities occurring in the study area, in particular those requiring Corps permits.

Table V-5 summarizes the policies of the various agencies, which are discussed in detail in the complete Governmental Profile, Volume II, Section VII-C. Not all agencies listed above are included in Table V-5, because some of them have only very general interests in the study area and/or because some do not have very specific policy statements. (For example, the National Park Service does not have any lands in the study area; the Council on Environmental Quality only provides a broad umbrella of general environmental policy.)

It should be noted that all federal agencies are under the authority of Executive Order 11990 for preservation and protection of wetlands (see Section I of this volume).

Cultural and Economic Resources (Volume II, Section VIII)

The Humboldt Bay study area is rich in archaeological and historical resources. An estimated 117 archaeological sites of the Wiyot tribe are known in the study area and most of the shorelines are considered archaeologically sensitive. The area has three archaeological or historical sites listed on the National Register of Historic Places and another five historical sites as Registered

California Landmarks. Local agencies have identified numerous other historic structures. Plate 20 shows archaeological/historical resources.

The study area is used extensively for water-related, active, and passive recreation, including boating, sport fishing and hunting, sport shellfish gathering, surfing and skindiving, bicycling, jogging and horseback riding, and camping, hiking and picknicking. The North and South Spits and the Mad River beaches are used by off-road vehicles. Birdwatching is popular around the Arcata Bottoms, the Arcata oxidation ponds, and other parts in the study area. Plates 21 and 22 show existing and proposed recreation facilities and points of public access to beaches and shorelines. The local school districts, Humboldt State University, and the College of the Redwoods all use part of the study area for educational and scientific study. There are several refuges and reserves in the Humboldt Bay area, including the Lanphere-Christensen Dunes Reserve, the Humboldt Bay National Wildlife Refuge, the Woodley Island Wildlife Habitat area, and state clam and oyster reserves (Plate 23).

Aesthetically, the Humboldt Bay area includes six major landscape types: water areas; coastal dunes; lowlands; uplands; urban areas; and gulches. Several important viewpoints have been identified (Plate 24).

Economically, the Humboldt Bay area is relatively isolated and depends primarily on resource-based industries such as agriculture, fisheries, forest products, shipping and harbor development, and tourism/recreation. Historically, the lumber and forest products industry has been the principal sector of the economy. Fisheries is second in importance and shows promise as a growth industry. Development of oil and gas resources on the outer continental shelf will tend to increase shipping and harbor development.

Table V-5

AGENCY POLICIES

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
FEDERAL			
Fish and Wildlife Service (FWS)	Fish and wildlife habitat, biologically productive wetlands and shallows, estuarine habitats, habitats of endangered, rare, or threatened species.	Approved area for Humboldt Bay Wildlife Refuge. Areas suitable for compensation for habitat loss.	Water dependency, all Corps permit activities.
Bureau of Land Management (BLM)	Multiple use of BLM lands, including uses such as fish and wildlife management, wilderness preservation, timber protection, and recreation. Protect wildlife habitat.	Acreage along the ocean beaches near north end of North Spit. Submerged lands included in OCS Lease Sale #53.	Mining, timbering, livestock grazing, recreation on BLM lands.
Heritage, Conservation, and Recreation Service (HCRS)	Fish and wildlife habitat for recreational benefits. Historical and archaeological resources; National Register of Historic Places.	Gunther Island Site 67 (Tolowat), the First and F Street Building (Eureka), the Humboldt Cultural Center (Eureka).	Recreation, standards for preserving historical archaeological resources.
National Marine Fisheries Service (NMFS)	Marine, estuarine, anadromous habitats, unique habitat, high productivity, recreational value, unique geology or topography, physical hazard potential, areas protecting coastal resources (agriculture, marine, etc.), critical habitats for endangered species.		Commercial fishing.

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
Environmental Protection Agency (EPA)	Maintenance of chemical, physical, biological integrity of the entire marine, estuarine, and freshwater system (40 CFR 230.5(a)(1)). Specific policy for wetlands protection. Air quality classification of areas as non-attainment for particulates.		Water quality standards; EPA Section 404 guidelines; discharge of pollutants to aquaculture projects. Air quality regulations and standards for stationary and vehicular sources.
Coast Guard		Coast Guard Station on North Spit, Coast Guard cutter dock at Fields Landing.	Vessel movement, navigation, handling of oil transfers and explosives.
Federal Highway Administration (FHWA)	Protection of wetlands under Interim Guidance and Procedures for compliance with EO 11990.	About 17 acres adjacent to Elk River and Route 101 south of Eureka, for compensation for wetland loss due to bridge construction at Mad River Slough.	Highway and bridge construction.
Advisory Council on Historic Preservation	Historic sites and resources; National Register	(see HCRS above)	
U.S. Department of Agriculture (SCS, ASCS, Agriculture Extension Service)	Wetlands used by migratory waterfowl; wildlife, fish, and recreation resources; conservation of soils and water resources. General preservation, restoration, enhancement of wetlands.		

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
STATE			
The Resources Agency	Basic Wetlands Protection Policy for the state; shoreline erosion protection policy.		Beach nourishment by use of dredged material.
Department of Conservation	Prime agricultural lands; soil, oil, and geothermal resources; reclamation of mined lands; seismic and geologic safety.		Mining, development of oil and geothermal resources.
Department of Fish and Game (DFG)	Fish and wildlife resources and habitats; streambed protection; fully protected fish and wildlife species; wetlands, for preservation and restoration.	No sale, lease, or granting of tide or submerged lands in South Humboldt Bay; oyster and clam reserves.	Boating facilities in degraded wetlands; fish hatcheries; aquaculture.
Department of Boating and Waterways (DBW)	Beach and shoreline areas; small craft harbors.	Erosion at Buhne Point.	Marinas, both recreational and commercial fishing; shoreline protection and stabilization; navigation and boating.
Department of Parks and Recreation (DPR)	State Parks; cultural resources and landscapes; recreational areas; coastal salt and tidal marsh; riparian greenbelts; ocean and bay frontage; lagoons, bays, estuaries.	Fort Humboldt State Park; State Azalea Reserve.	Development of outdoor recreation facilities; public access to shorelines.

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
Department of Water Resources	Development and management of water resources, including groundwater. Coastal zone land use mapping.		
California Coastal Commission, North Coast Region	Marine resources, wetlands, biologically productive areas, water quality, riparian habitats, environmentally sensitive habitat areas, prime agricultural lands, public access to shorelines, recreation areas and facilities, sites for industrial and energy facilities, visual resources and special communities, low-cost housing and visitor-serving facilities in the coastal zone, areas suitable for wetland restoration, sensitive coastal resource areas.	North Broadway wetlands. Public access points around the Bay (Plate 22). Riparian habitat around Jacoby Creek, McDaniel Slough, and other streams. Erosion control on the North Spit and at King Salmon. All wetlands and submerged lands in the study area (Plate 10). Dune forests on the North Spit. Potential restoration areas (see Section V-D above). Sites for petroleum storage, oil transport and OCS development on the east shore of the Bay. Areas identified by the California Natural Areas Coordinating Council (see Vol. II, Section VII-C, California Energy Commission). Publicly owned parks (Pl.21).	Diking, filling, and dredging, limited to only certain uses; commercial fishing and recreational boating; shoreline protection structures; alteration of rivers and streams; new development in the coastal zone; industrial facilities including tanker and liquefied natural gas (LNG) facilities, oil and gas development, refineries or petrochemical facilities, and thermal electric generating plants; runoff control techniques; coastal and wetlands restoration projects.
State Coastal Conservancy	Protection of agricultural lands; resource protection and enhancement, including public beaches, parks, natural areas and fish and wildlife preserves; coastal	63 acres for creation of a freshwater marsh in the City of Arcata (Plate 22).	Design and implementation of coastal restoration projects and coastal resource enhancement plans. Standards for acquiring and developing public access.

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
	restoration; preservation of significant coastal resource areas.		
California Energy Commission (formerly the Energy Resources Conservation and Development Commission)	Energy resource conservation; preservation of wetlands; seismic and geological hazard areas; water supplies, air quality; agricultural lands; habitats of endangered species; marine resource areas; coastal dunes and forests.	Areas designated by the Coastal Commission as unsuitable for siting new power plants or related facilities (Plate 16). Areas identified by the California Natural Areas Coordinating Council, as follows: . Arcata Bay North Mudflats . Azalea Reserve . College of the Redwoods . Eureka Slough . Indian Island . Humboldt Bay National Wildlife Refuge (Plate 23) . Lanphere-Christensen Dunes . Mad River Slough . Manila Dunes	Power plant facility and site certification; alternative energy source research and development, such as solar, geothermal, or chip-burning; uses of wastewaters (thermal); solid waste disposal.
State Lands Commission (SLC)	Uses of granted and ungranted tide and submerged lands; preservation of wetlands; tidelands and submerged lands of significant environmental value as identified by the SLC; marine resources; biological productivity; archaeological and paleontological resources; visual quality; public access.	. Humboldt Bay, including North and South Bay . Mad River	Oil transfer and transport, for protecton against spills; dredging, diking, filling, and dredged material disposal; shoreline protection structures; commercial fishing and recreation facilities; sand (beach) replenishment; projects affecting coastal streams; location of new development; coastal de-

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
			pendent development; recreational boating; tanker terminals and operating procedures; siting and design of LNG, petroleum, petrochemical facilities and refineries.
Air Resources Board, Air Pollution Control Council	Maintenance of air quality and attainment of standards.	Violation of state standards for particulate matter, lead, and hydrogen sulfide in the North Coast Air Basin.	Regulation of mobile (vehicular) sources; backup authority over stationary (nonvehicular) sources. Preparation of State Implementation Plan.
State Water Resources Control Board (SWRCB) and Regional Water Quality Control Board, North Coast Region	Non-degradation of water quality; water quality control policy for enclosed bays and estuaries; water quality control plans for ocean waters and for temperature control in bays and estuaries; use and disposal of power plant cooling waters; preservation of wetlands.	Sewage treatment methods, including the regional system, Arcata's proposed wastewater reclamation project, and other projects which may be proposed in the area; sedimentation and circulation in the Bay; agricultural and urban runoff and septic tank problems; a few remaining industrial discharges to the Bay.	Certification of wastewater treatment plants, and registration of liquid waste haulers. Regulation of discharges from point and nonpoint sources and of diking, dredging, filling, or disposal by discharge requirements. Effluent and receiving water limitations. Management of spills. Water quality monitoring. Criteria for individual waste treatment and disposal facilities (septic tanks), solid wastes, point source agricultural wastewaters (feedlots and dairies), mining wastes, and logging and construction activities.

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
Department of Transportation (Caltrans)	State Highway System and State Transportation Plan. Consistency with requirements for air and water quality.	. Elk River Road interchange with marsh compensation. . Mad River Slough bridge and approaches. . 17 acres on the west side of Elk River adjacent to Highway 101, for restoration of wetlands as compensation for Caltrans projects.	Planning, design, and construction of state roads and bridges.
Office of Planning and Research	General environmental quality. Air quality, water, noise control, environmental resources. Areas of Statewide Interest and Statewide Critical Concern. Scenic, scientific, educational, and recreational resource areas. Resource production areas. Hazardous areas.	. Humboldt Bay and Mad River as premium waterways (scenic, fishery, wildlife, recreation). . Historical/archaeoloigical resources - Carson House, Gunther Island Site 67, Fort Humboldt, and Tsahpekw (Plate 20). . Areas adjacent to National and State waterfowl, including areas in North and South Bay (Plate 23). . Areas owned by Nature Conservancy - Lanphere-Christensen Dunes (Plate 23). . Habitats of rare and endangered species as identified by California Fish and Game (Plate 12).	Environmental review of any proposed plans or projects.
State Historic Preservation Office	Historical and archaeological resources	Sites and areas shown in Plate 20.	

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
Department of Health	Commercial shellfish resources.	Conditional shellfish harvest certificate for Humboldt Bay.	Certification of shellfish harvesting.
LOCAL			
Humboldt County Planning Department			
a) General Plan	Conserve agricultural lands in floodplains, protect natural resources, including unique or unusual land or water resources, areas of endangered species, marshland fowl and wildlife habitat, critical water areas. Protect archaeological/historical resources and health, establish buffer zones around water and wetland areas.	. Class I and II soils in Mad River floodplain - Arcata Bottoms. . Sand dunes, sloughs, wetlands (Plate 10).	Noise control, public and seismic safety, recreation, housing and other development.
b) Local Coastal Program	Public access to shorelines; development of parks; riparian habitat, sloughs, water quality, coastal dune forests, wetlands; agricultural lands; archaeological/historical resources; visual resources and open space views; sites for coastal-dependent industry and OCS development.	. Parks at ocean beaches and Elk River Spit . 115 additional acres for private recreation facilities. . Jacoby Creek and Ryan Creek as Category A streams requiring minimum stream flows. . Groundwater withdrawal controls on North Spit. . Agricultural lands (SCS Class I and II, Storey Index 80+)	. Access through new development. . Enforcement of off-road vehicle regulations. . Low-cost housing. . Standards for diking, dredging, filling, shoreline structures. . Regulation of expanded fishing. . Timber preserve regulations . Location of new development - infilling. . Billboard control.

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
			. Sewer hookup restriction policies to be formulated. . Location of OCS, oil storage, industrial facilities. . Establish urban reserves on fringes of developed areas. . Commercial beach use. . Low-cost housing encouragement. . Limitation of uses in agricultural areas. . Removal of riparian vegetation - perennial and ephemeral streams.
Humboldt County Department of Public Works	General environmental quality.	Solid waste management - County landfills.	Environmental review of proposed projects.
City of Arcata Planning Department a) General Plan	Greenbelts of agricultural use; flood prone areas; hillside and forested areas and slopes over 25%; rivers, streams, marshes; unique vegetation and wildlife areas such as sand dunes, beachdune woodland, eelgrass areas, salt marshes, and areas used for tern and osprey nesting, cormorant rookery, harbor seals, and egret roosting.	. Bottom lands for agriculture. . Land area bordering the tidal flats as natural habitat. . Arcata Bay, Mad River, Mad River Slough, ocean beach, sand dunes, beachdune woodlands, steep slopes in coastal forest as natural resource lands. . Buffer strips along Mad	Noise control, energy and food production, residential development, public services.

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
		River, Janes Creek, Jacoby Creek, Jolly Giant Creek, Beef Creek, Campbell Creek, and McDaniel Slough, and the marsh reclamation area as recreation lands.	
b) Local Coastal Program	Public access; fish and wildlife habitat, riparian habitat; protection of aquaculture; agricultural lands; viewsheds; 100 year floodplain; location of urban/rural boundary.	. Arcata Bay and mudflats. . Bay marshes and associated pastures. . Humboldt Bay National Wildlife Refuge (Plate 23). . Arcata Bottoms and East Bay tidal plain as agricultural lands. . Stream channels (Jacoby, Jolly Giant, and Janes Creek). . Sensitive habitats - tidal flats and marshes, including about 100 acres along Bay's north shore. . Arcata Boat Basin, the oxidation pond and landfill, as recreation facilities. Also, the 63 acre Arcata Marsh Enhancement Project and the Bayview Levee Trail around Arcata Bay.	. Development in flood zones and areas of seismic (liquefaction) hazard. . Diking and shoreline structures.
Arcata Department of Public Works	Wastewater reclamation and marsh enhancement.	A wastewater reclamation project providing tertiary treatment and combined with	Alternative wastewater management techniques.

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
		ocean ranching, a freshwater marsh, and a recreation lake.	
City of Eureka Department of Community Development a) General Plan	Agricultural areas, forest areas, steep slopes; critical habitats, including eelgrass beds, mudflats, coastal salt marsh and freshwater marsh; fish and wildlife habitat; natural drainage areas; marine resources; public access; sensitive coastal habitat areas; visual qualities; prime industrial land for industrial use only.	. Greenways along Martin Slough and the gulches. . Agriculture/forest/open space in Eureka Slough area, along Elk River and Spit, and on Indian, Woodley and Daby Islands. . Critical habitats in Humboldt Bay and Eureka Slough.	. Location of coastal-dependent and waterfront industry and other development. . Discouragement of filling in Humboldt Bay. . Provision of public utilities.
b) Local Coastal Program	Environmentally sensitive and critical habitat areas; agriculture; sites for new, industriay and energy development.	Location of industrial and energy development generally in the area between Broadway and the western Eureka waterfront.	
Humboldt Bay Harbor, Recreation, and Conservation District	Resources such as wildlife habitat, open space, fish and wildlife, and aesthetics. Resource conservation and development of primary importance. Conservation Waters, Agriculture, and Public Open Space designations	. Conservation Waters: North and South Bay, waters around Indian Island shoreward of Samoa and Arcata channels, and area east of maintained channels from King Salmon north to and including Elk River.	Policies and standards for: . General property acquisition and use . Navigation . Industrial development . Public access . Tourism/recreation . Aquaculture

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
	are resource preservation categories (Ordinance No. 7).	. Public Open Space, Agriculture, and jointly designated lands: Generally include uplands adjacent to North Bay (except along north side of Eureka Slouth around Murray Field and parts of North Spit), Indian Island, part of Woodley Island, part of the North Spit, and portions of Elk River Spit, Buhne Point, and the Spruce Point area. . Woodley Island Marina, under construction. . An old logging pond west of Freshwater Slough north of Park Street for compensation use.	. Research/education . Dredging . Diking . Filling . Maintenance of environmental quality
Humboldt Bay Wastewater Authority	Wastewater treatment and discharge in compliance with the State's Bays and Estuaries Policy.	A regional wastewater system or alternative methods for the various member jurisdictions.	. Possible development of a contingency plan for ocean discharges of wastewaters.
Redwood Region Economic Development Commission	Economic development in Humboldt County.	Specific project funds or grants: . Humboldt County Airport improvements . Boat Repair and Construction Facility . Hardwood Industry Technical Assistance Grant	

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
		. Small business development loans	
Humboldt County Local Agency Formation Commission	Agency formation, annexation, and boundary decisions based on: . natural boundaries . public services . population/growth trends . effects on agricultural preserves and open space . conformity with agency plans; spheres of influence	1978 annexations of 347 acres to Arcata and about 118 acres to other special districts.	Annexation, incorporation, disincorporation, formation, reorganization, for local agencies.
Humboldt County Air Pollution Control District	Maintenance of air quality and attainment of standards.	Emissions from Kraft pulp mills at Fairhaven and Samoa (largely under control at present).	Regulation of stationary source emissions: . emission limitations . construction and operating permits . enforcement actions
School Districts, College of the Redwoods, Humboldt State University, Audubon Society	Areas for educational and scientific study.	. Arcata boat ramp and oxidation ponds. . North Spit and Jetty. . South Spit and Jetty. . Mad River Slough wetlands. . Lanphere-Christensen Dunes . Table Bluff . Eureka, Fay, and Freshwater Sloughs and Marhses. . Highway 101 marshes between Eureka and Arcata.	

Table VI-5 (continued)

AGENCY	GENERAL PRESERVATION	SPECIFIC AREA PRESERVATION OR CONCERN	ACTIVITY STANDARDS
		. Elk River and Spit. . North and South Bay waters and mudflats.	
Other Special Purpose Districts	Water and sewer services, street lighting, drainage and flood control services, fire districts.		

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