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Staff Report:	May 27, 2004
Hearing Date:	June 9, 2004
Commission Action:	

STAFF REPORT: REGULAR CALENDAR

APPLICATION NO.:	**1-03-024**
APPLICANT:	**Table Bluff Reservation – Wiyot Tribe**
AGENT:	Humboldt Water Resources – Engineering & Science Attn: Mike Wilson PE
PROJECT LOCATION:	Along the northeastern shoreline of Indian Island in Humboldt Bay, City of Eureka, Humboldt County. APNs 405-011-02 & -03.
PROJECT DESCRIPTION:	Place 391 cubic yards of revetment materials along a 400-foot-long segment of the bay shoreline of Indian Island to stabilize and protect the Tuluwat Village Shell Mound Place from further shoreline erosion and help preserve the remaining Tribal artifacts and cultural resources at the site.
LOCAL APPROVALS RECEIVED:	None required.
OTHER APPROVALS RECEIVED:	(1) U.S. Army Corps of Engineers Permit FCWA Section 404 Nationwide Permit No. 13 – Bank Stabilization.

SUBSTANTIVE FILE DOCUMENTS: *Considerations for the In Situ Conservation and Treatment of Tolowat (CA-HUM-67) Indian Island, Humboldt County, California*, (Thorne & Ehrenhard, 2000), *Geotechnical Review* (William A. Smith, 2002), *Wetland Delineation Indian Island, Humboldt County California* (Mad River Biologists, 2002), *Vegetation Survey, Indian Island, Humboldt County, California* (Annie L. Eicher, 2003), and *Indian Island Restoration, Littoral Drift and Sand Supply* (Randy Klein, 2003).

SUMMARY OF STAFF RECOMMENDATION

Staff recommends that the Commission approve with conditions this application for the placement of revetment materials on a portion of the bay shoreline of Indian Island within Humboldt Bay to protect cultural resources at the former Wiyot village site of Tuluwat.

The project would entail the erection of an engineered shoreline protective structure composed of approximately 391 cubic yards of sheetpile bulkhead, quarry stone, soil, jute matting, oyster shells, and large woody debris fill materials along an approximately 400-foot-long portion of the island's northeast shoreline. In addition, dune willow, wax-myrtle, and salt grass would be planted within the upper rock slope protection materials to further bind the revetment materials together so as to protect the island from the erosive forces of the bay.

The project is located on a portion of Indian Island that was the site of the former Wiyot village of Tuluwat. Representing over 1,000 years of continuous human occupation, the village was built on a portion of a roughly 4.5-acre shell midden formed from the shallow lands of the island by the accumulation of discarded marine shell debris. Over time, storm surge and boat wake waves on the bay in combination with other activities on the island (i.e., construction of drainage ditching, tide gates, and diking, cattle grazing, demolition) have caused the eastern edge of the village site to erode back approximately 100 feet over the last century, allowing approximately 2,000 cubic yards of the shell mound materials to be swept away into the bay waters. As a result of this erosion, interred cultural artifacts and gravesites have become exposed at the bay margin.

The proposed project would stabilize and provide protection from further coastal erosion losses to the significant cultural resources on the island consistent with the provisions of Section 30235 of the Coastal Act which provides that revetments shall be permitted to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion, when designed to eliminate or mitigate adverse impacts on local shoreline sand supply.

The wetland fill associated with the project is not for one of the allowable uses enumerated in Coastal Act Section 30233(a)(1) through (8) Therefore, the proposed development is inconsistent with Section 30233(a) of the Coastal Act. Nonetheless, the shoreline altering device must be permitted pursuant to Coastal Act Section 30235. The applicant has documented that the shell midden is being damaged by erosion. As conditioned, there are no other less damaging alternatives available to reduce the risk from continued erosion or minimize impacts on shoreline sand supply. Therefore, notwithstanding the inconsistency of the project with Section 30233(a), the proposed protection of the shell midden must be permitted pursuant to Section 30235 of the Coastal Act.

With the recommended special conditions, the proposed project would have no significant adverse environmental impacts. Although approximately 7,100-square-feet of supra-tidal, unconsolidated bed estuarine wetlands would be covered by the bank slope protection materials, this area represents a high-energy environment that affords only nominal habitat to aquatic and terrestrial species. Impacts to environmentally sensitive areas in proximity to the site, namely offshore eelgrass beds, would be avoided by scheduling the transportation of construction materials, equipment, and personnel to traverse the channel during high tide times when these fish habitat areas are inundated. In addition, to the greatest extent possible hand-labor will be used to place the various revetment materials during the lower stages of the tide so that operation of heavy mechanized equipment near the water's edge would be minimized. The project also incorporates a suite of water quality best management practices to ensure that coastal waters are not degraded during construction. In addition, after the revetment is completed, the applicant proposes to revegetate the upper elevations of the shoreline protective device with salt-tolerant dune willow and wax-myrtle cuttings and salt grass plugs. Finally, the project as designed will not result in any significant adverse impact on public access as the revetment will not displace or affect any sandy beach because the island with its location in the middle of Humboldt Bay is surrounded by mudflat rather than beach.

Staff is recommending four special conditions. Special Condition No. 1 would require that prior to the start of construction activities, a demolition disposal management plan be prepared and submitted for the approval of the Executive Director detailing the location where the debris not otherwise incorporated into the revetment, if any, would be disposed following its removal from the site.

Special Condition No. 2 would identify water quality best management practices to be employed during demolition and construction, including the installation of containment barriers to prevent entry of debris into bay waters and immediate extrication of any materials that should enter the bay. Special Condition No. 2 would also set standards for the staging, operation, fueling, hydraulic fluid type, and hazardous material spill

prevention and clean-up contingencies to prevent similar entry of hydrocarbon products into coastal waters.

Special Condition No. 3 would direct that the development be implemented in strict compliance with the proposal set forth in the permit application as modified by the special conditions. Any deviations in the shoreline revetment materials or to the configuration of the facility, including proposed development that further encroaches into the bay, shall require an approved permit amendment, unless the Executive Director determines that a permit amendment is not legally required.

Special Condition No. 4 would require the applicant to submit evidence that any necessary authorization from the State Lands Commission has been obtained prior to issuance of the permit to assure that the applicant has a sufficient legal property interest in the site to carryout the project and to comply with the terms and conditions of this permit.

Staff recommends that the Commission find the project, as conditioned, consistent with the Chapter 3 policies of the Coastal Act.

The motion to adopt the Staff Recommendation of Approval with Conditions is found on page 5.

STAFF NOTES

1. Jurisdiction and Standard of Review.

The proposed project site has not been put into federal trust or granted sovereign land status and is subject to the Coastal Act's coastal development permit requirements. In addition, the proposed project site is located in the Commission's retained permit jurisdiction. The City of Eureka has a certified LCP, but the site is within an area shown on State Lands Commission maps over which the State retains a public trust interest. Therefore, the standard of review that the Commission must apply to the project is the Chapter 3 policies of the Coastal Act.

2. Commission Action Necessary

The Commission must act on the application at the June 9, 2004 meeting to meet the requirements of the Permit Streamlining Act.

I. MOTION, STAFF RECOMMENDATION, AND RESOLUTION

The staff recommends that the Commission adopt the following resolution:

Motion:

I move that the Commission approve Coastal Development Permit No. 1-03-024 pursuant to the staff recommendation.

Staff Recommendation of Approval:

Staff recommends a **YES** vote. Passage of this motion will result in approval of the permit as conditioned and adoption of the following resolution and findings. The motion passes only by affirmative vote of a majority of the Commissioners present.

Resolution to Approve Permit:

The Commission hereby approves a coastal development permit for the proposed development and adopts the findings set forth below on grounds that the development as conditioned will be in conformity with the policies of Chapter 3 of the Coastal Act. Approval of the permit complies with the California Environmental Quality Act because either: (1) feasible mitigation measures and/or alternatives have been incorporated to substantially lessen any significant adverse effects of the development on the environment; or (2) there are no further feasible mitigation measures or alternatives that would substantially lessen any significant adverse impacts of the development on the environment.

II. STANDARD CONDITIONS: See attached.

III. SPECIAL CONDITIONS:

1. Debris Disposal Plan

A. **PRIOR TO ISSUANCE OF THE COASTAL DEVELOPMENT PERMIT,** the applicant shall submit for the review and approval of the Executive Director a plan for the disposal of construction-related debris and excavated materials.

(1) The debris disposal plan shall demonstrate that:

(a) All stockpiling and disposal sites are in upland areas where construction-related debris from the project may be lawfully disposed;

(b) Any and all debris resulting from construction activities shall be removed within 10 days following completion of construction;

(c) The plan shall be consistent with the requirements of Special Condition No. 2

(2) The plan shall include, at a minimum, the following components:

(a) A description of the manner by which the material will be removed from the construction site and identification of all debris disposal sites that will be utilized;

(b) A schedule for removal of all debris.

B. The permittee shall undertake development in accordance with the approved plan. Any proposed changes to the approved plan shall be reported to the Executive Director. No changes to the approved plan shall occur without a Commission amendment to this coastal development permit unless the Executive Director determines that no amendment is legally required.

2. <u>Construction Responsibilities</u>

The permittee shall comply with the following construction-related requirements:

(a) All construction materials and debris originating from the project shall be stored and/or contained in a manner to preclude their uncontrolled entry and dispersion to the waters of Humboldt Bay. Any debris resulting from construction activities that should inadvertently enter the bay shall be removed from the bay waters immediately;

(b) Any and all debris resulting from construction activities shall be removed from the project site within 10 days of project completion and in accordance with the construction debris removal and disposal plan required by Special Condition No. 1;

(c) Silt screens, straw bales, coir-rolls, coffer damming, and/or water bladder walls appropriate for use in estuary and intertidal setting applications shall be installed at the toe of the slope and around the perimeter of the area to be graded prior to the initiation of the grading activities and shall be maintained throughout project construction. Additional siltation barrier materials shall be kept at the site and deployed as needed to reinforce sediment containment structures should unseasonable rainfall occur;

(d) Any fueling of construction equipment shall occur on the paved areas within the adjoining former boat yard structures on the site at a minimum of 100 feet from the Mean High High Water line of the bay;

(e) Fuels, lubricants, and solvents shall not be allowed to enter the waters of Humboldt Bay. Hazardous materials management equipment including oil containment booms and absorbent pads shall be available immediately on-hand at the project site, and a registered first-response, professional hazardous materials clean-up/remediation service shall be locally available on call. Any accidental spill shall be rapidly contained and cleaned up. All heavy equipment operating in or near the water's edge shall utilize vegetable oil as hydraulic fluid;

(f) A minimum 20-foot-wide buffer around the eelgrass beds offshore of the project site shall be maintained; and

(g) Watercraft crossings between the project site and Eureka site shall occur only during the daily high tide when other eelgrass beds would be inundated and shielded from the potentially adverse impacts associated with transiting motorized watercraft.

(h) Revetment materials shall only be installed during lower stages of the tide.

3. Permit Amendment

All development authorized by Coastal Development Permit No. 1-03-024 must occur in strict compliance with the proposal as set forth in the application for the permit as modified by the special conditions. Any deviation from the plan proposal, including a change in the materials shoreline protection materials, to install the revetment in a manner that requires further encroachment into the waters of Humboldt Bay, or to make any other changes to the proposed project shall require an amendment to this permit, unless the Executive Director determines that no amendment is legally required.

4. State Lands Commission Review

PRIOR TO ISSUANCE OF THE COASTAL DEVELOPMENT PERMIT, the applicant shall submit to the Executive Director a written determination from the State Lands Commission that:

A. No State or public trust lands are involved in the development; or

B. State or public trust lands are involved in the development and all permits required by the State Lands Commission have been obtained; or

C. State or public trust lands may be involved in the development, but pending a final determination an agreement has been made with the State Lands Commission for the project to proceed without prejudice to that determination.

IV. FINDINGS AND DECLARATIONS.

A. Project Background.

Indian Island lies within the ancestral lands of the Wiyot people and represents a focal point for the tribe's cultural rehabilitative efforts. Indian Island is considered to be the center of the Wiyot world and as such, a sacred place. Each year, the Tuluwat Village on the northern end of the island hosted a World Renewal Ceremony to ask the creator's blessings for all people and the land for the coming year with tribal members gathering from the other Wiyot villages that lined Humboldt Bay. The revival dance gathering would typically last eight to ten days in duration.

On the morning of February 26, 1860, in a series of raids conducted simultaneously on three villages in the Eel River - Humboldt Bay area, a group approximately 80 to 100 sleeping Wiyot men, women and children, exhausted from a week of ceremonial dance on the island, were caught unaware and brutally slain by a group of white settlers armed with hatchets, clubs and knives who had paddled across the bay from Eureka. Altogether, the death toll from the massacre at the three villages is estimated at 200.

Following the massacres, U.S. troops collected the surviving Wiyot people from the villages between the Mad and Eel Rivers, initially placing them in protective custody at Fort Humboldt near the community of Bucksport, now southwestern Eureka. The survivors were later removed to the Klamath River Reservation. After a disastrous flood on the Klamath River, the reservation internees were taken in turn to the Smith River Reservation at Fort Dick in present-day Del Norte County, and later confined at the more inland Hoopa and Round Valley Reservations.

In the wake of the Wiyot diaspora from the Humboldt Bay area, Indian Island was acquired and occupied by white settlers. Around 1870 a shipyard repair facility was built on the property now owned by the Tribe. Upon obtaining the island in 1860, Robert Gunther and other settlers constructed a series of dikes and drainage channels in the hope of reclaiming the island for cattle ranching and upland agriculture. These modifications changed the tidal action along the shore, accelerating erosion at the bay edge of the shell mound. The shipyard operated sporadically until the early 1990s when it was abandoned leaving the site contaminated by creosote, solvents and other chemicals used in ship repair and maintenance. Dilapidated buildings and tons of scattered metal and wood

debris still litter the area. Remnants of the dikes and drains that crisscross the island continue to allow bay waters to inundate portions of the island that would normally lie above the tidal range, degrading the brackish habitat therein. Falling into disuse and subsequently deserted, much of the island reverted to Federal or City ownership. Currently there are only eight privately-owned parcels on the southeast side of the island over one-half mile from the project across State Route 255.

Between 1913 and 1985, an estimated 2,000 cubic yards of the shell mound were lost to erosion at the bay edge with the midden edge undergoing approximately 100 feet of retreat. The erosion continues to this day and may be accelerating due in part to the boat wake-generated waves associated with increased motorized vessel traffic on Humboldt Bay. In addition, the shell mound was the site of uncontrolled scavenging and pilfering related excavation in the early part of the 20th century. One amateur archaeologist was said to have looted as many as 500 gravesites. For the most part, structures of the Tuluwat village that were still visible in 1913 are now gone, having been destroyed or carried away by wind and waves.

Although decimated in numbers, exiled to distant lands, and incarcerated against their will, the displaced original inhabitants of the Wiyot villages along Humboldt Bay and their descendants never lost hope of a return to their homeland and rebuilding their broken culture. In 1908, a local church group donated 20 acres of land in the Table Bluff area approximately 17 miles south of Eureka for tribal members to return to live. In 1981, the Wiyot Tribe became a federally-recognized tribe with the rancheria holdings granted sovereign land status and expanded by acquisition of adjoining lands to the 88 acres that comprise the current Table Bluff Reservation.

In 1964, the Tuluwat village site was designated a National Historic Landmark by the U.S. Department of the Interior and identified as "Gunther Island Site 67." In the early 1990's, Wiyot tribal members began a renewed effort to resurrect their lost heritage and repatriate Indian Island. In 1992, a public candlelight vigil was held on the anniversary of the 1860 massacre, later becoming an annual community event. This remembrance served as a catalyst for fund-raising efforts by the Tribe to reacquire the island. In March 2000, the Tribe initially purchased the 1½-acre parcel where the shipyard had been constructed. On May 20, 2004, the City of Eureka ceded title to an additional 40 contiguous acres to the Wiyot Tribe. Efforts to acquire additional portions of the island, restore the Tuluwat village, reinstate the World Revival Ceremony, and conduct linguistic, native craft, and natural history guided interpretation events at the site are ongoing.

The proposed project site has not been put into federal trust or granted sovereign status. Although the Tribe has acquired a fee or easement interest in parts of the island, the proposed project will be undertaken on non-federal trust lands owned by the Tribe in fee over which the state retains a public trust easement.

B. Site and Project Description.

Comprised primarily of supra-tidal salt marsh with elevations ranging from 0 to +14' NGVD29, the 270-acre Indian Island is the largest of a cluster of islands situated at the northern end of the roughly 1½-mile-wide strait between the northern and southern lobes of Humboldt Bay in Humboldt County (see Exhibit Nos. 1-3). The island lies approximately one-half mile north of downtown Eureka across State Route 255, and four miles from the bay's entrance to the Pacific Ocean. Although traversed by a state highway, there is no vehicular access onto the island or to the project site.

The project site lies along a roughly 600-foot-long segment on the northeastern side of the island bracketing a cluster of abandoned boat repair yard structures and docking. Representing over 1,000 years of continuous human occupation dating back to 900 AD, the village site covers approximately 4.5 acres and is comprised primarily of discarded organic matter, containing a variety of bivalve shells and other food wastes, interspersed with interred cultural artifacts and human remains.

Vegetation cover is composed of a mixture of native coastal scrub plants and exotic species brought in by settlers to the island, including coyote brush (Baccharis pilularis), cow parsnip (Heracleum lanatum), pearly everlasting (Anaphilis margaritacea) Queen Ann's lace (Daucus carota), yarrow (Achillea millefolium), evergreen huckleberry (Vaccinium ovatum), and Himalaya blackberry (Rubus discolor), with scattered tree cover composed on black acacia (Acacia melanoxylon), red alder (Alnus rubra), arroyo willow (Salix lasiolepis), wax-myrtle (Myrica californica), and Sitka spruce (Picea sitchensis). Damper areas adjacent to the bay are vegetated with a variety of emergent saltmarsh vegetation, including pickleweed (Salicornia virginica), saltgrass (Distichlis spicata), scirpus (Scirpus cernuus), Chilean cordgrass (Spartina densiflora) and common rush (Juncus effusus).

The project site consists of non-federal trust land fee-simple title Tribal holdings situated within the boundaries of the City of Eureka over which the State retains a public trust easement. The project site lies within Natural Resource (NR) and Water Conservation (WC) zoning districts under the City's Coastal Zoning Regulations. The project area represents a significant Native American cultural heritage site and is listed in the National Register of Historic Places and as a threatened National Historic Landmark.

Before its destruction, the site consisted of a large shell mound, encompassing approximately 6 acres and attaining depths of up to 14 feet above Mean High Water. The village consisted of eleven house pits accommodating approximately 50 full-time residents, numerous burial plots and funereal remains, and other cremated and inhumed cultural artifacts. As one of the largest Wiyot villages, Tuluwat typified the late prehistoric period and was instrumental in outlining the prehistory of the northern California coast, especially with regard to the stylization of the stone-carved burial accompaniments, its concentration of large woodworking tool relics, and the unique

presence of fired clay figurines, collectively referred to as the "Gunther Phase" or "Pattern. " The site is also nationally significant for the large amount of archeological research material remaining.

To stabilize the eroded banks of the island and to prevent further coastal erosion, the applicant proposes to install a 20-25-foot-wide band of revetment materials along a 400-foot segment of the island's northeastern shoreline. The shoreline protection works would be composed of a series of 12-foot-long fiberglass-polyester sheet pile bulkhead panels set to a depth of 10 feet with two feet of freeboard extending above grade. The sheet pile would be buttressed on the exposed bayward face with 52 cubic yards of minimum six-inch-diameter cobble and 23 cubic yards of large woody debris anchored in front of the pilings to provide additional wave protection and to screen the panels from view. Behind the sheet pile, approximately 316 cubic yards of soil rock, and shell fill would be placed over jute mat or other geo-textile fabric in one-foot lifts with slopes not to exceed 2V:1H. Once put in place, the backfill would be planted with a variety of native plants, including dune willow (Salix hookeriana), wax myrtle (Myrica californica), and saltgrass (Distichlis spicata) to help bind the revetment materials together.

Table One below, summarizes the construction fill quantities:

Table One: Construction Wetland/Upland Fill Quantities

Fill Material	Areal Coverage (ft^2)	Volume (yd^3)
Soil, Rock & Shell Backfill	4,791	277
Sheet Pile	392	0
Cobble Armor	1307	52
Large Woody Debris Facia	610	23
Total Wetland Fill:	**7,100**	**352**
Upland Fill (Backfill)	1,742	39
Total Fill Quantities:	**8,842**	**391**

The project would result in a total of an additional 7,100 square feet of fill being placed over areas of unconsolidated supra-tidal estuarine shoreline wetlands at and above the Mean High Water Line. It should be noted that although the fill would cover this additional amount of shoreline area, the revetment would be situated wholly above the Mean High Water line. Accordingly, none of the fill would extend into the water column during the average tidal cycles on the bay. Nonetheless, the revetment is designed to allow water to flow through the sheetpile materials and the underlying geo-textile fabric to allow equalization of pore pressure exchange between the sediments behind the revetment and the adjoining tidal inundated sediments.

The area in which the new fill would be placed is currently composed of a mixture of bivalve shell fragments, cobbles, and sand inter-layered with bay mud and silt fines of varying depth, and flotsam debris extending approximately 10 to 20 feet inland from the

bay edge. This type of substrate is not utilized for spawning or forage area by fish, which instead prefer the eelgrass beds offshore in the bay from the project site. Similarly, because of the size of the sediments and the high-energy environment to which these materials are exposed, the sediments do not provide habitat for intertidal species such as Pacific mussels (Mytilus trossulus) and barnacles (Balanus sp.), razor clams (Siliqua patula), or geoduck clams (Panope generosa), fat innkeeper worms (Urechis caupo), or other benthic macro-invertebrates who prefer either consolidated rocky substrate, well-sorted sandy beaches or uniform mud flat materials.

C. Permitted Revetment

Section 30235 of the Coastal Act states, in part:

> *Revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls, and other such construction that alters natural shoreline processes shall be permitted when required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion, and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply.*

Coastal Act Section 30235 requires that seawalls, revetments, cliff retaining walls, groins and other such structures be approved under certain circumstances. However, Section 30235 also acknowledges that seawalls, revetments, cliff retaining walls, groins and other such structural or "hard" solutions alter natural shoreline processes. Thus, such devices are required to be approved only when the devices are: (1) necessary to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion; and (2) designed to eliminate or mitigate adverse impacts on shoreline sand supply. The Coastal Act does not require the Commission to approve shoreline altering devices to protect vacant land or in connection with the construction of new development.

1. Needed to Protect Existing Structures

The applicant seeks authorization for a shoreline revetment. As described in more detail above in the Project Description Finding Section IV.B above, the constructed revetment is composed of approximately 391 cubic yards of soil, rock and shell backfill behind a rigid fiberglass-polyester sheet pile faced with cobble and large woody debris and extending approximately 400 feet along the base of the island's northeastern shoreline with Humboldt Bay.

As discussed above, beach erosion from winter storm surge and passing boat wake waves has been undercutting the toe of the slope of the shell mound on which a prehistoric Wiyot village was constructed. A comparison of bay edge surveys conducted in 1913 and 1985 indicate that the bluff face was retreating at a rate of approximately one foot per year, and over the last century prior to installation of the emergency revetment materials

in 2001, the bay edge has retreated approximately 100 feet, resulting in the loss of approximately 2,000 cubic yards of shell mound materials and the cultural resources they contain. Tribal environmental resource specialists concede that the village site will continue to erode during the winter storm seasons. The proposed revetment is clearly needed to prevent the bluff from eroding and further damaging the cultural resources at the site.

Section 30106 of the Coastal Act, the section of the Coastal Act that defines develoment that requires a coastal development permit also defines the term "structure." Section 30106, in part, states:

> As used in this section, "structure" includes, but is not limited to, any building, road, pipe, flume, conduit, siphon, aqueduct, telephone line, and electrical power transmission and distribution line.

In this instance, the Commission notes that while the shell mound and the village site remnants do not immediately approximate the same sort of constructed edifice or building typically encountered in requests for the construction of protective shoreline works, the shell mound nonetheless functions as a foundation for the village site whose materials were purposefully accumulated and assembled by past native peoples for the purpose of establishing an inhabited settlement. Therefore, the revetment for which the applicant is seeking authorization protects existing structures (the prehistoric village's shell midden foundation), consistent with the purposes specified in Section 30235 for which revetments must be approved.

2. Alternatives

The applicant analyzed a range of alternatives to protect the village site other than by the proposed revetment. These alternatives included (1) installation of "geo-grid mattresses" by the U.S. Army Corps of Engineers; and (2) the no project alternative.

Upon purchasing the Tuluwat village site in 2002, the Tribe consulted with the U.S. Army Corps of Engineers as to appropriate methods to stabilize and prevent further erosion to the island shell mound. The Corps developed a preliminary design that involved the use of backfilled geo-grid mattress structures to be set at a slope of 1V:3H encompassing a 20 to 40-foot-wide area between the bay waters and the eroding face of the shell mound and extending to a height of +14′ NGVD. This geo-grid design would be much more massive and require much greater amount of wetland fill than the proposed project.

Given the relatively low intensity of the wave attack (1 to 2-foot height) and velocity of the lateral scouring force of the tidal flows affecting the island edge (0.6 feet/second), the alternative of installing 1′ x 5′ x 20′ polyethylene geo-grid mattresses filled with cobble and back-filled with soil and rock as the U.S. Army Corps of Engineers proposed would

be more appropriate for a higher energy environment, such as in an embayment with a significantly larger tidal bore.

In addition, with no provision to otherwise screen or hide the revetment, the bayward side of the structure would be visible from a variety of distant public vantage points and have significant adverse impacts on the visual resources of the Middle Bay area. Thus, constructing a geo-grid mattress modular retaining wall to stabilize the island edge would itself have significant environmental impacts that would be greater than the proposed project.

The "no project" alternative would not provide any protection of the village site from continued bluff erosion. As noted previously, the Tribe's Environmental Department anticipates that without any protection, the shell mound will continue to be directly damaged during each winter storm season. Based upon estimates derived from past erosion rates, the entire shell mound location would be completely destroyed within the next century if shoreline protection were not installed. Since the Tuluwat village site is of substantial importance as an archeological, historical, cultural, and educational resource, the loss of the shell mound and the artifacts and burial remains it contains would be a significant loss to both the Wiyot Tribe and the people of California.

Therefore, none of the identified alternatives are feasible less environmentally damaging alternatives that would still protect the village site threatened by erosion. Therefore, the proposed revetment is required to protect existing structures in danger of erosion.

3. Impacts on Shoreline Sand Supply

Although construction of the seawall, retaining wall, revetment or similar structure on a permanent basis is required to protect the existing cultural resources site, Section 30235 of the Coastal Act requires that shoreline protection be approved only if it is designed to eliminate or mitigate adverse impacts on local shoreline sand supply. There are a number of potential adverse impacts to public resources associated with the construction of shoreline protection. The natural shoreline processes referenced in Section 30235, such as the formation and retention of sandy beaches, can be significantly altered by construction of a seawall, since bluff retreat is one of several ways that beach area and material is added to the shoreline. This retreat is a natural process resulting from many different factors such as erosion by wave action, saturation of the bluff soil from ground water causing the bluff to slough off, and natural bluff deterioration. When a seawall is constructed at the toe of the bluff, it directly impedes these natural processes.

In a longshore current / sand supply analysis prepared for the project (Randy Klein PhD, 2003), it was noted that the site is located within an enclosed bay and removed from the longshore drift along this portion of the open ocean coastline (see Exhibit No. 9). According to Dr. Klein's analysis, beach sand in Humboldt Bay area is generally angular, suggesting stream transport by creeks feeding into the bay to the northeast (e.g., Janes,

Jolly Giant, Jacoby, and Freshwater Creeks). Although the rock slope protection would reduce the contribution of sediments from the shell mound scarp to the total amount of sediment contained in the ebb and flow tides in the bay, Dr. Klein believes that the midden erosion control facilities will not appreciably affect littoral transport processes or sand supply for the following reasons:

- As designed, the retaining wall would not protrude outward much farther than the present position of the midden scarp. In fact, the wall would be placed considerably farther inland than the position of the shoreline prior to erosional retreat. Consequently, littoral materials will easily bypass the site to down drift areas. This would be true regardless of transport direction; and

- The erosion control work would not affect sand supply to the beach and littoral zone because the midden material is composed of shell and other culturally-derived materials. There is no sand incorporated in the midden. Sand supplied to the beach comes from other source areas, predominantly from areas to the northern up drift side of the project site.

Thus, as discussed above, the retaining wall will not significantly affect sand movement past the site in either direction. The project would have no significant adverse effect on sediment delivery from or within Humboldt Bay. Therefore, the revetment does not significantly affect shoreline sand supply.

4. Conclusion

In conclusion, the Tuluwat village shell mound cultural resources on Indian Island are in danger from further damage and loss by coastal erosion. In addition, an analysis of alternatives indicates that there is not a feasible less environmentally damaging alternative for protecting these resources. Further, the installation of the revetment would not result in a significant adverse effect on shoreline sand supply. Therefore, the shoreline-altering device must be permitted to protect the existing structure pursuant to Coastal Act Section 30235.

Moreover, as discussed in the Findings Section IV.D below, the Commission finds that the project, even with the attachment of special conditions, would not be fully consistent with Section 30233 of the Coastal Act regarding allowable uses for fill in open coastal waters and wetlands. Notwithstanding this inconsistency with Section 30233, the shoreline altering device must be permitted to protect an existing structure pursuant to Section 30235.

D. Protection of Marine Resources and Coastal Water Quality.

Section 30108.2 defines "fill" as the placement of earth or any other substance or material in a submerged area.

The project involves the placement of 7,100 square feet of fill in estuarine wetlands to install revetment materials within and along the northeastern banks of Indian Island. Although the revetment would be constructed above the high tide line, the majority of the fill materials would be placed on areas meeting the Commission's definition of wetlands due to their supra-tidal hydrology and the likelihood that any soil materials incorporated within the shell mound materials would be hydric soils. A wetland delineation conducted at the project site substantiated these conditions and found that 80% of the proposed development would be located within an area meeting the definition of wetlands (see Exhibit No. 5).

Section 30230 of the Coastal Act states, in applicable part:

> *Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.*

Section 30231 of the Coastal Act addresses the protection of coastal water quality and marine resources in conjunction with development and other land use activities. Section 30231 states:

> *The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of wastewater discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with the surface water flow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.*

Section 30233(a) of the Coastal Act provides as follows, in applicable part:

> *The diking, filling, or dredging of open coastal waters, wetlands, estuaries, and lakes shall be permitted in accordance with other applicable provisions of this division, where there is no feasible less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects, and shall be limited to the following:*

...

(7) Restoration purposes.

(8) Nature study, aquaculture, or similar resource dependent activities.
[emphases added]

The above policies set forth a number of different limitations on what development projects may be allowed in coastal wetlands. For analysis purposes, the limitations can be grouped into four general categories or tests. These tests are:

- The purpose of the filling, diking, or dredging is for one of the uses enumerated in Section 30233(a);
- The project has no feasible less environmentally damaging alternative;
- Feasible mitigation measures have been provided to minimize adverse environmental effects; and
- The biological productivity and functional capacity of the habitat shall be maintained and enhanced where feasible.

1. Permissible Use for Fill

The first test for a proposed project involving fill is whether the fill is for one of the eight allowable uses under Section 30233(a). Among the allowable use which most closely match the project objectives are enumerated in Section 30233(a)(7) and (8) involving fill relating to "restoration purposes," "nature study," or "similar resource dependent activities."

The construction of the proposed revetment is being proposed in the interest of armoring the bayside edge of the shell mound to protect the structure from being further eroded by storm surge and boat wake waves generated on Humboldt Bay. The purpose of such development is not to "restore" the eroded shoreline, only to stabilize and protect it. Accordingly, the fill for construction of the proposed shoreline protective structure is not for "restoration purposes."

With respect to project being recognized as either "nature study" or "similar resource dependent activities" as identified in Section 30233(a)(8), the Commission notes that while the applicant has expressed plans to restore and develop the Tuluwat village site to conduct cultural dance ceremonies, tribal artistry and crafting, linguistic studies, and expositions on other pre-Columbian natural history subject matter, the permit request before the Commission at this time is solely for the development of the subject shoreline protective structure. Moreover, even if the project description were to include proposals

for developing other site improvements or for instituting a museum/interpretative center public assembly use at the site, the proposed fill is not functionally related to either of these development activities. Accordingly, the proposed fill for the shoreline protective device is not a form of "nature study" or "similar resource dependant activity."

Therefore, the Commission finds that the filling for the shoreline revetment structure is not for one of the allowable uses for dredging, diking, and filling of coastal waters pursuant to Sections 30233(a)(7) and (8) of the Coastal Act. Nonetheless, the shoreline altering device must be permitted to protect an existing structure pursuant to Section 30235. The applicant has documented that the shell midden is being damaged by erosion. As conditioned, there are no other less damaging alternatives available to reduce the risk from continued erosion or minimize impacts on shoreline sand supply. Therefore, notwithstanding the inconsistency of the project with Section 30233(a), the proposed protection of the shell midden must be permitted pursuant to Section 30235 of the Coastal Act.

2. Least Environmentally Damaging Feasible Alternative

The second test of Section 30233(a) is whether there are feasible less environmentally damaging alternatives to the proposed project. In this case, the Commission has considered project options, and determines that there are no feasible less environmentally damaging alternatives to the project as conditioned. Alternatives that have been identified include: (1) construction of geo-grid mattress retaining wall structures; and (2) the "no project" alternative.

a. Installation of Geo-grid Mattress Modular Retaining Walls

One alternative to the proposed project would be to utilize a revetment design initially proposed in 2002 by the U.S. Corps of Engineers to place "geo-grid mattress" modular retaining wall structures along the eroding shoreline. This alternative would require greater amounts of new fill with its larger footprint. Additionally, use of the geo-grid mattress retaining wall alternative would cause significantly greater impacts to the visual resources of the Middle Bay area as the structure would be much more visible from a variety of public vantage points and contrast with the natural materials on the island's edge. Therefore, use of geo-grid mattress modular retaining wall components as recommended by the U.S. Army Corps of Engineers is not a feasible less environmentally damaging alternative.

b. No Project Alternative

The no project alternative means that no revetment would be constructed at the Tuluwat Village / Shell Mound site. The objective of the proposed project—to protect further loss to significant cultural resources would not be met. Without

the proposed revetment, the shell midden and the cultural artifacts and human remains it contains would continue to erode into Humboldt Bay. Such continued damage would represent a significant adverse impact to renowned California archaeological and historical resources.

Based on the alternatives analysis above, the Commission concludes that the proposed project is the least environmentally damaging feasible alternative.

3. Feasible Mitigation Measures

The third test set forth by Section 30230 and 30233 is whether feasible mitigation measures have been provided to minimize significant adverse environmental impacts.

Depending on the manner in which the proposed revetment is constructed, the proposed project could have four potential adverse effects on the marine environment of Humboldt Bay. The project could have potential adverse impacts to: (1) unconsolidated bed estuarine wetlands where the proposed fill would be placed; (2) shoreline essential fish habitat associated with the eelgrass beds offshore of the site; (3) estuarine water quality from construction activities conducted at the water's edge and the release of leachate from inappropriate sheet pile materials; and (4) aquatic life from mechanized equipment fuel or hydraulic spills into Humboldt Bay. The potential adverse impacts and their mitigation are discussed in the following four sections:

a. Unconsolidated Bed Estuarine Wetlands

As detailed in the attached wetland delineation, the project would result in the placement of fill atop approximately 7,100-square feet of supra-tidal wetlands consisting of the unconsolidated shell mound bank materials, site debris, and flotsam that comprises the bank scarp on the island's northeastern shore with Humboldt Bay. These areas are largely denuded of vegetation and consist primarily of friable shell fragments, inter-bedded with sand, bay mud, and other culturally-derived artifact materials. Because of the location of the materials above the intertidal range of the bay, these sediments are periodically saturated to within 18-inches of their surface for substantial periods of the growing season. In addition, any soil materials within these sediments would likely qualify as hydric soils. Accordingly, notwithstanding the lack of hydrophytic vegetation and the nominal habitat potential these areas afford, the subject area would meet the Commission's definition of "wetlands."

The community of organisms that inhabit the bank scarp, though low in density, would be lost as a result of the construction of the revetment. However, the proposed cobble and large woody debris to be placed as buttressing fascia for the revetment would provide surfaces for these organisms to colonize in amounts greater than would be lost from the removal of the existing bank face and

emergency shoreline stabilization materials. Furthermore, the backfill behind the sheetpile bulkhead materials to be placed over the denuded bank would be planted with native salt-tolerant facultative wetland plants that would approximate the composition of vegetation that would develop in this setting if the site were not actively eroding. Therefore, the Commission finds that no additional mitigation is necessary for the loss of emergent and aquatic bed wetland habitat associated with the proposed project.

b. Eelgrass Bed Essential Fish Habitat

Eelgrass (Zostera marina) is considered to be an environmentally sensitive habitat area because of the cover and foraging habitat that it provides for fish and other wildlife. In addition, eelgrass beds provide a spawning place for Pacific herring. Pacific herring occur as a commercial fishery in Humboldt Bay and are known to spawn in eelgrass in the North Bay near the proposed project. Eelgrass beds are located just offshore of the project site, approximately 150 feet east of the shore on the edge of the bay's Middle Channel between Indian and Daby Islands.

A portion of the proposed project involves the transport by motor vessel of revetment supplies, equipment, and personnel across the bay from Eureka. These activities could traverse the area where eelgrass beds are present and, depending upon the water depth at the time of the crossing, could result in damage to the habitat the beds afford by entanglement of the vegetation within the propeller blades of the watercraft.

The applicant has proposed to maintain a minimum 20-foot-wide buffer around the nearby eelgrass bed. In addition, the applicant proposes to conduct watercraft crossings to the project site only during the daily high tide when other eelgrass beds between the project site and Eureka would be inundated and shielded from the potentially adverse impacts associated with transiting motorized watercraft. Special Condition No. 2 requires the applicant to comply with these protective measures. Therefore, the Commission finds that as conditioned, the project will not result in significant adverse impacts to eelgrass bed habitat.

b. Estuarine Water Quality

Construction activities in and adjacent to the bay would result in degradation of water quality through the entry of soil materials either directly or entrained in runoff passing over ground disturbed areas. To prevent sediment discharge from upland sources into the bay, the applicant proposes to: (1) install the proposed revetment materials during low tide times when the bay waters have receded from the margins of the island; and (b) contain all revetment materials, construction equipment and debris at upland areas adjacent to the revetment work site in a manner that would preclude entry into the water; and (c) monitor and promptly

repair and/or remove any such material, debris and equipment that inadvertently becomes dislodged from the revetment.

By timing the project work to be undertaken when the greatest separation between the construction activities and the bay waters would be afforded, maintaining and storing construction materials and equipment in areas well away from the bay edge, monitoring and maintaining the integrity of the revetment and effecting repairs and clean-up as needed, and avoiding the use of polymer-based sheetpile materials with a history of potential water pollution impacts, the potential adverse impacts to estuarine water quality have been mitigated to less than significant levels. Special Conditions 1 and 2 require the applicant to comply with these protective measures. Therefore, the Commission finds that as conditioned, the project will not result in significant adverse impacts to estuarine water quality.

c. Accidental Hazardous Materials Spills

With the specified exception of the use of a pneumatic vibratory driver to be used to install the sheetpile panels, the majority of the proposed revetment construction would utilize hand tools and labor. Re-fueling or lubricating motorized equipment (i.e., air compressors, electrical generators, chainsaws) during project construction is not anticipated. Should re-fueling of equipment become necessary, the applicant proposes to conduct any such re-fueling within the paved-floor boat repair structure adjoining the revetment site where facilities would be in place to minimize the occurrence and magnitude of impact of fueling spills. Special Condition No. 3 requires any fueling of equipment to occur on the paved areas within the adjoining former boat yard structures, a minimum of 100 feet away from the Mean High Water Line. In addition, the condition requires that fuels, lubricants, and solids not be allowed to enter the Bay, and that hazardous materials response equipment be immediately on hand at the project site. As conditioned, potential adverse impacts from accidental fuel or oil spills to marine resources will be reduced to less-than-significant levels.

As proposed and conditioned, the Commission finds that feasible mitigation is included within the project design to minimize all significant adverse impacts associated with the proposed filling of coastal waters.

4. Maintenance and Enhancement of Marine Habitat Values

The fourth general limitation set by Section 30233 and 30231 is that any proposed filling in tidal waters or submerged land must maintain and enhance the biological productivity and functional capacity of the habitat, where feasible.

As discussed above, the project will not have significant adverse impacts on the marine resources of Humboldt Bay. The mitigation measures incorporated into the project and

required by the Special Conditions discussed above will ensure that the construction of the revetment would not significantly adversely affect the biological productivity and functional capacity of the tidal waters or marine resources. Furthermore, by aiding the re-establishment of emergent salt-tolerant vegetation along a mostly denuded stretch of the northeastern bank of the island, the project will help stabilize further erosion of shell fragments and other cultural resource-derived materials into the bay and prevent bottom habitat from being further degraded. Therefore, the Commission finds that the project, as proposed, will maintain and enhance the biological productivity and functional capacity of the habitat consistent with the requirements of Section 30233 and 30231 of the Coastal Act.

5. Conclusion

The wetland fill associated with the project is not for one of the allowable uses enumerated in Coastal Act Section 30233(a)(1) through (8) Therefore, the proposed development is inconsistent with Section 30233(a) of the Coastal Act. Nonetheless, the shoreline altering device must be permitted pursuant to Coastal Act Section 30235. The applicant has documented that the shell midden is being damaged by erosion. As conditioned, there are no other less damaging alternatives available to reduce the risk from continued erosion or minimize impacts on shoreline sand supply. Therefore, notwithstanding the inconsistency of the project with Section 30233(a), the proposed protection of the shell midden must be permitted pursuant to Section 30235 of the Coastal Act.

E. Protection of Environmentally Sensitive Riparian Habitat Areas.

Section 30240 of the Coastal Act states:

(a) Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas.

(b) Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas.

Coastal Act Section 30107.7 defines "environmentally sensitive area as meaning:

> *...any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments.*

Section 30240 of the Coastal Act states that development in areas adjacent to environmentally sensitive habitat areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat areas.

The proposed project involves development activities in proximity to irregularly flooded saltmarsh habitat on the adjacent island areas. The condition of the saltmarsh vegetation habitat on Indian Island in the vicinity of the project was analyzed in botanical analysis prepared in 2001 and 2002 by Botanist Annie L. Eicher (see Exhibit No. 6). Additional endangered and threatened vegetation inventory work for listed plant species was also completed by Mad River Biologists as part of the wetland delineation conducted during the summer of 2002. In summary, this information indicates that the eastern half of Indian Island (which includes the Tuluwat site) is heavily hydrologically modified by the drainage ditching & diking and associated land uses of the past, and has since been in a very gradual ecological recovery. These studies found several rare saltmarsh plant species on the upland portions of the island, including Humboldt Bay owl's clover (Castilleja ambigua ssp. humboldtiensis), Point Reyes bird's beak (Cordylanthus maritimus ssp. palustris), and an outcropping of a rare bryophyte, possibly either bog club-moss (Lycopodiella inundatum) and/or ground pine (Lycopodium clavatum). All of these rare plant occurrences are located several hundred feet from the development site, at higher elevations on the island, and are not associated with the project's estuarine edge setting.

The Commission thus finds that the environmentally sensitive habitat areas adjacent to the development would be protected against any significant disruption of habitat values, and only uses dependent on those resources would be developed within those areas. In addition, the proposed revetment structure and the staging areas and construction activities have been sited and designed to prevent impacts that would significantly degrade environmentally sensitive areas, and would be compatible with the continuance of those habitat and recreation areas. Therefore, the Commission finds that the proposed development, as proposed, is consistent with Section 30240 of the Coastal Act.

F. Visual Resources.

Coastal Act Section 30251 requires permitted development to be designed and sited to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, and to be visually compatible with the character of surrounding areas.

There are views of the site from State Route 255, from the easternmost portions of the paths within the City of Eureka's Waterfront Park, and from the waters of Humboldt Bay. However, consistent with Section 30251, the project as designed and sited would not significantly obstruct any views to or along the ocean and the Humboldt Bay estuary.

The proposed revetment would not rise appreciably above the existing bank in a manner that would block views.

The proposed project as sited and designed would also not result in any appreciable alteration of any landforms. Although the project involves a certain amount of grading and excavation to install the shoreline protective works, the new revetment would replace an existing emergency repair assemblage of geo-textile fabric, sand-bagged shell fragments, and wooden debris that is presently shoring up the eroded bank scarp. In addition, installation of the new revetment materials would not significantly alter the shape and form of the island shoreline from that that currently exists at the site.

The project has also been designed to be visually compatible with the character of the surrounding area. The proposed revetment materials would approximate the appearance of other shoreline materials and settings in the immediate vicinity of the project. In addition, the willow, wax-myrtle, and salt grass sprigs to be planted to stabilize the rock, soil, and shell backfill would serve to screen and soften the appearance of the new rock slope protection while not blocking any additional views of the bay from the shoreline. Furthermore, the materials and colors proposed to form the shoreline revetment would blend with the island bank materials, and with the character of the surrounding estuary.

Special Condition No. 3 is added to ensure that the proposed neutral-colored sheetpile panels and greenstone quarry rock are used for the project, and that any deviation from the plan proposal, including, but not limited to a change in the color of the revetment materials would require an amendment to the permit, unless the Executive Director determines that no amendment is legally required. This condition will ensure that the Commission can review any changes to the project for conformance with Section 30251. Therefore, the Commission finds that the proposed development, as conditioned, will protect views to and along the ocean and scenic coastal areas, minimize the alteration of landforms, and be compatible with the character of the surrounding area consistent with Section 30251 of the Coastal Act.

F. Public Access and Coastal Recreational Opportunities.

Coastal Act Sections 30210, 30211, and 30212 require the provision of maximum public access opportunities, with limited exceptions.

Coastal Act Section 30210 requires in applicable part that maximum public access and recreational opportunities be provided when consistent with public safety, private property rights, and natural resource protection. Section 30211 requires in applicable part that development not interfere with the public's right of access to the sea where acquired through use (i.e., potential prescriptive rights or rights of implied dedication). Section 30212 requires in applicable part that public access from the nearest public roadway to the shoreline and along the coast be provided in new development projects, except in

certain instances, such as when adequate access exists nearby or when the provision of public access would be inconsistent with public safety.

In applying Sections 30211 and 30212, the Commission is limited by the need to show that any denial of a permit application based on these sections, or any decision to grant a permit subject to special conditions requiring public access, is necessary to avoid or offset a project's adverse impact on existing or potential public access.

Although one can reach Indian Island by boat, there is no vehicular access to the island and the island is not generally open to public recreational use. As discussed in Finding Section IV.B above, the proposed development entails the construction of a shoreline revetment structure along a 400-foot length of the shoreline of Indian Island in Humboldt Bay. The project as designed will not result in any significant adverse impact on public access. Due to its location in the middle of Humboldt Bay rather than on the open coast, the island is not surrounded by a sandy beach. Although areas immediately adjacent to portions of the eroding bank edge are built up with shell fragments eroded by storm surge from the shell mound, the shell fragments overlie and are mixed within mudflat rather than overlying a sandy beach. The mudflats around the island do not provide significant recreational opportunities such as a sandy beach would. Thus, armoring the shell mound will not result in the loss of recreational beach area, either by the displacement of the area that the revetment will occupy or by halting the establishment of any new potential beach area. Therefore, the Commission finds that the proposed project as conditioned, which does not include substantial new public access, is consistent with the public access policies of the Coastal Act.

G. Geologic Stability.

The Coastal Act contains policies to assure that new development provides structural integrity, minimizes risks to life and property in areas of high flood hazard, and does not create or contribute to erosion. Section 30253 of the Coastal Act states in applicable part:

> *New development shall:*
>
> (l) *Minimize risks to life and property in areas of high geologic, flood, and fire hazard.*
>
> (2) *Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.* [emphasis added]

Coastal Act Section 30253 requires the project to assure long-term stability and structural integrity, minimize future risk, and avoid additional, more substantial protective measures in the future. This requirement is particularly relevant to the proposed project given the dynamic shoreline environment within which the proposed project would be placed. Since hydraulic forces increase with the square of the water height, a small increase in water depth and wind wave height can cause a significant increase in wave energy and potential structural damage. Thus, a small rise in tidal waters can expose bay front development to increased live and static hydraulic forces associated with inundation, scour, and wave attack.

The project would involve construction activities along approximately 400 lineal feet of the banks of Indian Island within Humboldt Bay, the second largest estuary in California. Although the currents generated on the bay by tidal flood and flow can be substantial, especially in areas in proximity to Humboldt Bay's relatively narrow entrance, typical tidal velocities in the shoreline areas adjacent to the Middle Channel offshore of the site are much less, estimated at approximately 0.6 feet/second. In addition, being situated on the leeward side of the island with respect to prevailing storm wind direction, the site is exposed to less intense storm surge, generally not exceeding two feet in wave height.

To ensure that the revetment is designed to withstand these storm surge forces, the applicant contracted civil and geo-technical engineering investigations for the project (see Exhibit No. 8). Based on measured tidal flow and storm surge, the surveyed bathymetry of the bay in proximity to the replacement ramp, and other relevant factors such as wind loading and tidal bore, the engineering analyses reviewed the materials sizing specifications for the proposed sheetpile bulkhead and determined that given the tensile strength of the subject material, the intention to set the bulkhead to a ten-foot depth with only a two-foot of above-grade freeboard, the fore and aft buttressing of the structure by cobble and large woody debris facing and the rock/soil/shell backfill materials, the revetment was adequately designed to withstand the hydraulic forces it would be subject to at the project site.

The project as proposed would assure stability and structural integrity, primarily because the revetment has been designed with site-specific conditions taken into account, utilizing established design principles to ensure the structure can adequately withstand the tidal and stormwater forces they would be exposed to during the economic lifespan of the improvements. Therefore, the Commission finds the project as designed would minimize risks to life and property in areas of high flood hazard, and assure stability and structural integrity of the site and its surroundings so that the need for further or additional shoreline protective works would be avoided, as required by Section 30253.

H. California Environmental Quality Act.

Section 13906 of the Commission's administrative regulation requires Coastal Commission approval of Coastal Development Permit applications to be supported by a

finding showing the application, as modified by any conditions of approval, is consistent with any applicable requirements of the California Environmental Quality Act (CEQA). Section 21080.5(d)(2)(A) of CEQA prohibits a proposed development from being approved if there are any feasible alternatives or feasible mitigation measures available, which would substantially lessen any significant adverse effect the proposed development may have on the environment.

The Commission incorporates its findings on Coastal Act consistency at this point as if set forth in full. Those findings address and respond to all public comments regarding potential significant adverse environmental effects of the project that were received prior to preparation of the staff report. As discussed above, the proposed project has been conditioned to be consistent with the policies of the Coastal Act. As specifically discussed in these above findings, which are hereby incorporated by reference, mitigation measures that will minimize or avoid all significant adverse environmental impacts have been required. As conditioned, there are no other feasible alternatives or feasible mitigation measures available which would substantially lessen any significant adverse impacts, which the activity may have on the environment. Therefore, the Commission finds that the proposed project, as conditioned to mitigate the identified impacts, can be found consistent with the requirements of the Coastal Act and to conform to CEQA.

EXHIBITS:

1. Regional Location Map
2. Vicinity Map
3. Site Aerial Photograph
4. Project Site and Revegetation Plans
5. Wetland Delineation
6. Botanical Survey
7. Cultural Resources Mitigation Feasibility Analysis
8. Geotechnical Report
9. Littoral Drift and Sand Supply Impact Analysis

APPENDIX A

STANDARD CONDITIONS

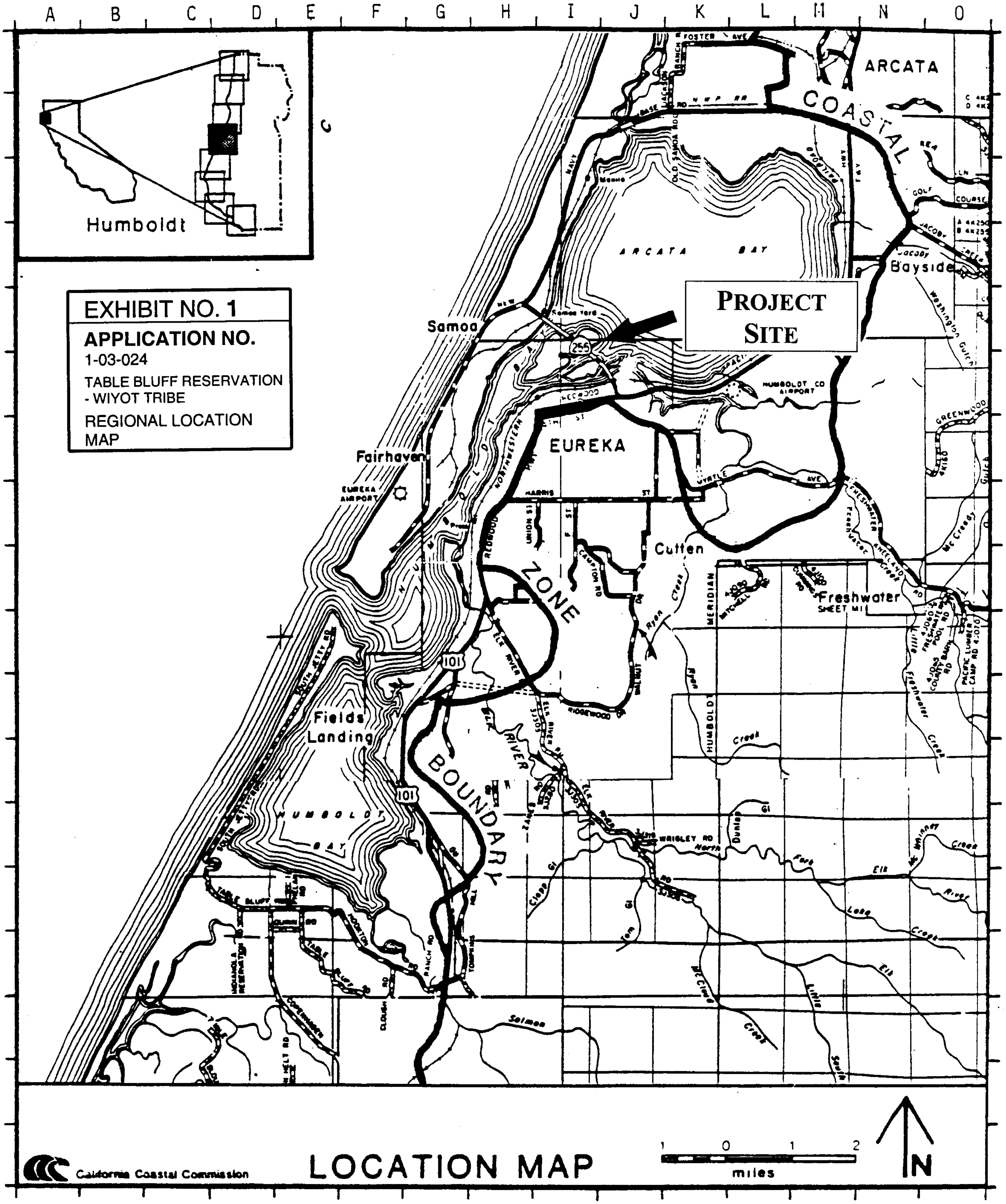
1. Notice of Receipt and Acknowledgement. The permit is not valid and development shall not commence until a copy of the permit, signed by the permittee or authorized agent, acknowledging receipt of the permit and acceptance of the terms and conditions, is returned to the Commission office.

2. Expiration. If development has not commenced, the permit will expire two years from the date on which the Commission voted on the application. Development shall be pursued in a diligent manner and completed in a reasonable amount of time. Application for extension of the permit must be made prior to the expiration date.

3. Interpretation. Any questions of intent of interpretation of any condition will be resolved by the Executive Director of the Commission.

4. Assignment. The permit may be assigned to any qualified person, provided assignee files with the Commission an affidavit accepting all terms and conditions of the permit.

5. Terms and Conditions Run with the Land. These terms and conditions shall be perpetual, and it is the intention of the Commission and the permittee to bind all future owners and possessors of the subject property to the terms and conditions.



County of Humboldt

Sheet 4 of 8

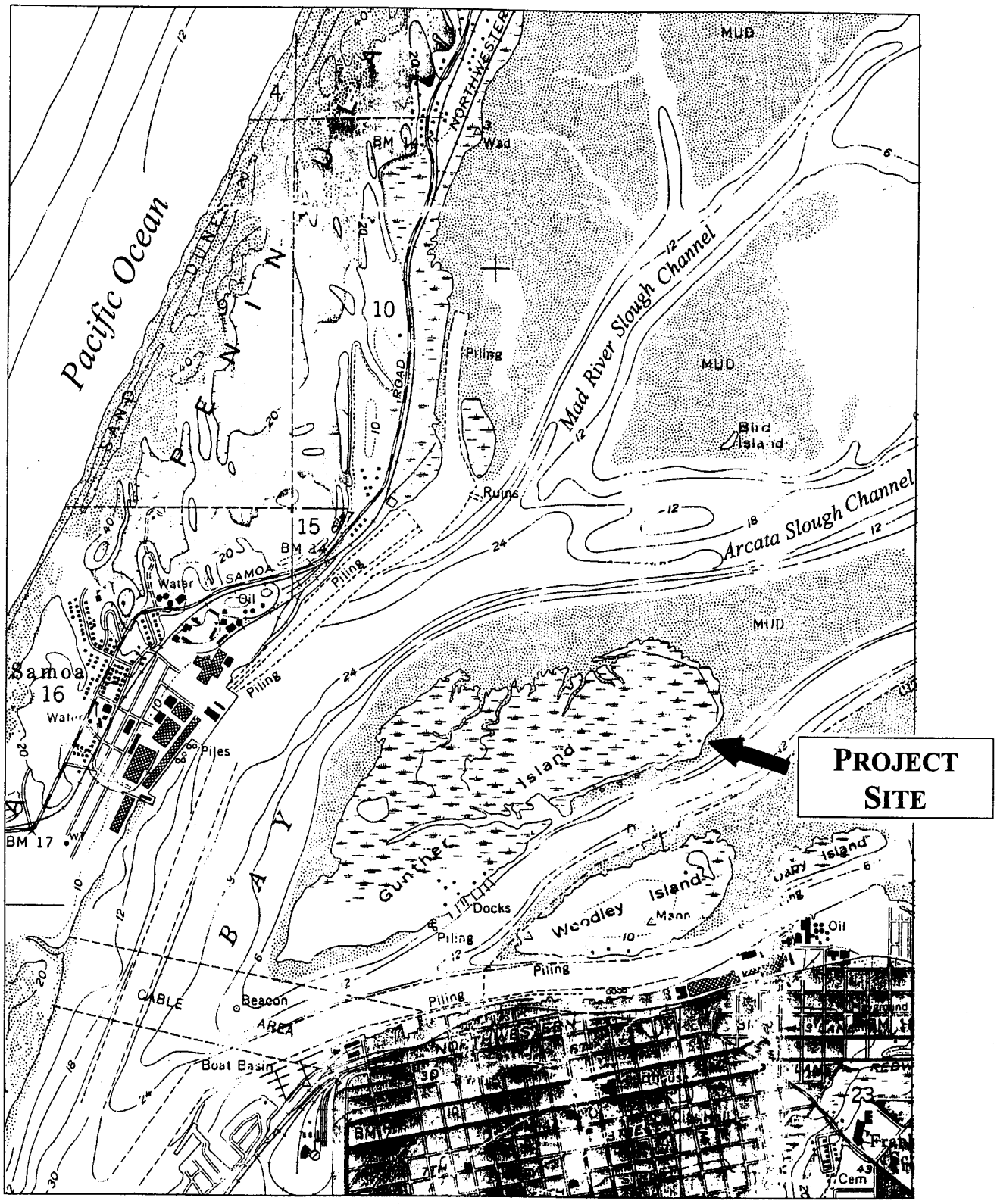


EXHIBIT NO. 2

APPLICATION NO.
1-03-024

TABLE BLUFF RESERVATION - WIYOT TRIBE

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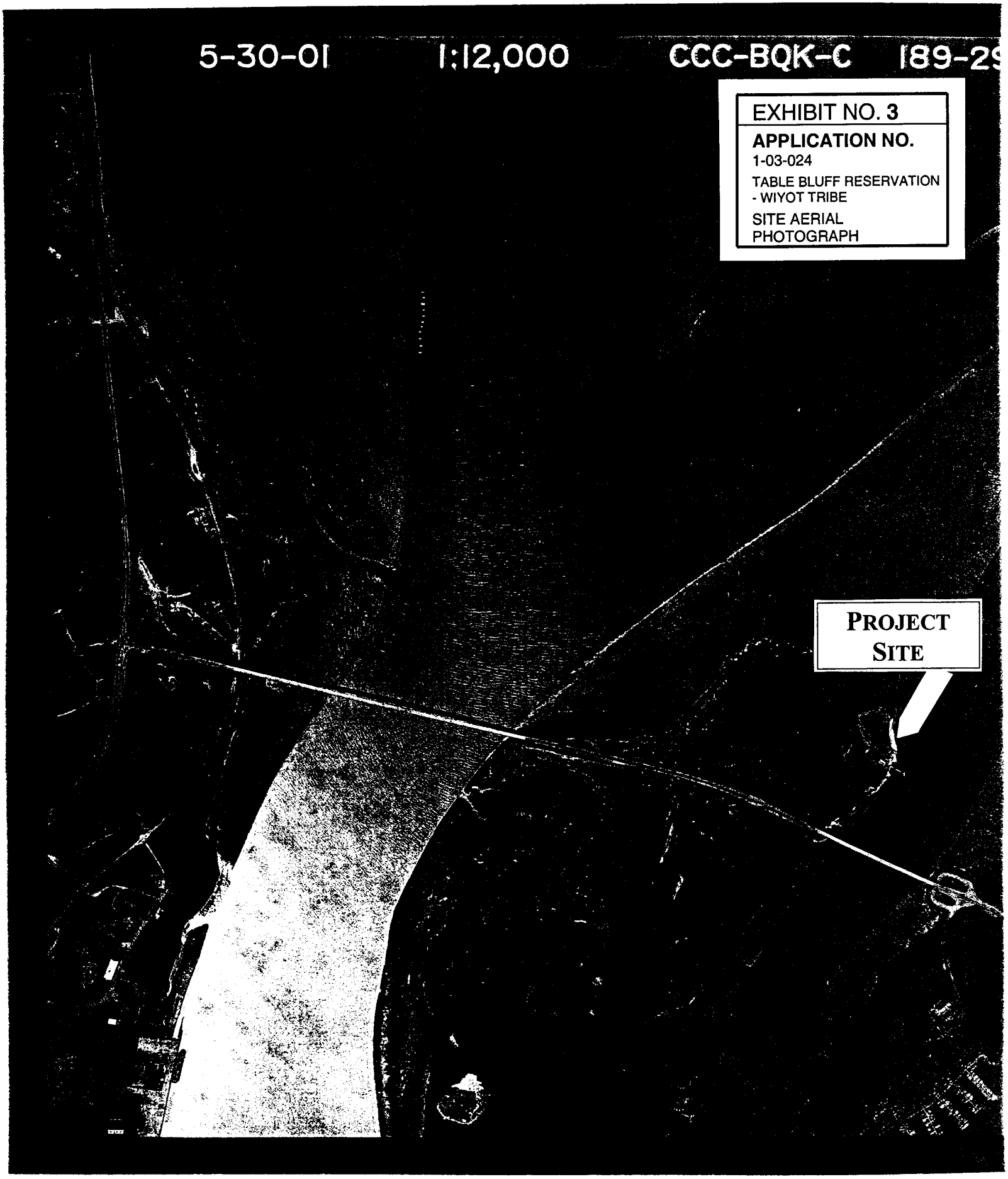
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EXHIBIT NO. 3
APPLICATION NO.
1-03-024
TABLE BLUFF RESERVATION - WIYOT TRIBE
SITE AERIAL PHOTOGRAPH
PROJECT SITE

INDIAN ISLAND
EROSION CONTROL PROJECT

EXHIBIT NO. 4

APPLICATION NO.
1-03-024

TABLE BLUFF RESERVATION - WIYOT TRIBE
PROJECT SITE & REVEGETATION PLANS (1 of 13)

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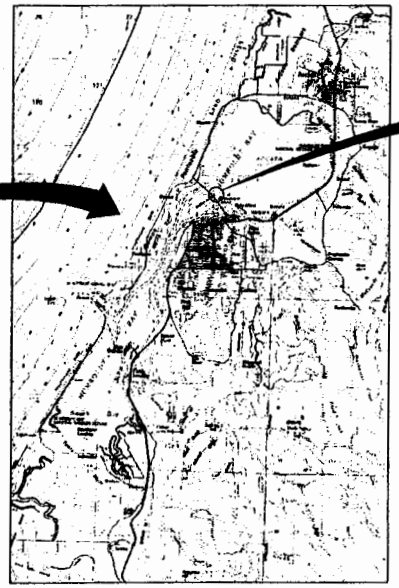

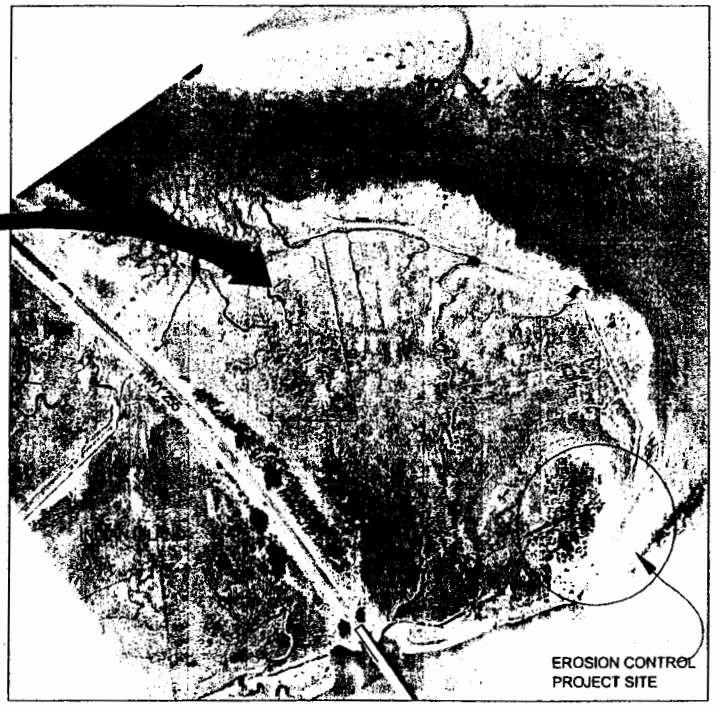

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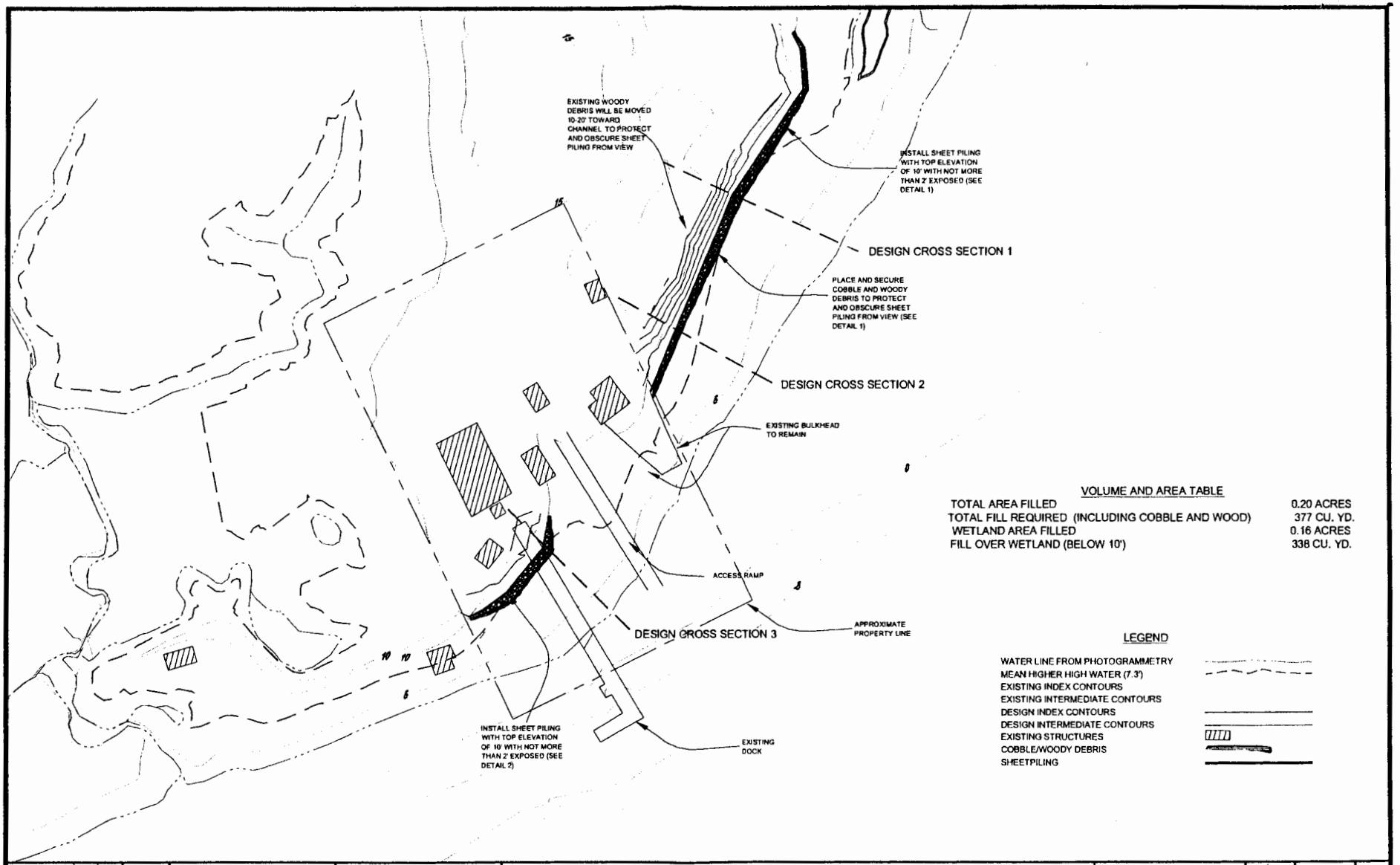

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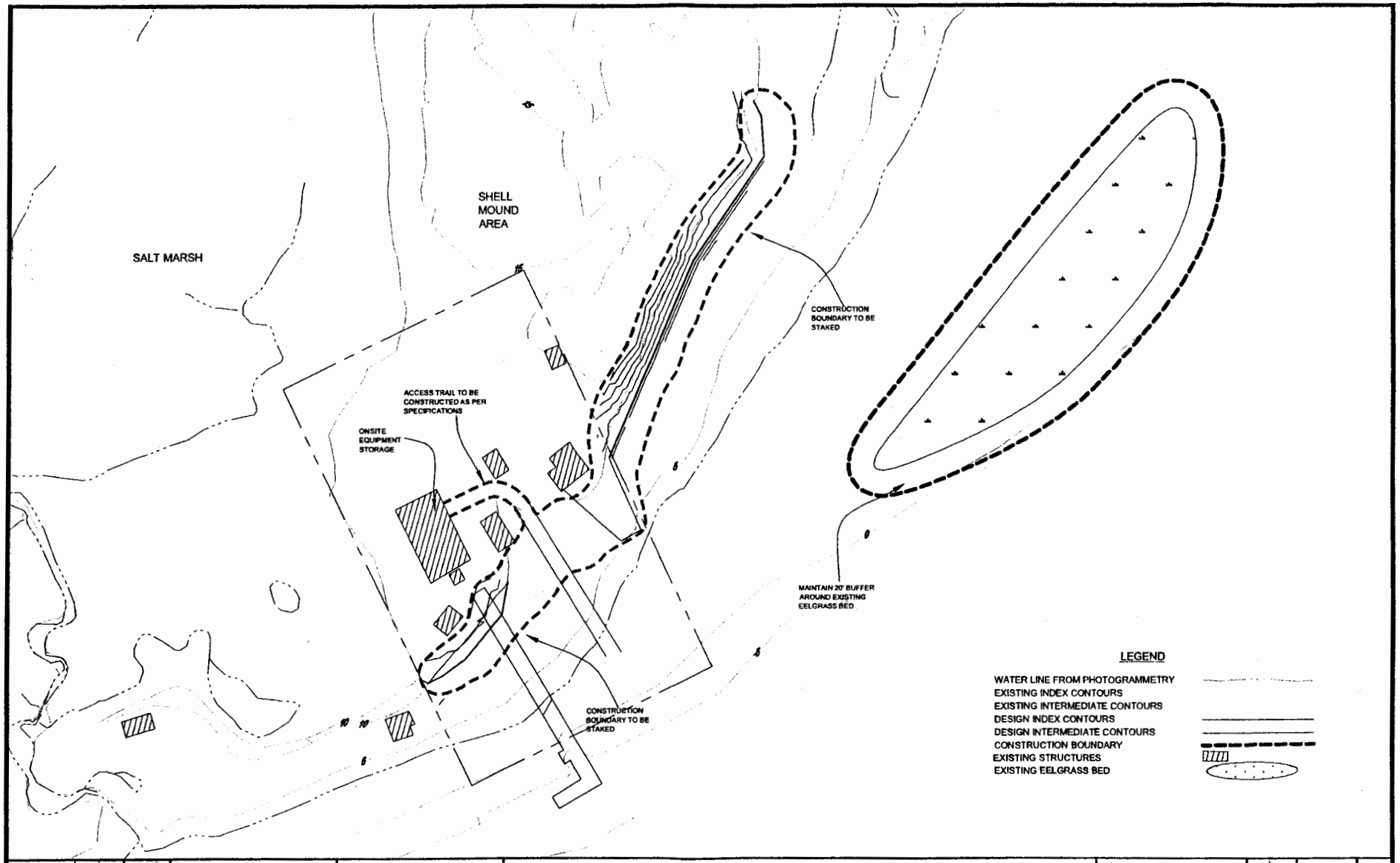

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REVIEWED BY	MW	6/03						SHEET 3/6

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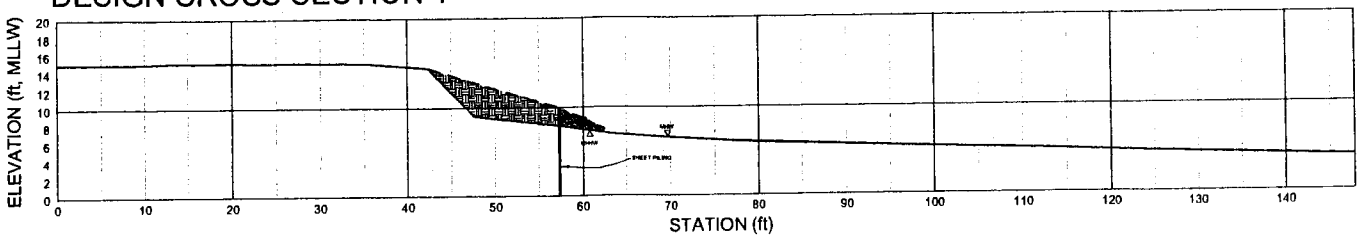

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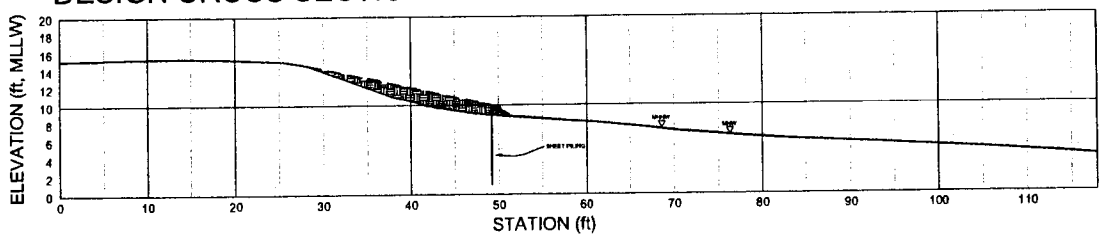

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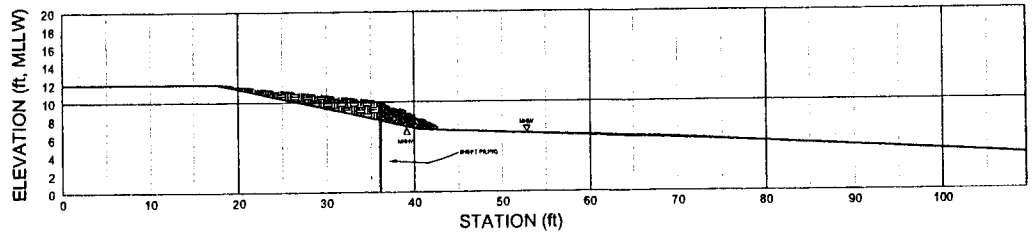

LEGEND

EXISTING SURFACE ——————

DESIGN SURFACE — — — —

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REVIEWED BY	MW	6/03								

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1 TYPICAL EROSION CONTROL CROSS SECTION
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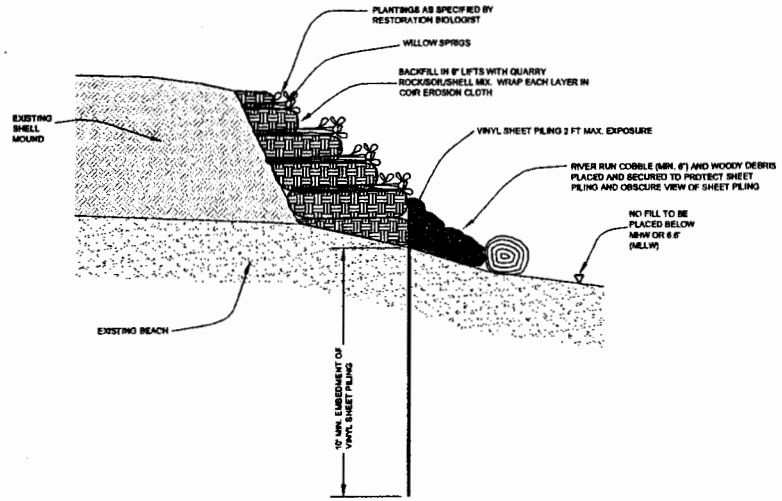

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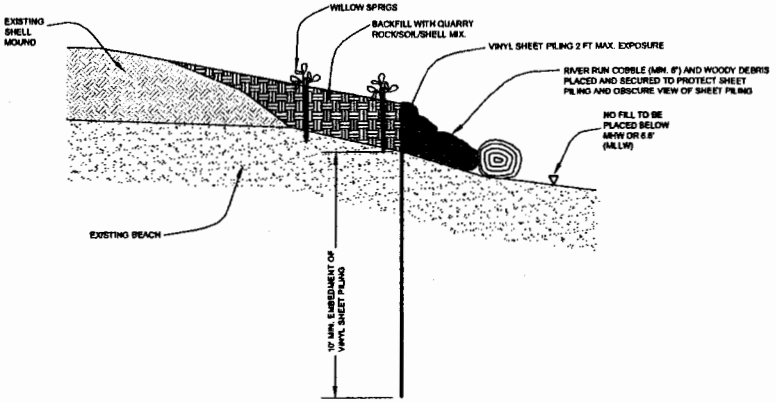

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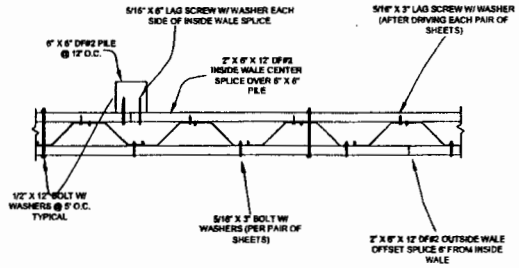

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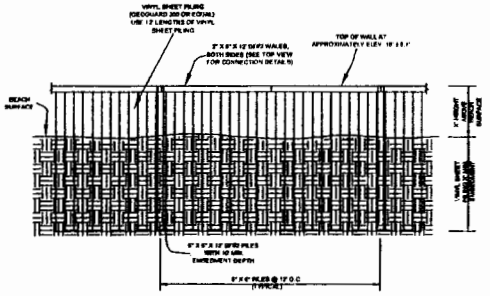

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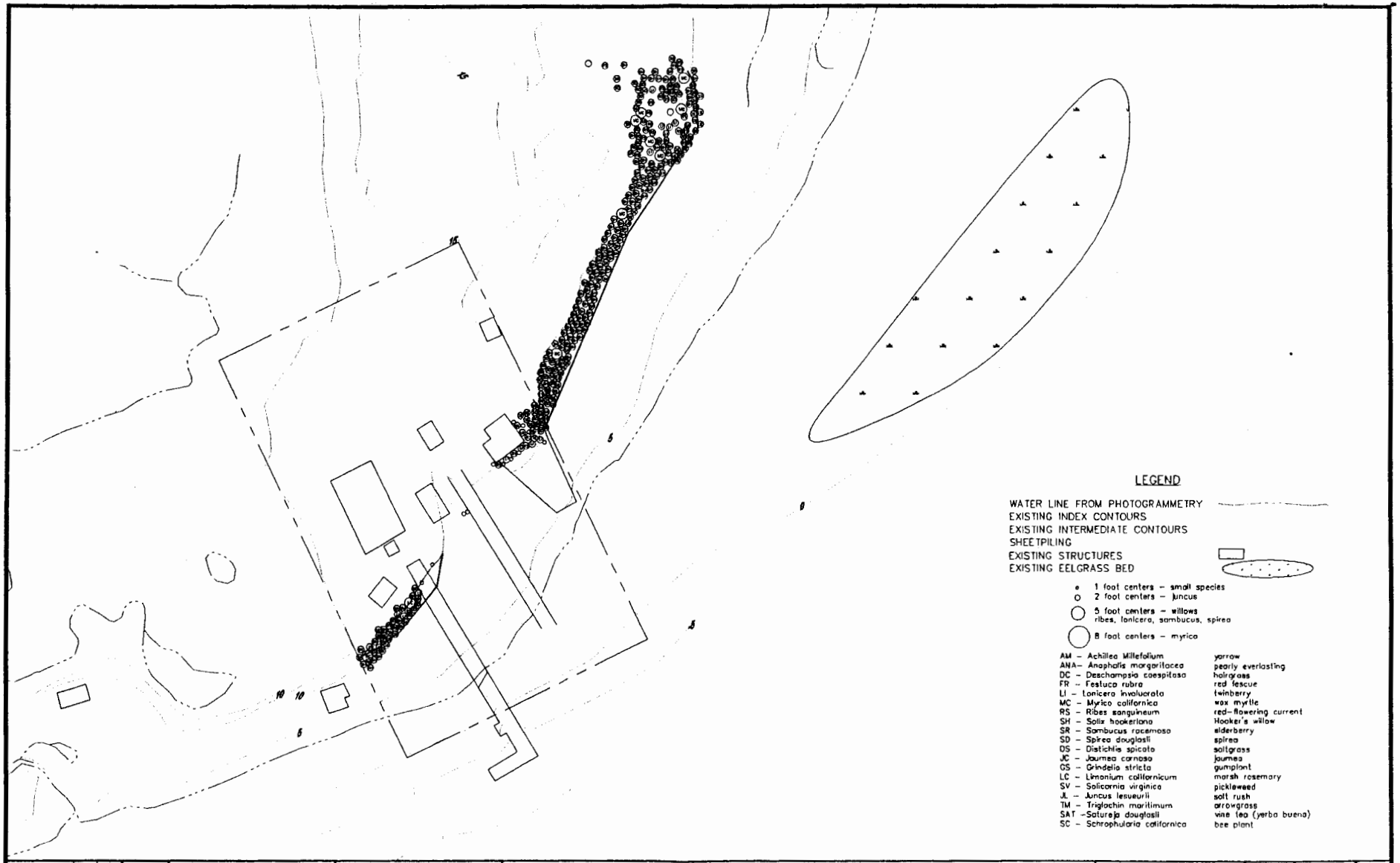
REVIEWED BY	MW	6/03								



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REVIEWED BY	MW	6/03							

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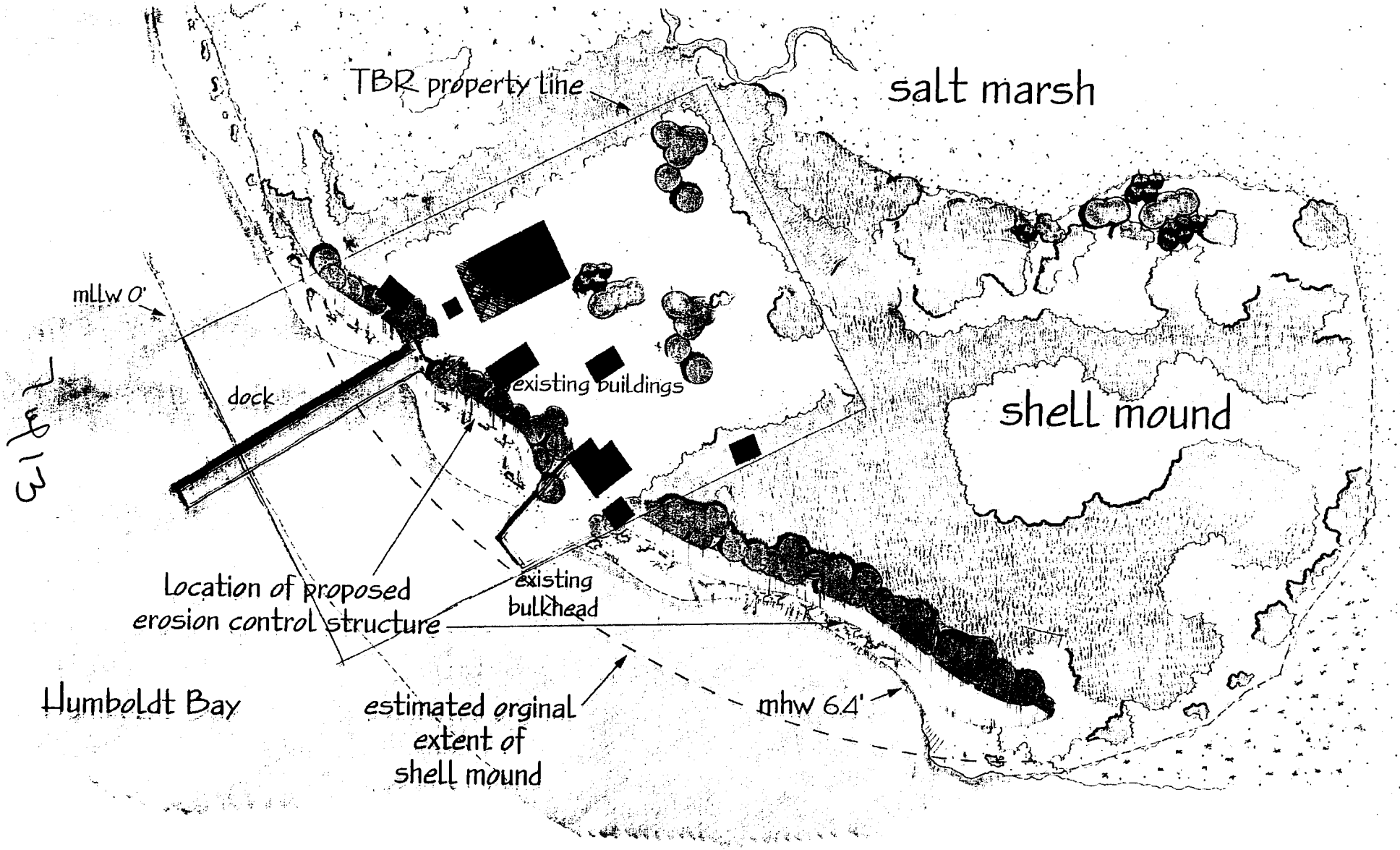

INDIAN ISLAND EROSION CONTROL ILLUSTRATIVE SITE PLAN

EUREKA, CALIFORNIA

TABLE BLUFF RESERVATION
WIYOT TRIBE

HWR

FIGURE 3

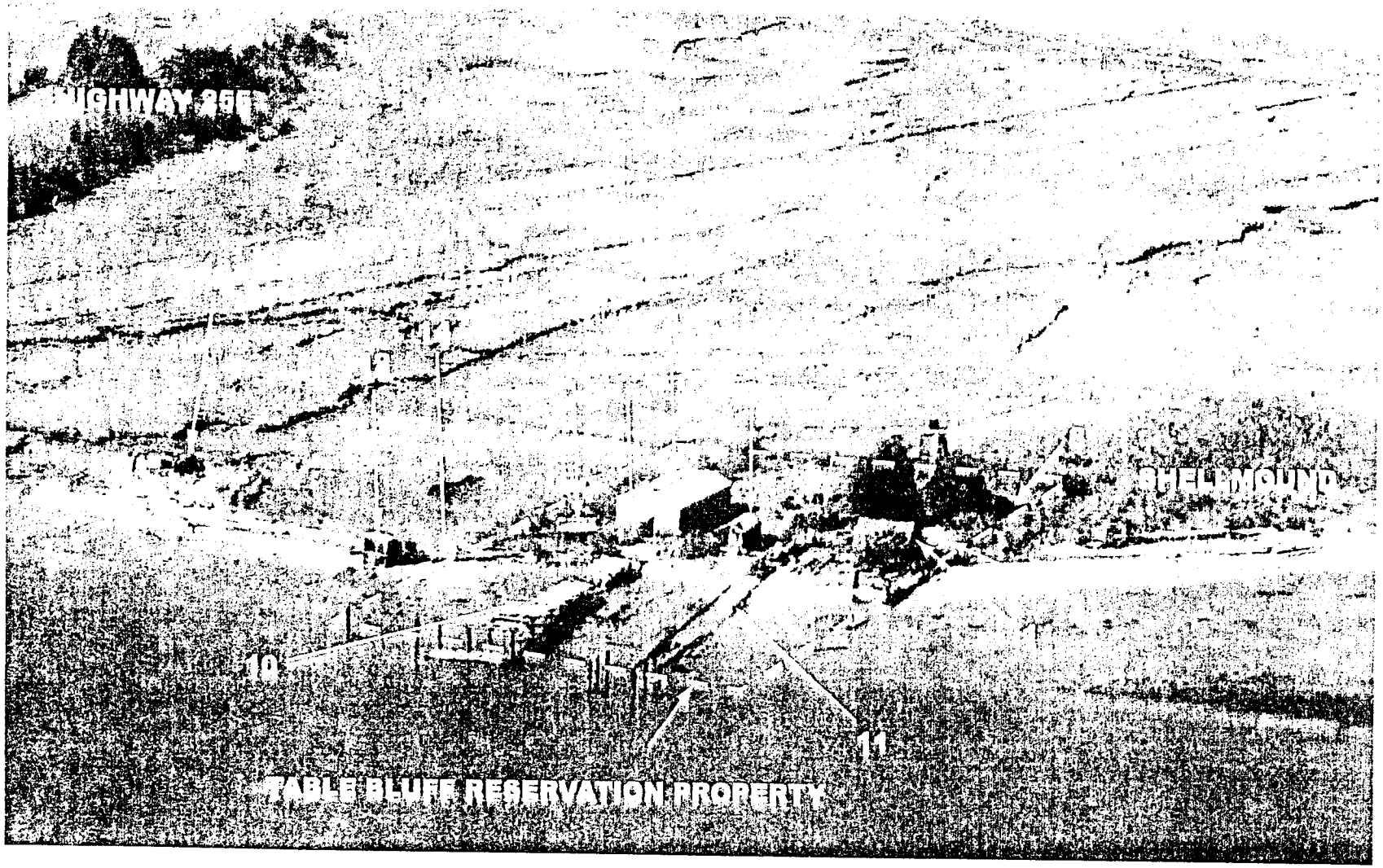

Figure 4. Existing Structures on the Table Bluff Reservation Property

Figure 5. Initial Erosion Control Measures (November 1999).

Figure 6. Erosion Control Measures After First Repair (February 2002).

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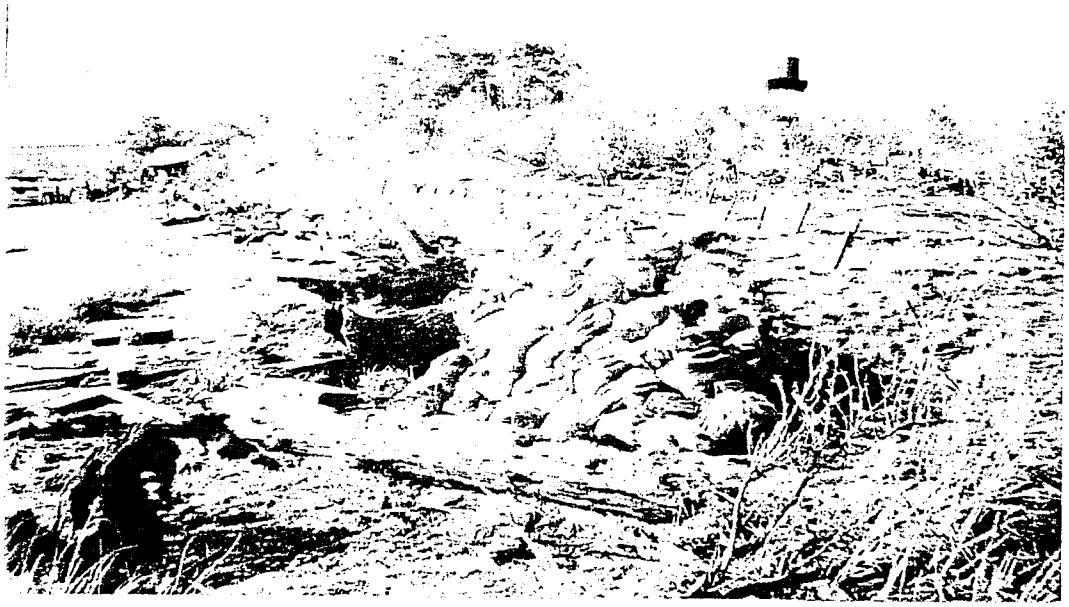

Figure 7. Erosion Control Measures After Second Repair (November 2002).

Figure 8. Exposed Midden After Winter Storms and High Tides (November 2003).

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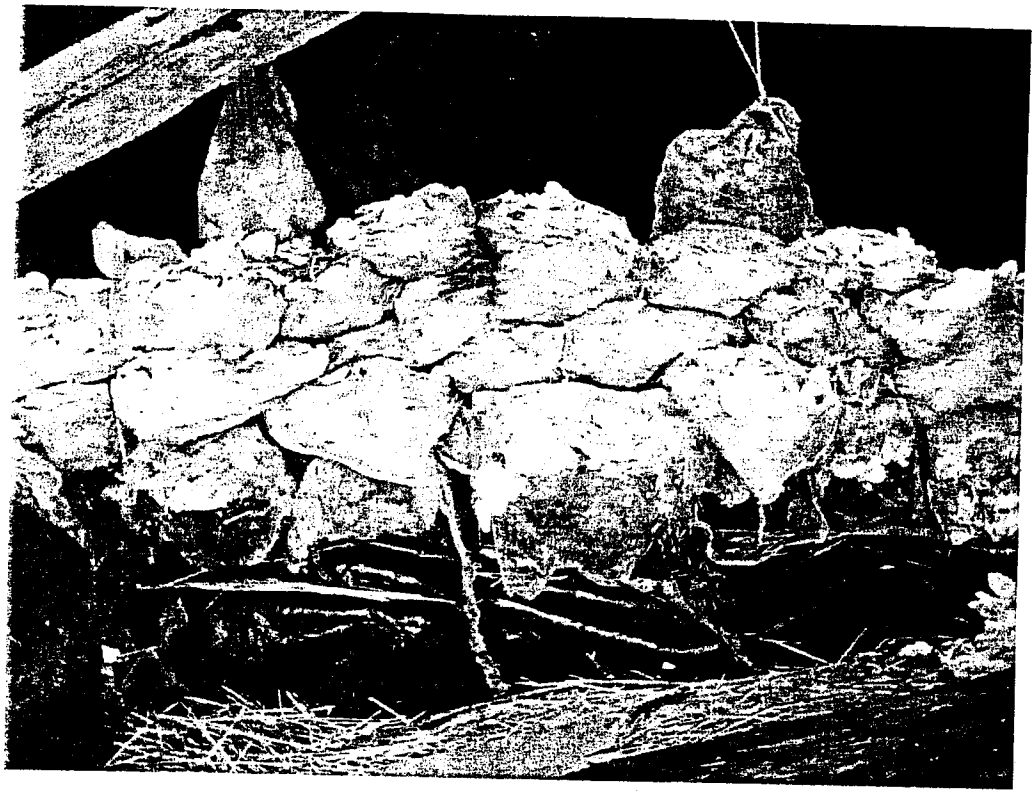

Figure 9. Close-up of Current Condition of Temporary Erosion Control (January 2003).

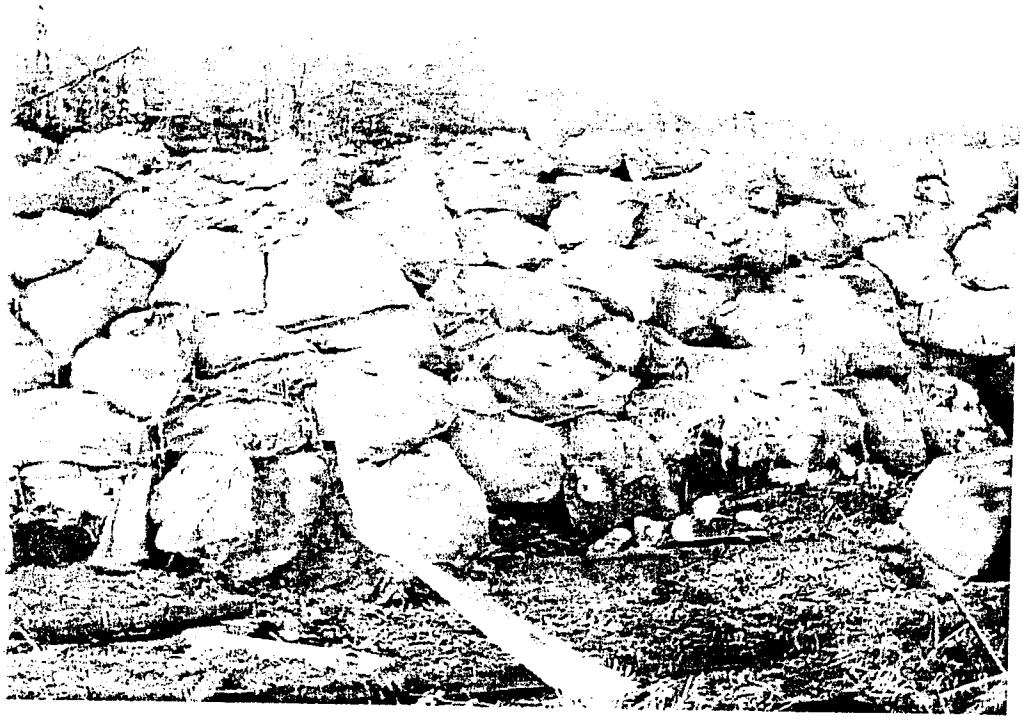

Figure 10. Current Condition of Temporary Erosion Control (January 2003).

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Figure 11. California Conservation Corps Placing Temporary Erosion Control Measures (November 2002).

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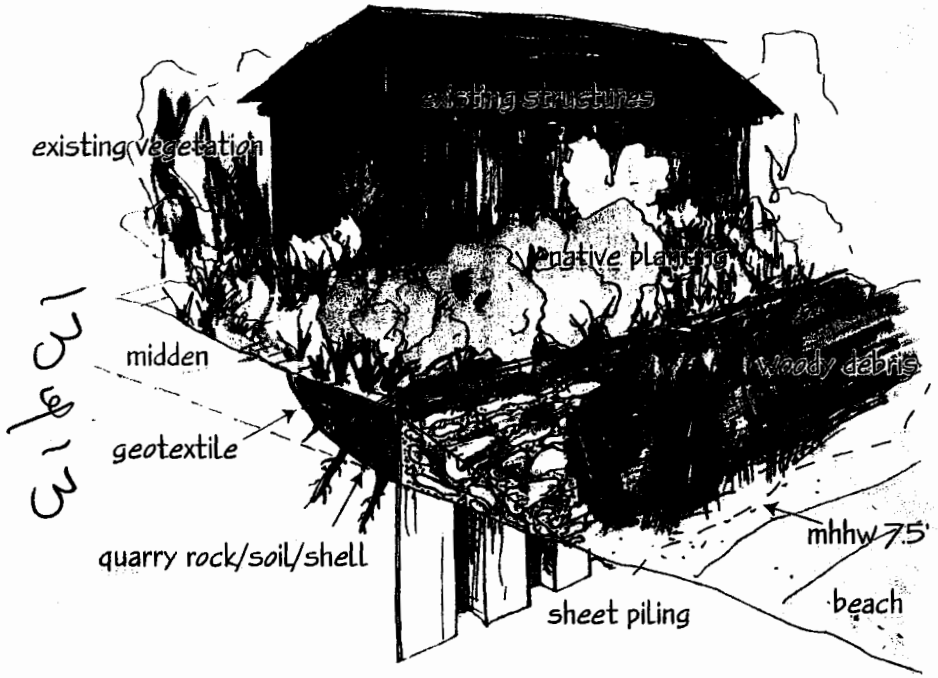
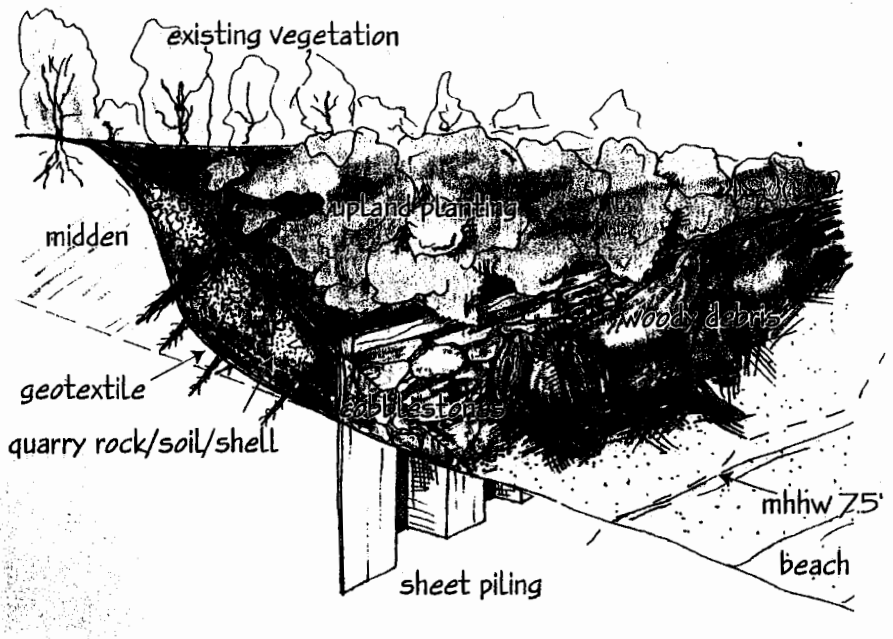
Erosion Control on South Side of Project Site
(Table Bluff Reservation Property)



Erosion Control on North Side of Project Site
(City of Eureka Property)



notes:

- All fill (except woody debris) shall be placed at or above 8.0 elevation (mllw).
- Fill slope to be no steeper than 2:1 (distance:rise)
- Fill to be gravel/soil/shell mix as specified by restoration ecologist.
- River run rounded cobble (minimum 6") will be installed to protect sheet piling and obscure it and provide a "natural" look.
- Quarry rock/soil/shell mix to be installed as specified by an engineer.
- Geotextile will be installed to delineate midden from fill, and to add strength to the structure.
- Sheet piling shall have a face no more than 2 feet in height, a top not above 10.0 elevation, and be installed to a depth as specified by an engineer

- Color of sheet piling material shall match beach to extent possible.
- Existing native plants will remain undisturbed, to the extent possible.
- Upland areas (higher than 10.0 elevation) shall be planted with shrub species such as willow, twinberry, and coyote bush or as specified by restoration ecologist.
- Where feasible wetland (10.0 elevation) shall be planted with native salt marsh species such as including pickleweed, saltgrass, jaumea, arrowgrass, and sea lavender or as specified by restoration ecologist.
- Woody debris shall be secured and placed in a way as to obscure view of sheet piling and provide additional habitat.

INDIAN ISLAND EROSION CONTROL ILLUSTRATIVE SECTIONS

Eureka, California

TABLE BLUFF RESERVATION
WIYOT TRIBE

HWR GMA

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Wetland Delineation

Indian Island

Humboldt County, California

Prepared For: Humboldt Water Resources
791 8th Street
Arcata, CA 95521
Attn: Mike Wilson, Susan Gaydos

Prepared By: Stephanie Morrissette, Associate Biologist
Mad River Biologists
1497 Central Avenue
McKinleyville, CA 95519
stephanie@madriverbio.com

Submitted: August 6, 2002

Stephanie Morrissette

EXHIBIT NO. 5
APPLICATION NO.
1-03-024
TABLE BLUFF RESERVATION - WIYOT TRIBE
WETLAND DELINEATION
(1 of 17)

Table Bluff Reservation - Wiyot Tribe
Indian Island Cultural and Environmental Restoration Project
Feasibility Study

Prepared for:
Northern California Indian Development Council
Eureka, California

Prepared by:
Humboldt Water Resources
Arcata, California

April 2003

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Submitted: August 6, 2002

Stephanie Morrissette

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Table of Contents

List of Figures, Tables and Attachments

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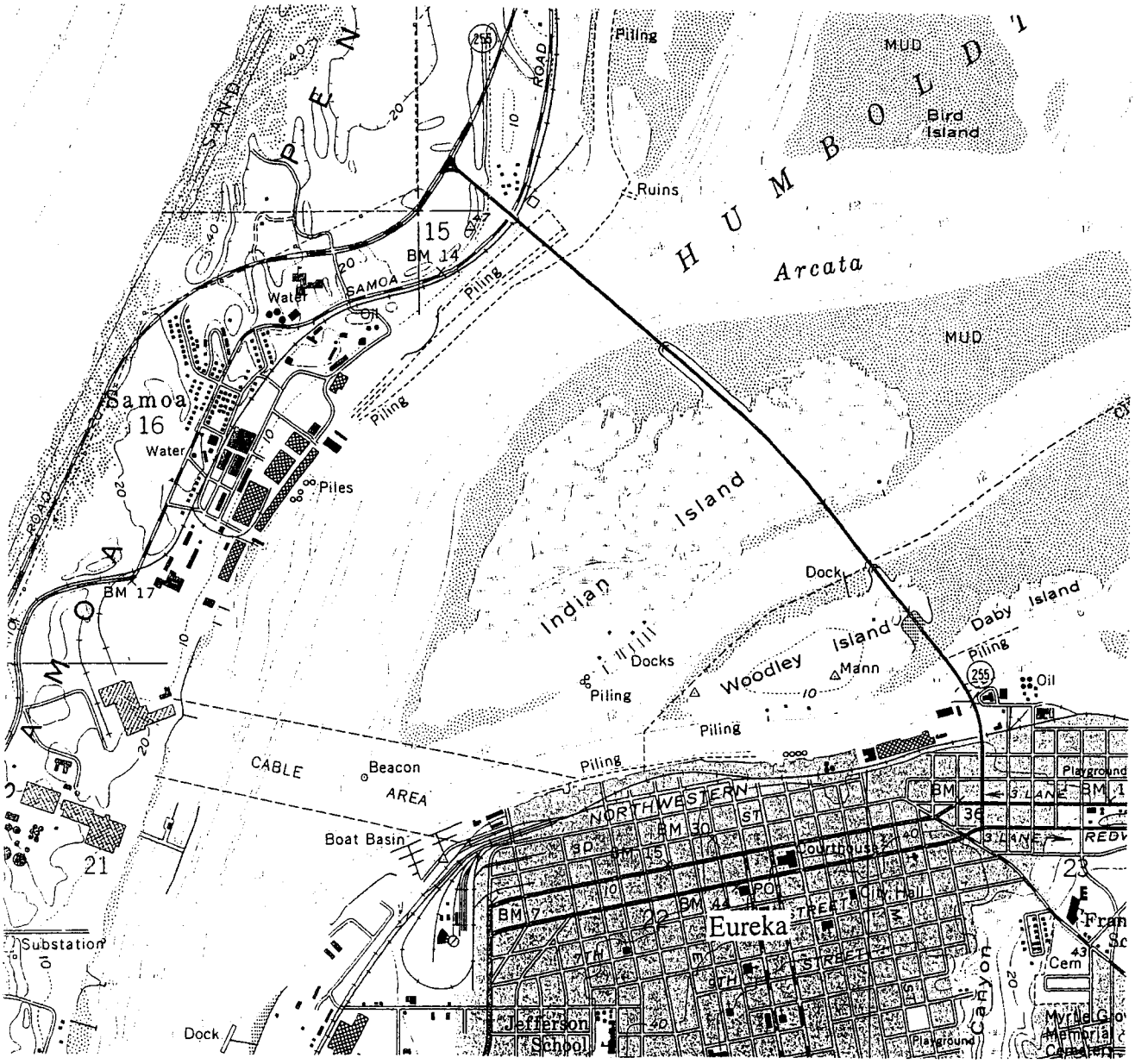
I. Introduction

On January 11, 2002 Mad River Biologists (MRB) conducted a wetland delineation on Indian Island under the direction of Humboldt Water Resources. The property is an island salt marsh located at the south end of Arcata Bay, within Humboldt Bay, north of Eureka (Figure 1). Access is from highway 255, which bisects the northern end of the island. The purpose of the investigation was to characterize wetland and upland habitats and map the location of two upland areas at the north end of the island. The two upland areas, a fill site at the footing of Samoa Bridge and the shell mound at the northeast end of the island, were delineated on a base map at a scale of 1"=200' (Attachment 3). The wetland delineation serves as one component of a feasibility study being prepared by Humboldt Water Resources on behalf of the property owner, the Weott Tribe of California. The Tribe is seeking to restore the area as a ceremonial site. The State Coastal Commission retains jurisdiction of the estuarine wetlands that comprise most of the island.

Figure 1 Site Location Map - Indian Island

Eureka. 7.5 minute USGS quadrangle Scale 1:24,000
T5N, R1W, NW ¼ of Sec. 14 and NE ¼ of Sec. 15



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II. Methods

MRB Associate Biologist Stephanie Morrissette and Staff Biologist Tamara Gedik conducted a field visit to the north end of Indian Island on January 11, 2002. Humboldt Water Resources Engineer Susan Gaydos accompanied project personnel in the field. The two upland areas, a fill site that comprises a footing of Samoa Bridge and the shell mound at the northeast end of the island, were delineated by State Coastal Commission standards following methods outlined in the currently applicable 1987 U.S. Army Corps of Engineers (ACOE) Wetland Delineation Manual. The ACOE utilizes a three-parameter method for making wetland determinations. It is based on the presence of three wetland indicators: wetland hydrology (permanent inundation or periodic saturation of the soil to the surface at some time during the growing season of the prevalent vegetation), a predominance of hydrophytic (water-loving) vegetation (plants adapted to anaerobic conditions resulting from a prolonged inundation with water) and hydric soils (soils that become saturated, flooded or ponded long enough during the growing season to develop anaerobic conditions that favor the growth of hydrophytic vegetation). The State Coastal Commission definition of wetlands is more restrictive in that it utilizes a one-parameter criterion for determining wetlands. It is based on the presence of any single wetland parameter: the presence of hydric soils, hydrophytic vegetation *or* wetland hydrology. Since Indian Island is located within the coastal zone and falls within Coastal Commission jurisdiction, the one-parameter criterion for making the determination was incorporated rather than the ACOE three-parameter criteria.

Digging was not permissible near the shell mound due to the culturally sensitive nature of the site. The wetland boundary along the perimeter of the mound was determined based on the dominant vegetation and surface indictors for wetland hydrology. Vegetation and hydrology data were collected at three observation points (one in the wetland, one along the wetland boundary, and another in the upland) along three transects that were established perpendicular to the wetland boundary. Tide data for the island furnished by Humboldt Water Resources, was obtained from local benchmarks in Humboldt Bay (NOAA website). Water marks, drift lines and sediment deposits were noted where they occurred. At the footing of the bridge, soil pits were dug along an additional three transects established perpendicular to the wetland boundary at this location. At each soil pit, all three parameters for determining wetland habitats were evaluated. The wetland/upland boundaries and all observation points/soil pits were marked in the field using white pin flags, and later surveyed and mapped by Humboldt Water Resources (Attachment 3). Data forms for all observation points and soil pits are included as Attachment 2 to this report. The data is summarized in Table 1 on page 4.

A compiled species list for the property is included as Attachment 1. Due to the seasonality of the field investigation, it is by no means a complete list of the species that inhabit the island. It is, however, useful in characterizing the site and can be used as baseline data for future studies or incorporated into existing species lists for the island. Nomenclature used follows *The Jepson Manual: Higher Plants of California* (Hickman 1993). The list includes the wetland status indicator for each species, taken from the most recent update of the *National List of Plant Species That Occur in Wetlands: 1988 National Summary* (Reed), as defined below:

OBL = Obligate Wetland. Occur in wetlands under natural conditions at an estimated probability > 99%.
FACW = Facultative Wetland. Usually occur in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands.
FAC = Facultative. Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).
FACU = Facultative Upland. Usually occur in non-wetlands (estimated probability 67%-99%), but occasionally found in wetlands (estimated probability1%-33%).
UPL = Obligate Upland. Occur in wetlands in another region, but occur almost always (estimated probability >99%) under natural conditions in non-wetlands in the region specified.
NL = Not Listed, generally considered upland.
NI = Not Indicated. Recorded for those species for which insufficient information was available to determine an indicator status.
* = Tentative assignment due to limited information.

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III. Results

As previously described, two upland sites occur on the north end of Indian Island, the shell mound and the area that makes up the footing of Samoa Bridge. The remaining land north of the bridge is considered estuarine salt marsh. Chilean cordgrass (*Spartina densiflora*) dominates much of the estuarine wetlands on the island. The highest elevations of the wetlands are characteristic of the mixed marsh subtype described by Eicher (1987) that support sizeable populations of two rare salt marsh species, Point Reyes Birds Beak (*Cordylanthus maritimus* ssp. *palustris*) and Humboldt Bay Owl's Clover (*Castilleja ambigua* ssp. *humboldtiensis*) (pers. comm. S. Gaydos, Humboldt Water Resources). Both species have annual life cycles and bloom during the summer months. They were not visible during the January 11 site visit. Identification of many other species proved difficult due to the time of year for which the site visit occurred.

The shell mound is dominated by upland vegetation, primarily exotic species brought in by settlers but also native coyote brush (*Baccharis pilularis*-NL). The mound is several feet deep, and has a thin (.25 inch) layer of black, loamy soil that is high in organic matter. Coyote brush is the dominant shrub along the perimeter of the mound and was one of the main indicators for the wetland/upland boundary. Other primary indicators include drift lines and sediment deposits, which were observed within the wetland transition zone. There is a distinct, more or less two-foot elevation drop between the edge of the shell mound where the coyote brush ends and where the lower elevation estuarine wetlands begin. The vegetation associated with wetland areas adjacent to the "inland" or southwest side of the shell mound includes pickleweed (*Salicornia virginica*-OBL), marsh rosemary (*Limonium californicum*-OBL), arrowgrass (*Triglochin maritimus*-OBL), Chilean cordgrass (*Spartina densiflora*-OBL), saltgrass (*Distichlis spicata*-FACW), *Jaumea carnosa*-OBL, and tufted hairgrass (*Deschampsia cespitosa*-FACW). Although soil pits were not dug in any wetland areas near the mound, the soils are expected to be hydric, unconsolidated bay mud and are subject to regular tidal inundation for at least part of the year. The National Wetland Inventory (NWI) classification for these wetlands is Estuarine (system), Intertidal (subsystem), Persistent Emergent (class) Wetlands or E2EM3 (Cowardin et al. 1979) that are regularly or irregularly flooded. Water chemistry is hyperhaline (dominance of ocean salts) to mixohaline (bwrackish).

There is an existing revetment on the bayside of the island bordered by a sparsely vegetated, sandy beach. The beach transitions into mudflats. Limited amounts of pickleweed, brass buttons (*Cotula coronopifolia*) and spear oracle (*Atriplex patula*) occur here (less than 2% cover). The NWI wetland classification for the beach and mudflats is Estuarine (system), Intertidal (subsystem), Unconsolidated Shore (class) wetlands that are regularly or irregularly flooded (Cowardin et al. 1979). During the field visit, a wrack line was observed slightly above the mean higher high water (MHHW) mark for the island, which is considered to be 7.32 ft. (National Oceanic and Atmospheric Association, August 6, 2002). Since the site visit occurred during a winter month, it is possible that the high wrack line was the result of a recent (extreme) storm event. The drift line likely represents the maximum level of inundation. Drift lines are considered a primary indicator for wetland hydrology and for this project may be used independently to determine the wetland boundary.

The wetlands on the northwest / bayside of the island transition into "deepwater habitats" at the mean lower low water (MLLW) mark of 0 feet. Deepwater habitats are defined as permanently flooded lands lying below the deepwater boundary (MLLW) of wetlands. The appropriate NWI classification for these habitats is Estuarine (system), Subtidal (subsystem), and Unconsolidated Bottom (class) (Cowardin et al. 1979). No appreciable amount of eel grass (*Zostera marina*) occurs in this area.

The fill material at the footing of Samoa Bridge was placed greater than five years prior to this investigation. It is considered the "new normal condition" as a strip of upland adjacent to the surrounding marsh. The fill soil is a dark grayish brown (10YR 4/2) sandy loam. It has a low chroma but no mottling or other oxidation-reduction features, except along the wetland boundary. The dominant vegetation in upland areas consists of upland or facultative upland herbs and shrubs such as Fuller's teasel (*Dipsacus sativus*-NL), cow parsnip (*Heracleum lanatum*-FACU), pearly everlasting (*Anaphalis margaritacea*-NL), yarrow (*Achillea millefolium*-FACU), sword fern (*Polystichum munitum*-NL), Queen Ann's lace (*Daucus carota*-NL), and coyote

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brush – NL, mixed with facultative and facultative-wet shrub and tree species such as California blackberry (*Rubus ursinus*-FAC+), red alder (*Alnus rubra*-FACW), Sitka spruce (*Picea sitchensis*-FAC) and/or wax myrtle (*Myrica californica*-FAC+). Along the wetland boundary, sandy loam soils become saturated within the upper twelve inches, and mottling and oxidized root channels occur occasionally. The vegetation is predominantly facultative and facultative wet. The wetland pits are all within the estuarine mixed marsh type, consisting of mainly obligate halophytic species such as arrowgrass, Chilean cordgrass, pickleweed, marsh rosemary, sicklegrass (*Parapholis* sp.) and a *Scirpus* sp. (possibly *Scirpus cernuus*). The soils within the estuarine wetland adjacent to the bridge site are a dark gray to very dark gray sandy loam or a sandy silt loam with common and distinct mottling. Soils become irregularly flooded with the tides.

IV. Wetlands Subject to Jurisdiction

The estuarine wetlands delineated on the north end of Indian Island occur within the Coastal Zone and fall under the jurisdiction of the State Coastal Commission. Generally, a 100-foot buffer is required to any development from a perennial wetland or drainage that occurs in the coastal zone. This buffer zone is measured as the horizontal distance from the wetland transition line, on either side of the perennial wetland or drainage. In addition, due to their association with Humboldt Bay, the estuarine wetlands meet the criteria for Waters of the United States and are subject to regulation by the U. S. Army Corps of Engineers.

Table 1. Summary of Soil Pit Data

Transect	Soil Pit	Hydrophytic Vegetation?	Wetland Hydrology?	Hydric Soils?	Determination
1	A	Yes	Yes	Yes	Wetland
1	B	Yes	Yes	No	Wetland Boundary
1	C	No	No	Marginal	Upland
2	A	Yes	Yes	Yes	Wetland
2	B	Yes	Yes	Yes	Wetland Boundary
2	C	No	No	No	Upland
3	A	Yes	Yes	Yes	Wetland
3	B	Yes	Yes	Yes	Wetland Boundary
3	C	No	No	No	Upland
4	A	Yes	Yes	*	Wetland
4	B	Yes	Yes	*	Wetland Boundary
4	C	No	No	*	Upland
5	A	Yes	Yes	*	Wetland
5	B	No	Yes	*	Wetland Boundary
5	C	No	No	*	Upland
6	A	Yes	Yes	*	Wetland
6	B	Marginal	Yes	*	Wetland Boundary
6	C	No	No	*	Upland

* = Observation point adjacent and/or on shell mound, no soil pit dug at this location.

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V. Discussion / Recommendations

Coastal estuarine wetlands are highly productive habitats. They provide essential breeding, rearing and feeding habitat for a variety of wildlife species, including mammals, birds, fish, and invertebrates. In and around Humboldt Bay they also provide habitat for two rare salt marsh plant species, Humboldt Bay owl's clover and Point Reyes bird's beak. Both Point Reyes bird's beak and Humboldt Bay owl's clover are on List 1B of the California Native Plant Society (CNPS) Inventory of Rare and Endangered Vascular Plants of California. They are distributed in a limited number of occurrences, endangered in a portion of their range, and endemic to California. Threats to these species are largely from coastal development (Skinner & Pavlik 1994).

In addition, a species of club-moss was observed near transect two in the upland adjacent to Samoa Bridge. Club mosses are rhizomatous perennials that do not die back during the winter. This specimen, however, was in poor condition and a positive identification was not made. It may be either bog club-moss (*Lycopodiella inundata*) or running pine (*Lycopodium clavatum*). Both bog club-moss and running pine are CNPS List 2 species, meaning they are considered rare, threatened or endangered in California, but are more common elsewhere. The population of club-moss should be investigated further in order to make a positive species identification, determine the overall health of the population, and to determine the extent of the population by conducting a more thorough botanical survey of the island prior to implementing any development in this location.

All plants on CNPS Lists 1B and 2 are eligible for state listing and must be fully considered during preparation of environmental documents relating to CEQA (California Environmental Quality Act) (Skinner & Pavlik 1994). Careful consideration should be given to any project design to insure that development and subsequent use of the site does not harm the integrity of these sensitive species and habitats.

The bayside of the shell mound supports intertidal mudflats and sandy beach that remain largely unvegetated, but are still part of the estuarine system connected to Humboldt Bay. This area provides limited foraging habitat for several different shorebird species, however it is not considered a primary shorebird use area within Humboldt Bay (pers comm. with Wildlife Biologist, David Fix, August 2002).

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VI. References and Literature Cited

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Attachment #1
Compiled Species List for North End of Indian Island
January 2002

Plant Species	Common Name	Wetland Status
Acacia melanoxylon	black acacia	NL
Achillea millefolium	yarrow	FACU
Agapanthus orientalis	lily-of-the-nile	NL
Agrostis stolonifera	creeping bent	FACW
Allium triquetrum	cultivated/ornamental onion	NL
Alnus rubra	red alder	FACW
Aloe sp.	aloe	Unknown
Alyssum sp.	alyssum	NL
Anaphalis margaritacea	pearly everlasting	NL
Athyrium felix-femina	lady fern	FAC
Baccharis douglasii	marsh Baccharis	OBL
Baccharis pilularis	coyote brush	NL
Bellis perennis	English daisy	NL
Botrychium multifidum	leather grape-fern	FAC
Brassica rapa	turnip, field mustard	NL
Cardamine oligosperma	bitter-cress, toothwort	FACW
Cirsium vulgare	bull thistle	FAC
Claytonia sibirica	candy flower	OBL
Conium maculatum	poison hemlock	FACW
Cortaderia jubata	pampas grass	NL
Cytisus scoparius	scotch broom	NL
Daucus carota	Queen Ann's lace	NL
Deschampsia cespitosa	tufted hairgrass	FACW
Dipsacus sativus	Fuller's teasel	NL
Distichlis spicata	saltgrass	FACW
Equisetum sp.	horsetail	FAC
Erechites minima	fireweed	NL
Foeniculum vulgare	fennel	FACU
Fuchsia sp.	fuchsia	NL
Galium aparine	bedstraw	FACU
Geranium dissectum	wild geranium	NL
Geranium molle	geranium	NL
Gnaphalium sp.	cudweed	Unknown
Grindelia stricta var. *stricta*	gumplant	NL
Hedera helix	English ivy	NL
Heracleum lanatum	cow parsnip	FACU
Holcus lanatus	velvet grass	FAC
Hyacinthus sp.	hyacinth	Unknown
Hypochaeris radicata	rough cat's ear	NL
Jaumea carnosa	jaumea	OBL
Juncus effusus	common rush	OBL
Ligustrum sp.	privet	Unknown
Limonium californicum	western marsh rosemary	OBL
Lotus corniculatus	bird's foot trefoil	FAC
Lupinus sp.	lupine	Unknown
Lycopodium clavatum or	running pine or	NL

Plant Species	Common Name	Wetland Status
Lycopodiella inundata	bog club-moss	FAC
Montia linearis	montia	NL
Myrica californica	wax myrtle	FAC+
Narcissus sp.	daffodil	NL
Parapholis strigosa	sicklegrass	OBL
Phalaris sp.	reed grass	Unknown
Picea sitchensis	Sitka spruce	FAC
Pittosporum crassifolium	pittosporum	NL
Plantago lanceolata	English plantain	FAC-
Polygonum sp.	knotweed	Unknown
Polystichum munitum	sword fern	NL
Potentilla anserina ssp. pacifica	cinquefoil	OBL
Ranunculus repens	buttercup	FACW
Raphanus sativus	radish	UPL
Rhamnus purshiana	cascara	NL
Ribes sanguineum var. *glutinosum*	red-flowering currant	NL
Rubus ursinsus	California blackberry	FAC+
Rubus discolor	Himalayan blackberry	FAC+
Rumex sp.	dock	Unknown
Salicornia virginica	pickleweed	OBL
Salix lasiolepis (possible x *S. hookeriana)*	Arroyo willow	FACW
Scirpus cernuus	scirpus	OBL
Scrophularia californica	California figwort	FAC
Silybum marianum	milk thistle	NL
Solanum nigrum	black nightshade	FACU
Sonchus asper	sow thistle	FAC
Spartina densiflora	Chilean cordgrass	OBL
Trifolium sp.	clover	Unknown
Trifolium dubium	little hop clover	FACU*
Triglochin maritima	seaside arrowgrass	OBL
Triglochin concinna	arrowgrass	OBL
Vaccinium ovatum	evergreen huckleberry	NL
Vinca major	periwinkle	NL
Vicia sp.	vetch	Unknown

Note: All nomenclature conforms to The Jepson Manual (Hickman, 1993)

Wetland Status (National Wetland Inventory, 1996 revision):

OBL=obligate wetland
FACW=facultative wetland
FAC=facultative
FACU=facultative upland
UPL=upland
NL=not listed, generally considered upland
NI=insufficient information available to determine status
* = tentative assignment due to limited information
Unknown= unable to identify plant to species due to absence of key taxonomic feature(s)

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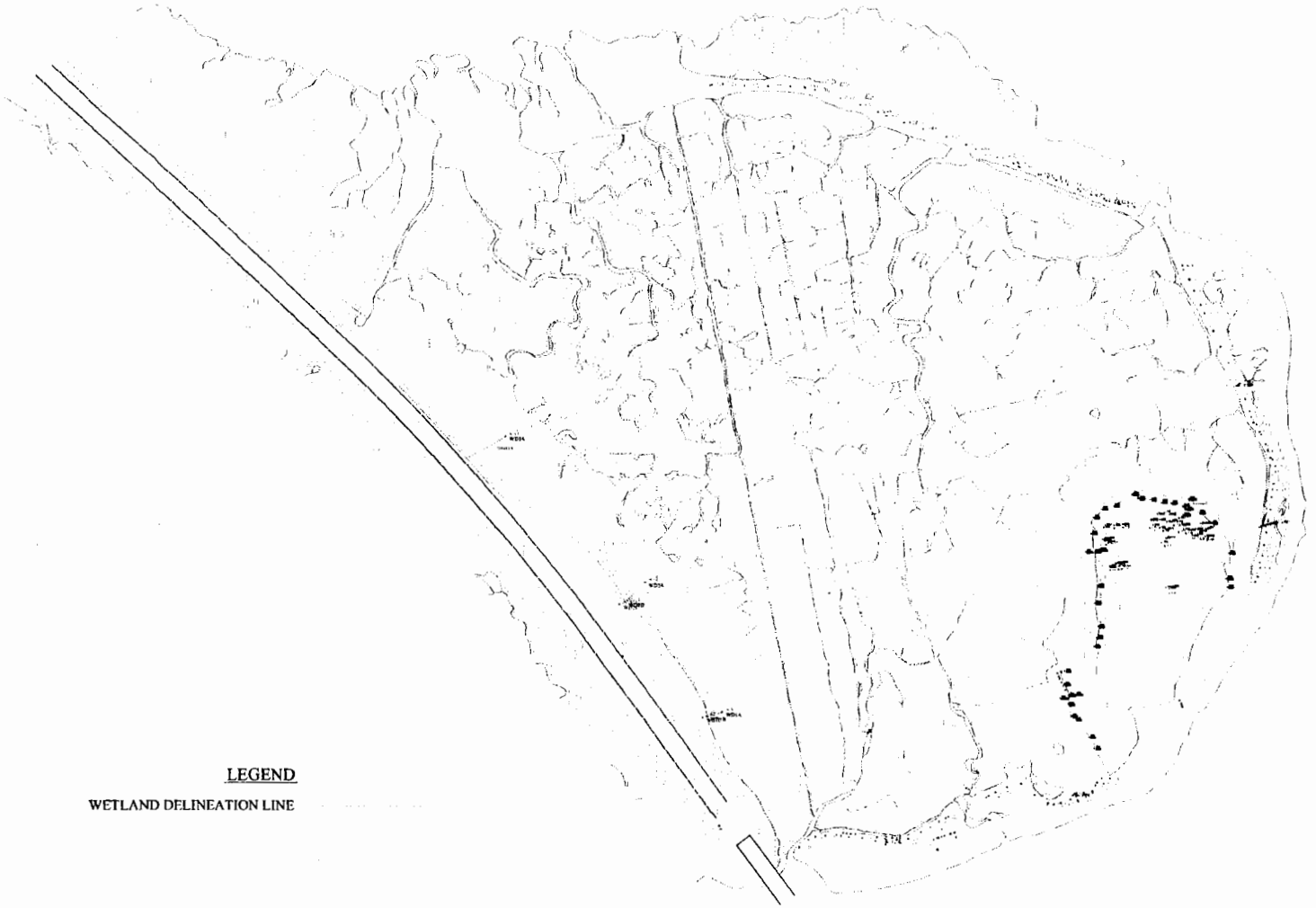
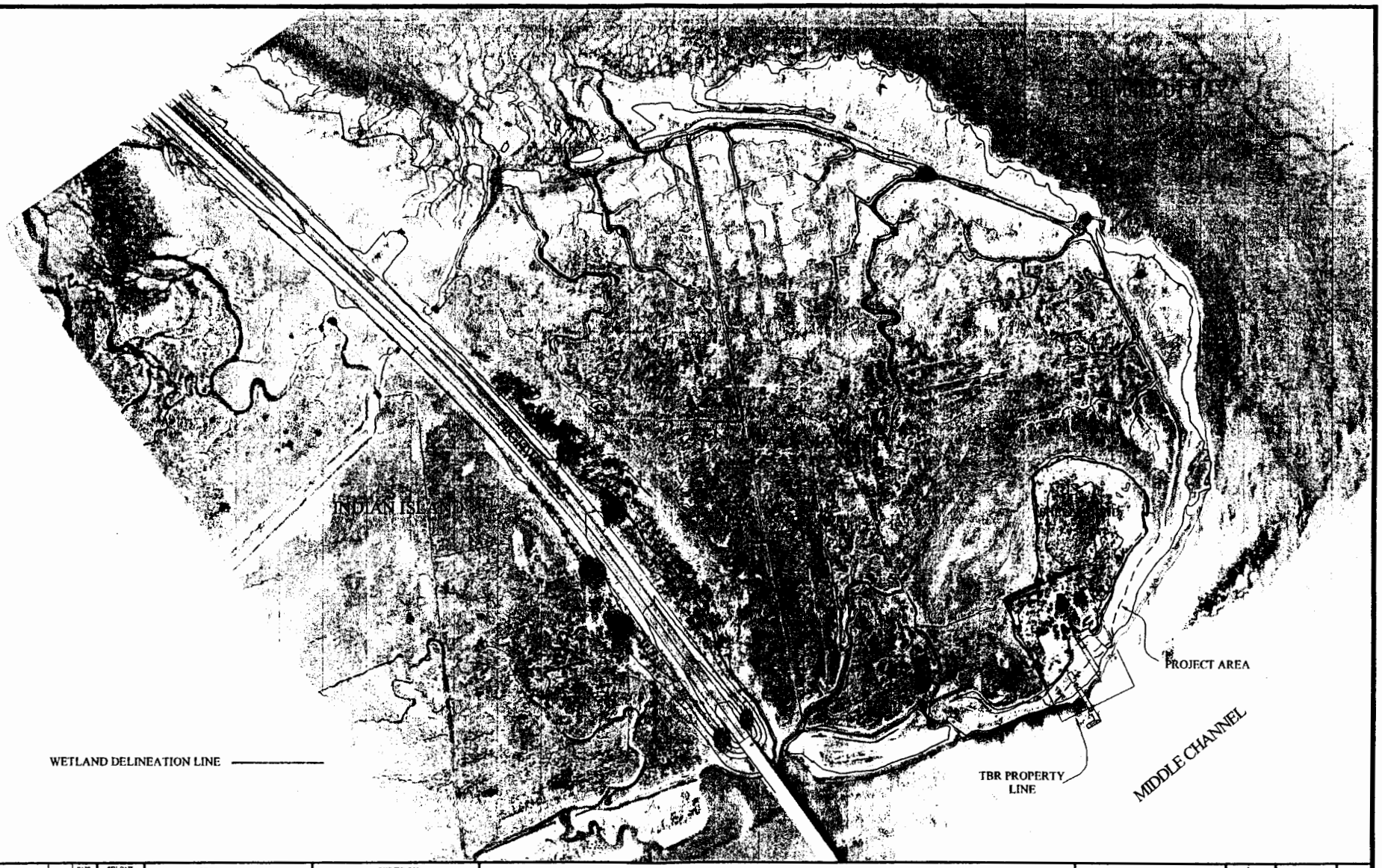


LEGEND

WETLAND DELINEATION LINE

PREPARED BY	KB	DATE 4/03	REV DATE	PREPARED FOR HUMBOLDT WATER RESOURCES P.O. BOX 165 ARCATA, CA 95521 (707)826-2869	OWNED BY	**INDIAN ISLAND** **WETLAND DELINEATION MAP** **Humboldt County, California**	GMA GRAHAM MATTHEWS & ASSOCIATES	N	SCALE 0 100	SHEET 1/1
REVIEWED BY									



		date	REV. DATE
PREPARED BY	KB	6/03	
REVIEWED BY	MW	6/03	

PREPARED FOR
HUMBOLDT WATER RESOURCES
P.O. BOX 145
ARCATA, CA 95521
(707)826-2869

OWNED BY
TABLE BLUFF
RESERVATION-WIYOT TRIBE
AND CITY OF EUREKA

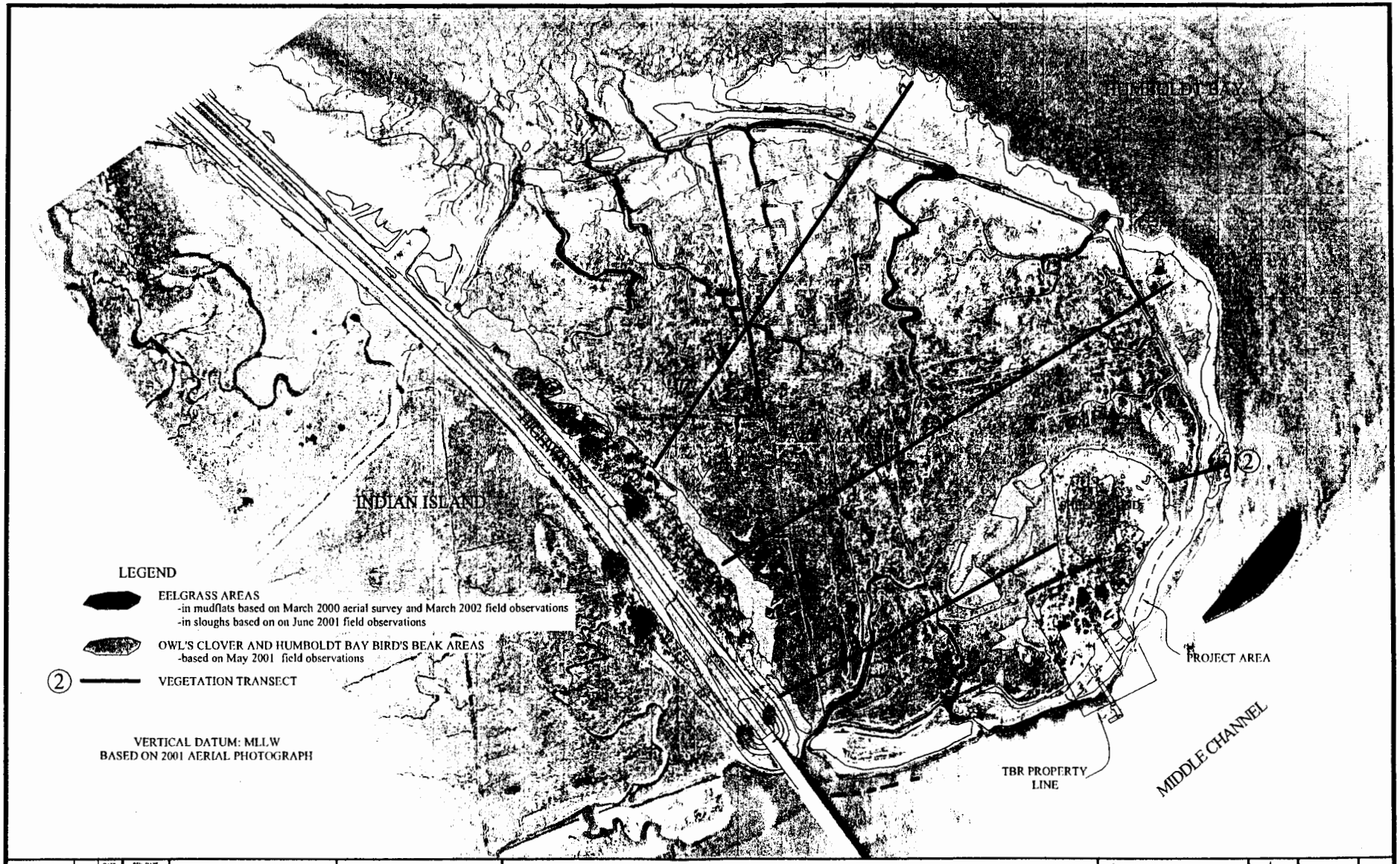
INDIAN ISLAND
WETLAND DELINEATION MAP
Humboldt County, California

GMA
GRAHAM MATTHEWS & ASSOCIATES

N

SCALE 0 100

SHEET 1/4



		DATE	BY: DATE
PREPARED BY	KB	6/03	
REVIEWED BY	MW	6/03	

PREPARED FOR
HUMBOLDT WATER RESOURCES
P.O. BOX 165
ARCATA, CA 95521
(707)826-2860

OWNED BY
TABLE BLUFF
RESERVATION-WIYOT TRIBE
AND CITY OF EUREKA

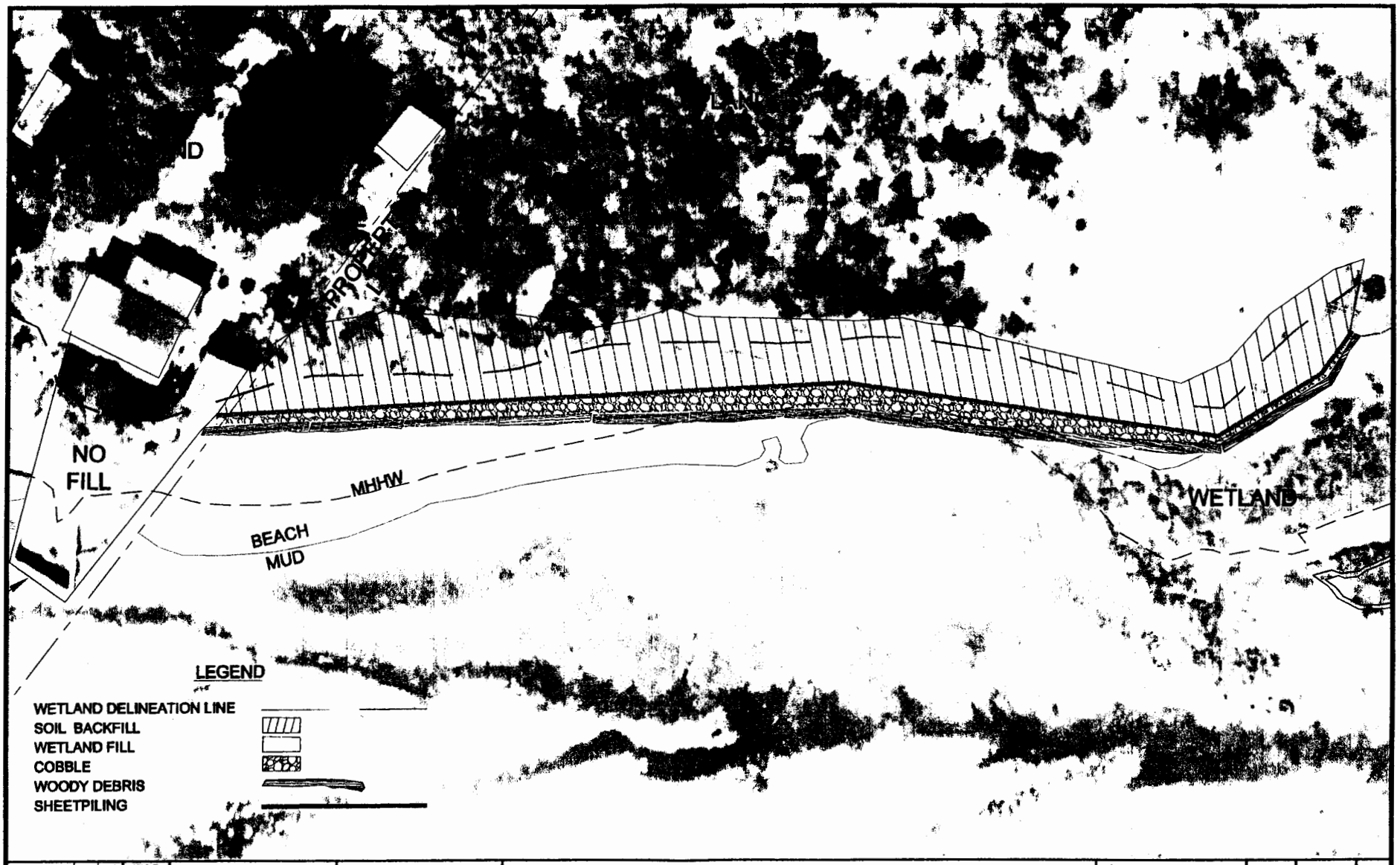
INDIAN ISLAND
VEGETATION TRANSECTS AND SPECIAL STATUS PLANT SPECIES
Humboldt County, California

GMA
GRAHAM MATTHEWS & ASSOCIATES

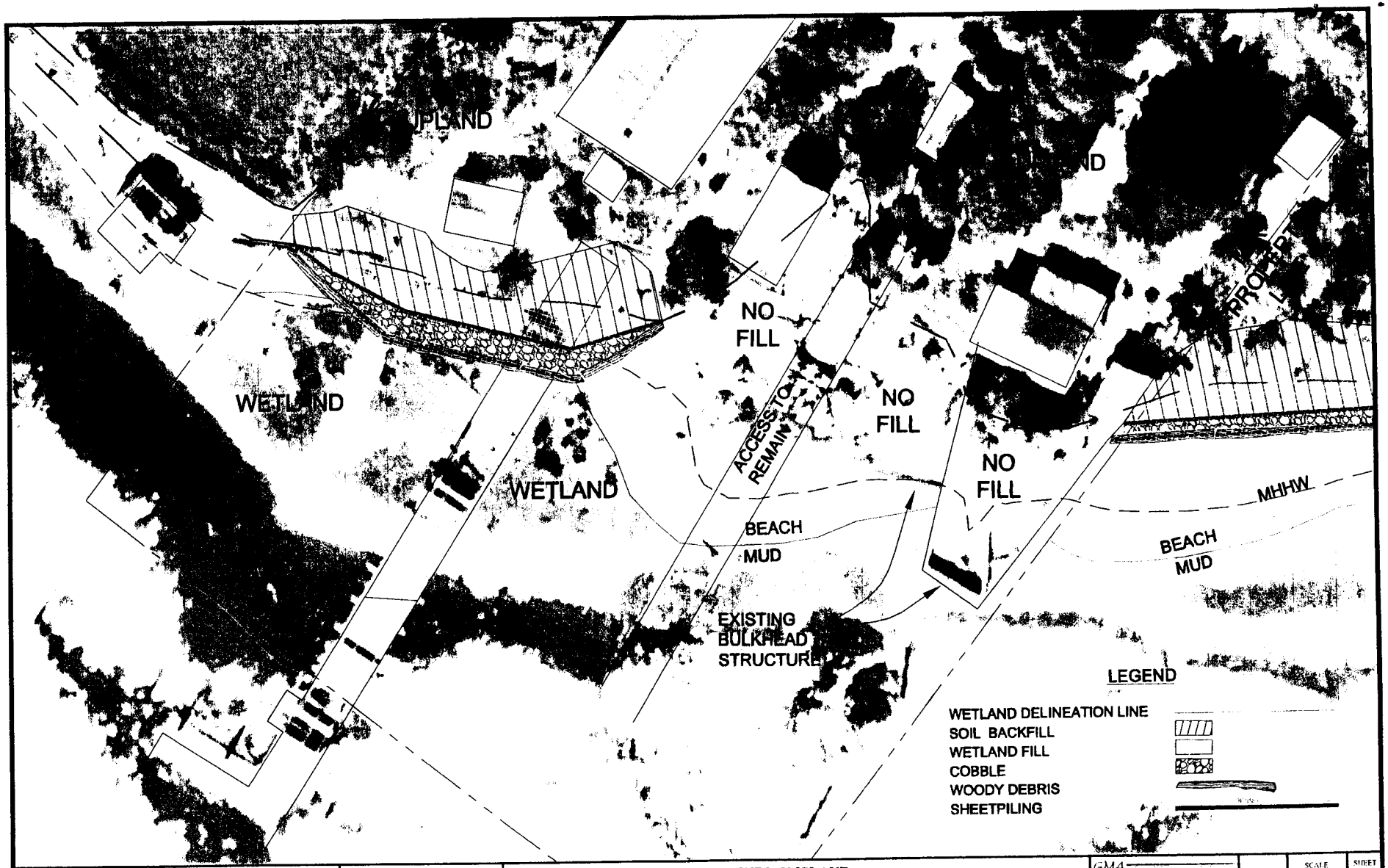
N

SCALE 0 100

SHEET 3/4



PREPARED BY	KB	6/03		PREPARED FOR: HUMBOLDT WATER RESOURCES, P.O. BOX 165, ARCATA, CA 95521, (707)826-2069	OWNED BY: TABLE BLUFF RESERVATION-WIYOT TRIBE AND CITY OF EUREKA	**INDIAN ISLAND** **NORTHERN SHEET PILE DETAIL WITH WETLAND DELINEATION** **Humboldt County, California**	GMA GRAHAM MATTHEWS & ASSOCIATES	SCALE 0 10	SHEET 3/4
REVIEWED BY	MW	6/03						



		DATE	REV. DATE	PREPARED FOR	OWNED BY	INDIAN ISLAND SOUTHERN SHEET PILE DETAIL WITH WETLAND DELINEATION Humboldt County, California	GMA GRAHAM MATTHEWS & ASSOCIATES		SCALE	SHEET
PREPARED BY	KB	6/03		HUMBOLDT WATER RESOURCES P.O. BOX 165 ARCATA, CA 95521 (707)826-2869	TABLE BLUFF RESERVATION-WIYOT TRIBE AND CITY OF EUREKA				0 10	4/4
REVIEWED BY	MW	6/03								

VEGETATION SURVEY
INDIAN ISLAND
HUMBOLDT COUNTY, CALIFORNIA

Prepared by

Annie L. Eicher

Results of Salt Marsh Sampling on Indian Island - November 13th 2001

Results of Salt Marsh Sampling on Indian Island - February 22nd, 2002

Results of Salt Marsh Sampling on Indian Island - June 14th, 2002

Results of Upland Plant Species Reconnaissance - March 18th, 2002

Results of Plant Species Reconnaissance - August 1st 2002

SALT MARSH SAMPLING ON INDIAN ISLAND
11-13-01

Methods
On November 13, 2001, a site visit was made to Indian Island. Two transects were established for the purpose of collecting information on the salt marsh vegetation types present on the site in a manner that could be correlated with tidal elevation. A total of 14 plots were established and flagged (numbers 1-14). Additional flags were placed along the transects to mark observed transitions between vegetation types (labeled A-Q). For transect 1, the plots were placed at approximate 100-foot intervals (measured by paces), and for transect 2, the plots were placed at approximate 20-foot intervals. At each sample plot, a 1-m^2 plot framed was placed down. All plant species observed occurring in the frame were recorded and an ocular estimate of relative cover was made for each species. Elevation data will be collected for all plot locations and the locations of transition points.

Results
Four types of salt marsh plant vegetation types were observed occurring at the study site. The pattern of distribution of these vegetation types is best described as a mosaic. The occurrence of any one vegetation type at any one location is influenced by a variety of factors including elevation, substrate, proximity to a channel, wave action, frequency and duration of tidal inundation, and salinity. Variations in one or more of these factors account for microhabitats, resulting in the mosaic pattern observed. The four vegetation types observed are:

1. Pickleweed
2. Cordgrass
3. Cordgrass/Pickleweed
4. Pickleweed/Saltgrass

A summary of plot data is shown in table 1. In table 2, the plots are arranged by vegetation type to provide a descriptive overview of plant species composition for each type. The low number of plots sampled does not provide much of a base for statistical analyses, however, a few general observations can be made. The most frequently encountered vegetation type was pickleweed/ saltgrass (7 of 14 plots or 50% frequency), and no plots fell in the cordgrass vegetation type. Table 3 and figure 1 provide summaries of the transition point data. A list of all species observed is included in tables 1-3. At this time of year, many salt marsh species are not visible above-ground. A plant survey conducted in May through September would yield a more complete plant species list. The largest increase in plant species diversity (i.e., in comparing the data collected 11-13-01 with a survey conducted during the growing season) would most likely be seen in the pickleweed/saltgrass vegetation type.

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Pickleweed

The pickleweed vegetation type is characterized by the sole dominant perennial pickleweed (*Salicornia virginica*) (table 2), but may include trace amounts of other species. This vegetation type is typically associated with low elevations in the salt marsh.

Cordgrass

The cordgrass vegetation type is characterized by the sole dominant Chilean cordgrass (*Spartina densiflora*), but may include trace amounts of other species. This vegetation type is typically associated with mid elevations in the salt marsh.

Cordgrass/Pickleweed

The cordgrass/pickleweed vegetation type is characterized by co-dominance of Chilean cordgrass and perennial pickleweed, but may include other species. This vegetation type is typically associated with mid elevations in the salt marsh. At the study site, sample plots in the cordgrass/pickleweed vegetation type had a mean cover of 56% cordgrass and 35% pickleweed (n=4) (table 2).

Pickleweed/Saltgrass

The pickleweed/saltgrass vegetation type is the most diverse of the types observed. Typically, perennial pickleweed and saltgrass (*Distichlis spicata*) have high cover, and fleshy jaumea (*Jaumea carnosa*) is commonly present, sometimes with high cover. At the study site, sample plots in the pickleweed/saltgrass vegetation type had a mean cover of 35% pickleweed, 28% saltgrass, and 16% jaumea (n=7) (table 2). Cordgrass is sometimes present, but generally with low cover and usually the plants themselves are less robust than the cordgrass found in the cordgrass or cordgrass/pickleweed vegetation types. This picleweed/saltgrass vegetation type is typically associated with high elevations in the salt marsh.

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Table 1. Salt Marsh Sample Plots on Indian Island, 11-13-01

Plot number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Plot location (transect-feet):	1-0	1-100	1-200	1-300	1-400	1-500	1-600	1-700	2-6	2-26	2-46	2-70	2-99	2-120
Plot type:	Sa/Di	Sp/Sa	Sa/Di	Sa	Sp/Sa	Sa/Di	Sa/Di	Sa/Di	Sa	Sa/Di	Sp/Sa	Sa/Di	Sa	Sp/Sa
Atriplex patula												5		
Cordylanthus maritimus			Tr											
Distichlis spicata	40		35			10	45	5		40		20		
Jaumea carnosa	10		45			25	1	5		5		20		
Limonium californicum	5		10					1				1		
Salicornia virginica	35	45	5	95	20	15	45	60	95	35	50	50	90	25
Spartina densiflora		45	Tr		70	20	5	20		15	40			70
Total Cover:	90	90	95	95	90	70	96	91	95	95	90	96	90	95

Plant Species List	
Atriplex patula	orache
Cordylanthus maritimus	Point Reyes bird's beak
Distichlis spicata	saltgrass
Jaumea carnosa	fleshy jaumea
Limonium californicum	sea lavender
Salicornia virginica	perennial pickleweed
Spartina densiflora	Chilean cordgrass

Vegetation Types	
Sa	Pickleweed
Sa/Di	Pickleweed/Saltgrass
Sp/Sa	Cordgrass/Pickleweed
Sp	Cordgrass

Table 2. Salt Marsh Sample Plots on Indian Island, 11-13-01: Summary by Plant Community Type

Plot number:	4	9	13			1	3	6	7	8	10	12			2	5	11	14		
Plot location (transect-feet):	1-300	2-6	2-99			1-0	1-200	1-500	1-600	1-700	2-26	2-70			1-100	1-400	2-46	2-120		
Plot type:	Sa	Sa	Sa	mean	st dev	Sa/Di	Sa/Di	Sa/Di	Sa/Di	Sa/Di	Sa/Di	Sa/Di	mean	st dev	Sp/Sa	Sp/Sa	Sp/Sa	Sp/Sa	mean	st dev
Atriplex patula				0.0	0.0							5	5.0	0.0					0.0	0.0
Cordylanthus maritimus				0.0	0.0		Tr						0.0	0.0					0.0	0.0
Distichlis spicata				0.0	0.0	40	35	10	45	5	40	20	27.9	16.0					0.0	0.0
Jaumea carnosa				0.0	0.0	10	45	25	1	5	5	20	15.9	15.5					0.0	0.0
Limonium californicum				0.0	0.0	5	10			1		1	4.3	4.3					0.0	0
Salicornia virginica	95	95	90	93.3	2.9	35	5	15	45	60	35	50	35.0	19.4	45	20	50	25	35.0	14.7
Spartina densiflora				0.0	0.0		Tr	20	5	20	15		15.0	7.1	45	70	40	70	56.3	16.0
Total Cover:	95	95	90	93.3	2.9	90	95	70	96	91	95	96	90.4	9.3	90	90	90	95	91.3	2.5

Plant Species List	
Atriplex patula	orache
Cordylanthus maritimus	Point Reyes bird's beak
Distichlis spicata	saltgrass
Jaumea carnosa	fleshy jaumea
Limonium californicum	sea lavender
Salicornia virginica	perennial pickleweed
Spartina densiflora	Chilean cordgrass

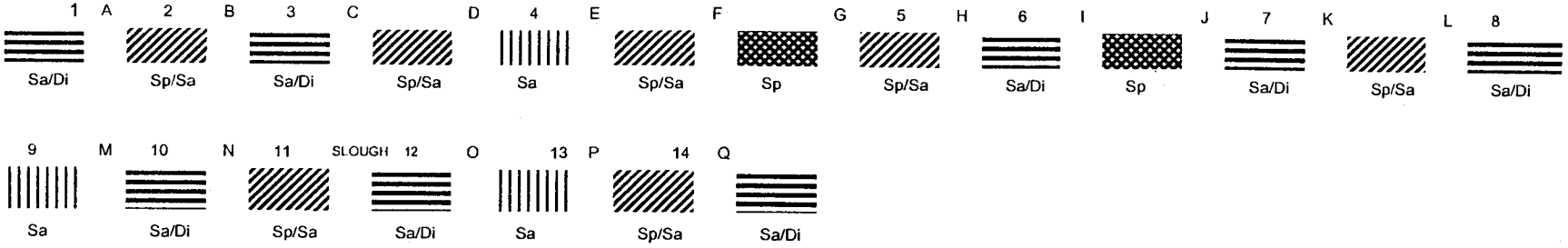
Vegetation Types	
Sa	Pickleweed
Sa/Di	Pickleweed/Saltgrass
Sp/Sa	Cordgrass/Pickleweed
Sp	Cordgrass

Table 3. Salt Marsh Sampling on Indian Island, 11-13-01: Summary of Transition Points

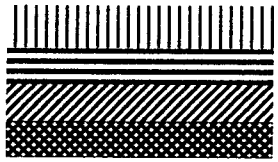
Transition point:	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Location, estimated (transect-feet)	1-30	1-156	1-284	1-298	1-316	1-340	1-396	1-456	1-515	1-592	1-604	1-698	2-20	2-29	2-76	2-100	2-124
Location, measured (transect-feet):																	
Located between plots:	1-2	2-3	3-4	3-4	4-5	4-5	4-5	5-6	6-7	6-7	7-8	7-8	9-10	10-11	12-13	13-14	
Transition type																	
Sa -> Sa/Di													X				
Sa -> Sp/Sa					X											X	
Sa -> Sp																	
Sa/Di -> Sa															X		
Sa/Di -> Sp/Sa	X		X								X			X			
Sa/Di -> Sp									X								
Sp/Sa -> Sa				X													
Sp/Sa ->Sa/Di		X						X				X					X
Sp/Sa -> Sp						X											
Sp -> Sa																	
Sp -> Sa/Di										X				X			
Sp -> Sp/Sa							X										
Edge of Slough								X	X					X			

Vegetation Types	
Sa	Pickleweed
Sa/Di	Pickleweed/Saltgrass
Sp/Sa	Cordgrass/Pickleweed
Sp	Cordgrass

Figure 1. Salt Marsh Sampling on Indian Island, 11-13-01: Summary of Transitions



Sa	Pickleweed
Sa/Di	Pickleweed/Saltgrass
Sp/Sa	Cordgrass/Pickleweed
Sp	Cordgrass



SALT MARSH SAMPLING ON INDIAN ISLAND
2-22-02

Methods
On February 22, 2002, a site visit was made to Indian Island. Two transects were established for the purpose of collecting information on the salt marsh vegetation types present on the site in a manner that could be correlated with tidal elevation. This data set supplements data collected November 13, 2001. A total of 24 plots were established and flagged (transect 3: plots 1-14 and transect 4: plots 1-10). Additional flags were placed along the transects to mark observed transitions between vegetation types (labeled TR through TBA). For both transects, the plots were placed at approximate 100-foot intervals (measured by paces). At each sample plot, a 1-m^2 plot frame was placed down. All plant species observed occurring in the frame were recorded and an ocular estimate of relative cover was made for each species. Elevation data will be collected for all plot locations and the locations of transition points.

Results
Four types of salt marsh plant vegetation types were observed occurring at the study site. The pattern of distribution of these vegetation types is best described as a mosaic. The occurrence of any one vegetation type at any one location is influenced by a variety of factors including elevation, substrate, proximity to a channel, wave action, frequency and duration of tidal inundation, and salinity. Variations in one or more of these factors account for microhabitats, resulting in the mosaic pattern observed. The four vegetation types observed are:

1. Pickleweed
2. Cordgrass
3. Cordgrass/Pickleweed
4. Pickleweed/Saltgrass

A summary of plot data is shown in table 1. In table 2, the plots are arranged by vegetation type to provide a descriptive overview of plant species composition for each type. The low number of plots sampled does not provide much of a base for statistical analyses, however, a few general observations can be made. The most frequently encountered vegetation types were cordgrass/pickleweed and cordgrass (each type occurring in 9 of 24 plots or 38% frequency), and no plots fell in the pickleweed vegetation type. A list of all species observed is included in tables 1-2. Table 3 provides a summary of the transition point data. At this time of year, many salt marsh species are not visible above-ground. A plant survey conducted in May through September would yield a more complete plant species list. The largest increase in plant species diversity (i.e., in comparing the data collected 2-22-02 with a survey conducted during the growing season) would most likely be seen in the pickleweed/saltgrass vegetation type.

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Pickleweed

The pickleweed vegetation type is characterized by the sole dominant perennial pickleweed (*Salicornia virginica*), but may include trace amounts of other species. This vegetation type is typically associated with low elevations in the salt marsh.

Cordgrass

The cordgrass vegetation type is characterized by the sole dominant Chilean cordgrass (*Spartina densiflora*) (table 2), but may include trace amounts of other species. This vegetation type is typically associated with mid elevations in the salt marsh.

Cordgrass/Pickleweed

The cordgrass/pickleweed vegetation type is characterized by co-dominance of Chilean cordgrass and perennial pickleweed, but may include other species. This vegetation type is typically associated with mid elevations in the salt marsh. At the study site, plots sampled 2-22-02 in the cordgrass/pickleweed vegetation type had a mean cover of 57% cordgrass and 33% pickleweed (n=9) (table 2). This is very close to the 11-13-01 data set, which resulted in 56% cordgrass and 35% pickleweed.

Pickleweed/Saltgrass

The pickleweed/saltgrass vegetation type is the most diverse of the types observed. Typically, perennial pickleweed and saltgrass (*Distichlis spicata*) have high cover, and fleshy jaumea (*Jaumea carnosa*) is commonly present, sometimes with high cover. At the study site, plots sampled 2-22-02 in the pickleweed/saltgrass vegetation type had a mean cover of 22% pickleweed (11-13-01: 35%), 45% saltgrass (11-13-01: 28%), and 8% jaumea (11-13-01: 16%) (n=5) (table 2). Cordgrass is sometimes present, but generally with low cover and usually the plants themselves are less robust than the cordgrass found in the cordgrass or cordgrass/pickleweed vegetation types. This picleweed/saltgrass vegetation type is typically associated with high elevations in the salt marsh.

9927

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Table 1. Salt Marsh Sample Plots on Indian Island, 2-22-02

Percent Cover

Transect number:	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Plot number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Plot location (feet):	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300
Plot type:	Sa/Di	Sp	Sp	Sp	Sa/Di	Sp/Sa	Sp/Sa	Sp/Sa	Sp	Sp/Sa	Sp/Sa	Sp/Sa	Sp	mud
Distichlis spicata	40				80								5	
Jaumea carnosa	2													
Limonium californicum	5				T									
Salicornia virginica	10	10	15	T*	10	30	30	30	5	40	40	40	15	
Spartina densiflora	5	80	80	95		40	65	65	90	55	55	50	50	
Triglochin maritimum	8													
Total Cover:	70	90	95	95	90	70	95	95	95	95	95	90	70	0

*T = Trace

Plant Species List	
Distichlis spicata	saltgrass
Jaumea carnosa	fleshy jaumea
Limonium californicum	sea lavender
Salicornia virginica	perennial pickleweed
Spartina densiflora	Chilean cordgrass
Triglochin maritimum	arrowgrass

Vegetation Types	
Sa	Pickleweed
Sa/Di	Pickleweed/Saltgrass
Sp/Sa	Cordgrass/Pickleweed
Sp	Cordgrass

Table 1. Salt Marsh Sample Plots on Indian Island, 2-22-02

Percent Cover

Transect number:	4	4	4	4	4	4	4	4	4	4
Plot number:	1	2	3	4	5	6	7	8	9	10
Plot location (feet):	0	100	200	300	400	500	600	700	800	900
Plot type:	Sa/Di	Sp/Sa	Sp	Sp	Sa/Di	SpSa	Sp	Sa/Di	Sp/Sa	Sp
Distichlis spicata					20			40		
Jaumea carnosa	10				20			1		
Limonium californicum										
Salicornia virginica	40	30			20	25		30	30	25
Spartina densiflora	20	45	95	95		70	95	5	65	70
Triglochin maritimum										
Total Cover:	70	75	95	95	60	95	95	76	95	95

*T = Trace

Plant Species List	
Distichlis spicata	saltgrass
Jaumea carnosa	fleshy jaumea
Limonium californicum	sea lavender
Salicornia virginica	perennial pickleweed
Spartina densiflora	Chilean cordgrass
Triglochin maritimum	arrowgrass

Vegetation Types	
Sa	Pickleweed
Sa/Di	Pickleweed/Saltgrass
Sp/Sa	Cordgrass/Pickleweed
Sp	Cordgrass

Table 2. Salt Marsh Sample Plots on Indian Island, 2-22-02: Summary by Vegetation Type

Percent cover

Transect number:	3		3	3	4	4	4				3	3	3	3	3	4	4	4	4		
Plot number:	14		1	5	1	5	8				2	3	4	9	13	3	4	7	10		
Plot location (feet):	1300		0	400	0	400	700				100	200	300	800	1200	200	300	600	900		
Plot type:	mud		Sa/Di	Sa/Di	Sa/Di	Sa/Di	Sa/Di	mean	st dev		Sp	Sp	Sp	Sp	Sp	Sp	Sp	Sp	Sp	mean	st dev
Distichlis spicata			40	80		20	40	45.0	25.2						5					5.0	N/A
Jaumea carnosa			2		10	20	1	8.3	8.8											0.0	0.0
Limonium californicum			5	T				5.0	N/A											0.0	0.0
Salicornia virginica			10	10	40	20	30	22.0	13.0		10	15	T*	5	15				25	14.0	7.4
Spartina densiflora			5		20		5	10.0	8.7		80	80	95	90	50	95	95	95	70	83.3	15.4
Triglochin maritimum			8					8.0	N/A											0.0	0.0
Total Cover:	0		70	90	70	60	76	73.2	11.0		90	95	95	95	70	95	95	95	95	91.7	8.3

*T = Trace

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Table 2. Salt Marsh Sample Plots on Indian Island, 2-22-02: Summary by Vegetation Type

Percent cover

Transect number:	3	3	3	3	3	3	4	4	4		
Plot number:	6	7	8	10	11	12	2	9	6		
Plot location (feet):	500	600	700	900	1000	1100	100	800	500		
Plot type:	Sp/Sa	Sp/Sa	Sp/Sa	Sp/Sa	Sp/Sa	Sp/Sa	Sp/Sa	Sp/Sa	SpSa	mean	st dev
Distichlis spicata										0.0	0.0
Jaumea carnosa										0.0	0.0
Limonium californicum										0.0	0.0
Salicornia virginica	30	30	30	40	40	40	30	30	25	32.8	5.7
Spartina densiflora	40	65	65	55	55	50	45	65	70	56.7	10.3
Triglochin maritimum										0.0	0.0
Total Cover:	70	95	95	95	95	90	75	95	95	89.4	9.8

*T = Trace

Table 3. Salt Marsh Sampling on Indian Island, 2-22-02: Transitions

Transect #	Feet	Vegetation Type	Transition	Plot #
3	0	Sa/Di		1
3	40		TR	
3	100	Sp		2
3	200	Sp		3
3	218		TS	
3		Sa/Di		
3	268		TT	
3	300	Sp		4
3	364		TU	
3	400	Sa/Di		5
3	456		TV	
3	500	Sp/Sa		6
3	omit		TW	
3	600	Sp/Sa		7
3	700	Sp/Sa		8
3	776		TX	
3	800	Sp		9
3	824		TY	
3	900	Sp/Sa		10
3	908		TZ	
3		Sa/Di		
3	924		TAA	
3		Sp		
3	938		TAB	
3		Sa/Di		
3	980		TAC	
3	1000	Sp/Sa		11
3	1026		TAD	
3		Sa/Di		
3	1032		TAE	
3		Sp		
3	1096		TAF	
3	1100	Sp/Sa		12
3	1134		TAG	
3		Sa/Di		
3	1178		TAH	
3	1200	Sp		13
3	1280		TAI	
3		Sp/Sa		
3	1300	pond		14
4	0	Sa/Di		1
4	6		TAJ	
4	100	Sp/Sa		2
4	114		TAK	
4		Sa		
4	128	slough (end of Sa)	TAL	
4	180	slough (beg of Sp)	TAM	
4	200	Sp		3
4	216		TAN	

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Table 3. Salt Marsh Sampling on Indian Island, 2-22-02: Transitions

Transect #	Feet	Vegetation Type	Transition	Plot #
4		Sa/Di		
4	272		TAO	
4	300	Sp		4
4	308		TAP	
4		Sa/Di		
4	322		TAQ	
4		Sp		
4	346		TAR	
4	400	Sa/Di		5
4	416		TAS	
4		Sp		
4	430		TAT	
4		Sa/Di		
4	466		TAU	
4		Sp		
4	498		TAV	
4	500	Sp/Sa		6
4	578		TAW	
4	600	Sp		7
4	634		TAX	
4		Sp/Sa		
4	662		TAY	
4	700	Sa/Di		8
4	724		TAZ	
4	800	Sp/Sa		9
4	900	Sp/Sa		10

Vegetation Types	
Sa	Pickleweed
Sa/Di	Pickleweed/Saltgrass
Sp/Sa	Cordgrass/Pickleweed
Sp	Cordgrass

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SALT MARSH SAMPLING ON INDIAN ISLAND
6-14-02

Methods
On June 14, 2002, a site visit was made to Indian Island. Four previously established transects were sampled for vegetation characteristics. The transects were established to collect information on salt marsh vegetation types in a manner that could be correlated with tidal elevation. All of the plots were flagged at the time of establishment. Humboldt Water Resources (HWR) collected elevation data for each sample plot.

Previous work included vegetation sampling on November 13, 2001 and February 22, 2002—times when some salt marsh species are dormant. The data presented in this report, collected during the growing season, therefore provide a more complete representation of the plants found on the site than the previous investigations.

A total of 38 plots were sampled. At each sample plot, a 1-m^2 plot frame was placed down. All plant species observed occurring in the frame were recorded and an ocular estimate of relative cover was made for each species.

Results
Four types of salt marsh plant vegetation types were observed occurring at the study site. The pattern of distribution of these vegetation types is best described as a mosaic. The occurrence of any one vegetation type at any one location is influenced by a variety of factors including elevation, substrate, proximity to a channel, wave action, frequency and duration of tidal inundation, and salinity. Variations in one or more of these factors account for microhabitats, resulting in the mosaic pattern observed. The four vegetation types observed are:

1. Pickleweed
2. Cordgrass
3. Cordgrass/Pickleweed
4. Pickleweed/Saltgrass

A summary of plot data is shown in table 1. In table 2, the mean cover of each species is shown for each vegetation type to provide a descriptive overview of plant species composition. A list of all species observed is included as appendix A.

The low number of plots sampled does not provide much of a base for statistical analysis, however, a few general observations can be made. The most frequently encountered vegetation types were cordgrass/pickleweed and pickleweed/saltgrass. The highest species diversity occurred in the pickleweed/saltgrass vegetation type. HWR found that the pickleweed type occurred at the lowest elevations, the cordgrass/pickleweed and cordgrass types occurred at mid elevations, and the pickleweed/saltgrass type occurred at

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the highest elevations. These results are consistent with Eicher (1987). The following section contains a description and notes about each of the salt marsh vegetation types found on Indian Island.

Pickleweed

The pickleweed vegetation type is characterized by the sole dominant perennial pickleweed (*Salicornia virginica*), but may include trace amounts of other species. This vegetation type is typically associated with low elevations in the salt marsh. The 6-14-02 data showed a mean cover of 92% perennial pickleweed (n=3) (table 2).

Cordgrass

The cordgrass vegetation type is characterized by the sole dominant Chilean cordgrass (*Spartina densiflora*) but may include trace amounts of other species. This vegetation type is typically associated with mid elevations in the salt marsh. The 6-14-02 data showed a mean cover of 83% Chilean cordgrass (n=9) (table 2).

Cordgrass/Pickleweed

The cordgrass/pickleweed vegetation type is characterized by co-dominance of Chilean cordgrass and perennial pickleweed, but may include trace amounts of other species. This vegetation type is typically associated with mid elevations in the salt marsh. At the study site, plots sampled 6-14-02 in the cordgrass/pickleweed vegetation type had a mean cover of 63% cordgrass and 29% pickleweed (n=13) (table 2).

Pickleweed/Saltgrass

The pickleweed/saltgrass vegetation type, the most diverse of the types observed, is typically associated with high elevations in the salt marsh. Perennial pickleweed and saltgrass (*Distichlis spicata*) generally have high cover, and fleshy jaumea (*Jaumea carnosa*) is commonly present, sometimes with high cover. At the study site, plots sampled 6-14-02 in the pickleweed/saltgrass vegetation type had a mean cover of 26% pickleweed, 20% saltgrass, and 19% jaumea (n=12) (table 2). Cordgrass is sometimes present, but generally with low cover (7%) and usually the cordgrass plants found here are less robust than those found in the cordgrass or cordgrass/pickleweed vegetation types.

References

Eicher, A. 1987. Salt marsh vascular plant distribution in relation to tidal elevation. M.A. thesis. Humboldt State University, Arcata, CA.

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Table 1. Salt Marsh Sample Plots on Indian Island, 6-14-02

Percent Cover

Transect number:	1	1	1	1	1	1	1	1	2	2	2	2	2	2
Plot number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Plot location (transect-feet):	1-0	1-100	1-200	1-300	1-400	1-500	1-600	1-700	2-6	2-26	2-46	2-70	2-99	2-120
Vegetation type:*	Sa/Di	Sp/Sa	Sa/Di	Sa	Sp/Sa	Sa/Di	Sa/Di	Sa/Di	Sa	Sa/Di	Sp/Sa	Sa/Di	Sa	Sp/Sa
Atriplex patula												5		
Baccharis douglasii														
Castilleja ambigua								2						
Cordylanthus maritimus	5		5					1	1			3		
Cotula coronopifolia												2		
Cuscuta salina								3						
Distichlis spicata	35		5			10	50			30		20		
Jaumea carnosa	35		40			25	2	10		5		25		
Juncus ambiguus														
Limonium californicum	10		20					4				1		
Parapholis strigosa			20											
Polypogon maritimus														
Potentilla anserina												15		
Salicornia virginica	10	35	4	98	20	10	35	35	94	40	55	25	85	20
Spartina densiflora		60	1		75	25	8	20		20	35		10	70
Spergularia canadensis														
Spergularia macrotheca			1									1		
Triglochin concinnum	2		1											
Triglochin maritimum								20						
Total Cover:	97	95	97	98	95	70	95	95	95	95	90	97	95	90

*Vegetation Types	
Sa	Pickleweed
Sa/Di	Pickleweed/Saltgrass
Sp/Sa	Cordgrass/Pickleweed
Sp	Cordgrass

Table 1. Salt Marsh Sample Plots on Indian Island, 6-14-02

Percent Cover

Transect number:	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Plot number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Plot location (feet):	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300
Vegetation type:*	Sa/Di	Sp	Sp	Sp	Sa/Di	Sp/Sa	Sp/Sa	Sp/Sa	Sp	Sp/Sa	Sp/Sa	Sp/Sa	Sp	mud
Atriplex patula														
Baccharis douglasii	1													
Castilleja ambigua	5													
Cordylanthus maritimus	2													
Cotula coronopifolia														
Cuscuta salina														
Distichlis spicata	3				45									
Jaumea carnosa	2				30								5	
Juncus ambiguus	5													
Limonium californicum	1				2					3				
Parapholis strigosa														
Polypogon maritimus	10													
Potentilla anserina														
Salicornia virginica	15	20	25	5	15	50	25	20	15	40	25	25	10	
Spartina densiflora		75	70	90		35	70	70	80	55	65	65	65	3
Spergularia canadensis	1													
Spergularia macrotheca														
Triglochin concinnum	2				5								10	
Triglochin maritimum	3													
Total Cover:	50	95	95	95	97	85	95	90	95	98	90	90	90	3

*T = Trace

*Vegetation Types	
Sa	Pickleweed
Sa/Di	Pickleweed/Saltgrass
Sp/Sa	Cordgrass/Pickleweed
Sp	Cordgrass

Table 1. Salt Marsh Sample Plots on Indian Island, 6-14-02

Percent Cover

Transect number:	4	4	4	4	4	4	4	4	4	4
Plot number:	1	2	3	4	5	6	7	8	9	10
Plot location (feet):	0	100	200	300	400	500	600	700	800	900
Plot type:	Sa/Di	Sp/Sa	Sp	Sp	Sa/Di	SpSa	Sp	Sa/Di	Sp/Sa	Sp
Atriplex patula										
Baccharis douglasii										
Castilleja ambigua										
Cordylanthus maritimus										
Cotula coronopifolia										
Cuscuta salina										
Distichlis spicata					20			20	T	
Jaumea carnosa	10				20	5		20		
Juncus ambiguus										
Limonium californicum										
Parapholis strigosa										
Polypogon maritimus										
Potentilla anserina										
Salicornia virginica	70	25	T		25	20	T	25	15	10
Spartina densiflora	10	65	95	95		70	95	3	80	85
Spergularia canadensis										
Spergularia macrotheca					T					
Triglochin concinnum	1				30			25		
Triglochin maritimum								2		
Total Cover:	91	90	95	95	95	95	95	95	95	95

*T = Trace

*Vegetation Types	
Sa	Pickleweed
Sa/Di	Pickleweed/Saltgrass
Sp/Sa	Cordgrass/Pickleweed
Sp	Cordgrass

Table 2. Summary of Vegetation Data on Indian Island, 6-14-02

Mean Percent Cover

	n=3	*n=13*	*n=9*	*n=12*
Vegetation type:	*Pickleweed*	*Cordgrass / Pickleweed*	*Cordgrass*	*Pickleweed / Saltgrass*
Atriplex patula				0.4
Baccharis douglasii				0.1
Castilleja ambigua				0.6
Cordylanthus maritimus	0.3			1.3
Cotula coronopifolia				0.2
Cuscuta salina				0.3
Distichlis spicata				19.8
Jaumea carnosa		0.4	0.6	18.7
Juncus ambiguus				0.4
Limonium californicum		0.2		3.2
Parapholis strigosa				1.7
Polypogon maritimus				0.8
Potentilla anserina				1.3
Salicornia virginica	92.3	28.8	12.1	25.8
Spartina densiflora	3.3	62.7	83.3	7.3
Spergularia canadensis				0.1
Spergularia macrotheca				0.2
Triglochin concinnum			1.1	5.5
Triglochin maritimum				2.1
Total Cover:	96.0	92.2	94.4	89.5

Appendix A. Plant Species List for Salt Marsh on Indian Island, 6-14-02

Scientific Name	*Common Name*	*Native / Introduced*
Atriplex patula	orache	I
Baccharis douglasii	marsh baccharis	N
Castilleja ambigua	Humboldt Bay owl's clover	N
Cordylanthus maritimus	Point Reyes bird's beak	N
Cotula coronopifolia	brass buttons	I
Cuscuta salina	marsh dodder	N
Deschampsia caespitosa	hairgrass	N
Distichlis spicata	saltgrass	N
Grindelia stricta	gumplant	N
Jaumea carnosa	fleshy jaumea	N
Juncus ambiguus	annual rush	N
Limonium californicum	sea lavender	N
Parapholis strigosa	sickle grass	I
Polypogon maritimus	beard grass	I
Potentilla anserina	Pacific silverweed	N
Salicornia virginica	perennial pickleweed	N
Spartina densiflora	Chilean cordgrass	I
Spergularia canadensis	sand spurrey	N
Spergularia macrotheca	sand spurrey	N
Triglochin concinnum	narrow arrowgrass	N
Triglochin maritimum	common arrowgrass	N

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Upland Plant Species List for Indian Island

Reconnaissance of the upland portions of Indian Island (north of the Samoa Bridge) was conducted on March 18, 2002, to compile a plant species list. The willow/alder scrub occurrring in upland areas near the Samoa bridge is comprised primarily of native plant species. An abandoned European homesite occurs on the island. Some cultivars planted by the settlers have naturalized in the area surrounding the homesite, but the extent of their spread is limited, since these species will not tolerate the conditions in the surrounding salt marsh or mudflats. The California Exotic Pest Plant Council (CalEPPC) and California Department of Food and Agriculture (CDFA) ratings for noxious weeds are indicated. The USDA has a Federal Noxious Weeds list; none of the plants found on site are listed by USDA.

Scientific name	Common name	Native/ Introduced	CalEPPC Rating*	CDFA Rating**	Notes
Acacia melanoxylon	blackwood acacia	I	Need more info		Planted at European homesite
Achillea millefolium	yarrow	N			
Agapanthus orientalis	lily-of-the-nile	I			Naturalized around homesite
Allium scorodoprasum	elephant garlic	I			Naturalized around homesite
Alnus rubra	red alder	N			
Aloe saponaria	aloe	I			Planted at European homesite; unusual for our area
Alyssum sp.	alyssum	I			Planted at European homesite
Anaphalis margaritacea	pearly evelasting	N			
Athyrium filix-femina	lady fern	N			
Baccharis douglasii	marsh baccharis	N			
Baccharis pilularis	coyote brush	N			
Bellis perennis	ox-eye daisy	I			
Brassica nigra	wild mustard	I	B		Not extensive
Cardamine oligosperma	bittercress	N			
Cirsium vulgare	bull thistle	I	B		Not extensive
Conium maculatum	poison hemlock	I	B		Occurs in area around homesite; pervasive
Cortaderia jubata	pampas grass	I	A1		A few clumps near the Samoa Bridge
Cupressus macrocarpa	Monterey cypress	I	Need more info		Bordering Samoa Bridge
Cytisus scoparius	Scotch broom	I	A1	C	Mostly on knoll at NW part of site
Deschampsia caespitosa	hairgrass	N			
Eucalyptus sp.	eucalyptus	I			Bordering Samoa Bridge
Festuca rubra	red fescue	N			
Foeniculum vulgare	fennel	I	A1		Bordering Samoa Bridge
Fuchsia microphylla	fuchsia	I			Planted at European homesite
Geranium dissectum	wild geranium	I			

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Scientific name	Common name	Native/ Introduced	CalEPPC Rating*	CDFA Rating**	Notes
Geranium molle	wild geranium	I			
Gnaphalium sp.	cudweed				
Grindelia stricta var. *stricta*	gumplant	N			
Hedera helix	English ivy	I	B		Occurs at scattered locations
Hyacinthus sp.	hyacinth	I			Planted at European homesite
Juncus effusus	soft rush	N			
Ligustrum sp.	privet	I			Naturalized around homesite
Lotus corniculatus	birdsfoot trefoil	I			
Lupinus sp.	lupine				
Myrica californica	California wax myrtle	N			
Narcissus spp.	daffodil	I			Naturalized around homesite
Pastinaca sativa	parsnip	I			Naturalized around homesite; pervasive
Picea sitchensis	Sitka spruce	N			
Pittosporum crassifolium	pittosporum	I			Planted at European homesite
Plantago lanceolata	English plantain	I			
Polystichum munitum	sword fern	N			
Raphanus sativus	wild radish	I			Not extensive on site
Rhamnus purshiana	cascara sagrada	N			
Ribes sanguineum var. *glutinosum*	flowering currant	N			
Rubus discolor	Himalaya blackberry	I	A1		Not extensive; some near homesite
Rubus spectabilis	salmonberry	N			
Rubus ursinus	California blackberry	N			
Rumex sp.	dock				
Salix hookeriana	coast willow	N			
Salix lasiolepis	arroyo willow	N			
Salix sitchensis	Sitka willow	N			
Sanicula crassicaulis	sanicle	N			
Scrophularia californica	bee plant	N			
Selaginella oregana	spikemoss	N			
Senecio vulgaris	groundsel	I			
Solanum sp.	nightshade	I			
Sonchus sp.	sowthistle	I			
Vaccinium ovatum	evergreen huckleberry	N			Planted recently by restorationists
Vinca major	periwinkle	I	B		Naturalized around homesite

Scientific name	Common name	Native/ Introduced	CalEPPC Rating*	CDFA Rating**	Notes
Yucca spp.	yucca	I			Planted at European homesite; two species: one clumped, other tree-like

*CalEPPC Noxious Weed Ratings
List A-1: Most Invasive Wildland Pest Plants: Widespread
List A-2: Most Invasive Wildland Pest Plants: Regional
List B: Wildland Pest Plants of Lesser Invasiveness
Red Alert:Species with Potential to Spread Explosively; Infestations Currently Restricted
Need More Information

**CDFA Noxious Weed Ratings
A: Agency policies call for eradication
B: Includes species more widespread; allows local Agricultural Commissioner to decide if local containment is warranted
C: Includes weeds that are so widespread that eradication measures are considered futile

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Results of Reconnaissance 8-01-02

Reconnaissance of the north end of Daby Island and the southwest end of Woodley Island was conducted 8-01-02. The purpose of the visit was to look for plant species that would be suitable for use in revegetation of an erosion control site on the north end of Indian Island. Plant species observed during reconnaissance were recorded and listed in the table shown below (N = Native, I = Introduced). The occurrence of each species at each site is indicated, along with a crude measure of relative abundance (C = Common, U = Uncommon). Recommendations for the use of selected plant species in revegetation at Indian Island are shown, including notes on suitable elevations and methods for planting. Where possible, collecting seed and cuttings from local stock is preferable.

Scientific Name	Common Name	Native/ Introd.	North end Daby	SW end Woodley	Recommendations for Revegetation at Indian Island
Abronia latifolia	yellow sand verbena	N		U	
Achillea millefolium	yarrow	N	U	U	Plant above 10 ft. MLLW, seed
Aira caryophllea	European hairgrass	I		U	
Ambrosia chamissonis	beach-bur	N		C	
Ammophila arenaria	European beachgrass	I		C	
Anaphalis margaritacea	pearly everlasting	N	C	C	Plant above 10 ft. MLLW, seed
Angelica lucida	angelica	N	U		
Anthoxanthum odoratum	sweet vernal grass	I		U	
Aster chilensis	aster	N	U		
Atriplex patula	orache	N	U		
Baccharis pilularis	coyote bush	N	C	C	Plant above 8.5 ft. MLLW, seed or plugs
Brassica sp.	mustard	I		U	
Calystegia soldanella	beach morning glory	N		U	
Camissonia cheiranthifolia	beach evening primrose	N		U	
Carex obnupta	slough sedge	N	U	U	
Carex pansa	coast sedge	N	C	U	
Castilleja ambigua	Humboldt Bay owl's clover	N	U	U	
Cirsium vulgare	bull thistle	I	U	U	
Cordylanthus maritimus ssp. palustris	Pt. Reyes bird's-beak	N	U	U	
Cuscuta salina	marsh dodder	N	C	C	
Deschampsia cespitosa ssp. cespitosa	hairgrass	N	U		Plant above 7.5 ft. MLLW, seed or plugs
Distichlis spicata	saltgrass	N	C	C	Plant between 6.5 and 9.0 ft. MLLW, seed or plugs
Eriogonum latifolium	beach buckwheat	N		C	
Festuca rubra	red fescue	N	C	C	Plant above 8.5 ft. MLLW, seed or plugs
Foeniculum vulgare	fennel	I		C	
Grindelia stricta var. stricta	gumplant	N	C	C	Plant between 7.5 and 9.0 ft. MLLW, seed or plugs
Holcus lanatus	velvet grass	I	U	u	
Jaumea carnosa	fleshy jaumea	N	C	C	Plant between 6.5 and 9.0 ft. MLLW, seed or plugs

Prepared by Annie L. Eicher 8-11-02

Results of Reconnaissance 8-01-02

Scientific Name	Common Name	Native/ Introd.	North end Daby	SW end Woodley	Recommendations for Revegetation at Indian Island
Juncus breweri	dune rush	N	C	U	
Juncus lesueurii	salt rush	N	C		Plant above 7.5 ft. MLLW, seed or plugs
Limonium californicum	marsh rosemary	N	U		Plant between 7.0 and 9.0 ft. MLLW, seed or plugs
Lonicera involucrata var. ledebourii	twinberry	N	U	U	Plant above 10 ft. MLLW, plugs, cuttings?
Lotus corniculatus	bird's foot trefoil	I	U		
Lupinus arboreus	yellow bush lupine	I	U	U	
Melilotus sp.	sweetclover	I	U		
Myrica californica	California wax myrtle	N		C	Plant above 8.5 ft. MLLW, plugs, cuttings?
Parentucelia viscosa	parentucelia	I		U	
Phragmites australis	common reed	I		C	
Picea sitchensis	Sitka spruce	N		C	Plant above 10 ft. MLLW, plugs
Pinus contorta ssp. contorta	shore pine	N		C	Plant above 10 ft. MLLW, plugs
Polypogon maritimus	beardgrass	I	U	U	
Polystichum munitum	sword fern	N	U	U	
Potentilla anserina	Pacific silverweed	N		U	
Rhamnus purshiana	cascara	N	U		
Ribes sanguineum var. glutinosum	red flowering currant	N		U	Plant above 10 ft. MLLW, plugs
Rubus discolor	Himalaya blackberry	I	U		
Rubus ursinus	California blackberry	N		C	
Salicornia virginica	perennial pickleweed	N	C	C	Plant between 5.5 and 9.0 ft. MLLW, seed or plugs
Salix hookeriana	coast willow	N	C	C	Plant above 8.5 ft. MLLW, cuttings
Sambucus racemosa var. racemosa	red elderberry	N		U	Plant above 10 ft. MLLW, plugs, cuttings?
Satureja douglasii	yerba buena, tea plant	N		U	Plant above 10 ft. MLLW, seed or plugs
Scrophularia californica ssp. californica	figwort	N	U		Plant above 10 ft. MLLW, seed
Solanum sp.	nightshade			U	
Solidago spathulata ssp. spathulata	coast goldenrod	N		U	
Spartina densiflora	Chilean cordgrass	I	U	C	
Spergularia macrotheca	spurrey	N		U	
Spiranthes romanzoffiana	ladies tresses	N		U	
Tanacetum douglasii	dune tansy	N		C	
Triglochin maritimum	common arrograss	N		C	Plant between 6.0 and 9.0 ft. MLLW, seed or plugs

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CONSIDERATIONS FOR THE
IN SITU CONSERVATION AND TREATMENT OF

TOLOWAT (CA-HUM-67)
INDIAN ISLAND
HUMBOLDT COUNTY, CALIFORNIA

Prepared by

Robert M. Thorne
Center for Archaeological Research
University of Mississippi

and

John E. Ehrenhard
Southeast Archeological Center
National Park Service
Tallahassee, Florida

November 2000

United States Department of the Interior

NATIONAL PARK SERVICE
Pacific Great Basin Support Office
600 Harrison Street, Suite 600
San Francisco, California 94107-1372

IN REPLY REFER TO:

H2217 (PGSO-PC)

November 21, 2000

Ms. Cheryl A. Seidner
Tribal Chairwoman
Wiyot Tribe, Table Bluff Reservation
Attention: Ms. Nina Hapner
Post Office Box 519
Loleta, California 95551

National Park Service
Mark O. Rudo, M.A.
Archaeologist

Pacific Great Basin Support Office
600 Harrison Street, Suite 600
San Francisco, CA 94107-1372

415/427 1405
415/427 1484 Fax
mark_rudo@nps.gov

Subject: Tolowat National Historic Landmark

Dear Ms. Seidner:

The enclosed report by Dr. Robert Thorne of the University of Mississippi and Mr. John Ehrenhard, Director of our Southeast Archeological Center, gives their assessment of erosion at Tolowat on Indian Island, Eureka, California. The report also provides treatment options for your consideration. Robert, John, and Archeologist Mark Rudo of my staff visited the site with Nina Hapner on July 25. If you have specific questions about the report please call John directly at (850) 580-3011 Extension 123 or send e-mail to john_ehrenhard@nps.gov. Tolowat is a registered National Historic Landmark and we appreciate the opportunity to help preserve this important site. If we can be of further assistance please call Mark Rudo at (415) 427-1405 or send e-mail to mark_rudo@nps.gov.

Sincerely,

for Paula Jack Creech

David W. Look, AIA
Team Leader, Cultural Resources
Pacific Great Basin Support Office

Enclosures(2copies)

Cc: John Ehrenhard, SEAC (w/o enclosures)

The University of Mississippi
Oxford • Jackson • Tupelo • Southaven

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BACKGROUND

At the request of the Pacific Great Basin Support Office of the National Park Service, the Southeast Archeological Center and the Center for Archaeological Research, University of Mississippi, provided archeological assistance with regard to the assessment and mitigation of erosional damage to archeological sites located in Humboldt County, California. The study was made possible through a cooperative agreement between the National Park Service and the University of Mississippi.

The authors visited Indian Island with Nina Hapner, Environmental Director of the Wiyot Tribe of Table Bluff Reservation, on July 25, 2000.

INTRODUCTION

Indian Island (Figure 1), formerly named Gunther Island after a dairy farmer who once owned it, is composed largely of Recent Alluvium (Evenson 1959). In areas around Humboldt Bay that have been reclaimed from marsh through the use of dikes, soils are mapped as Coquilla clay loam (Watson et al. 1925:878). A portion of Gunther Island that was reclaimed, has reverted to marsh. Wind-laid material described as Westport Sands make up the remainder of the island (Watson et al. 1925:881).

The system of levees created over the last 150 years may account for the various channels that either cross the island completely or partially. Figure 2 shows changes in the island's configuration between 1852 and 1958. The island's outline indicates an undivided deposit between 1852 and 1923. A channel was either dug or developed naturally during the fifteen year hiatus prior to 1938. The 1938 U.S. Coast and Geodetic Survey map of Humboldt Bay shows the island in two parts. Divided by a southwesterly trending channel, the larger portion lies to the north, while the remaining third lies to the south.

The main channel of the Mad River Slough (not to be confused with the Mad River, which does not currently drain into Humboldt Bay) and the Arcata Slough are located to the west of the island and immediately to the east of the sand spit that separates the bay from the open ocean. In the vicinity of Humboldt Bay, these sand spit dunes extend inland for as much as 800 feet and are the likely source of the coarser sands that are the primary constituent of the midden deposit (CA-Hum-67). The midden is composed of a mixture of this coarse sand and finer particles that are not characteristic of an alluvial marsh deposit.

Elevations on the island range from slightly above mean high tide to fourteen feet at the highest point of the midden deposit. Neither Loud nor Stuart, who conducted earlier excavations, distinguished any major stratigraphic differences in the mound fill (in Heizer et al. 1964:10). This suggests that the geologic structure of the midden deposit is of human origin, and probably developed its height as a consequence of the occupants' daily activities over some 900 years.

The floral cover over most of the island consists of characteristic salt marsh grasses. The sands thus form the supporting soil column for the more xeric vegetation present across the midden deposit. It should be noted that without this vegetation cover, the midden would likely have reacted to eolian forces and would have become an active sand dune similar to those on the spit to the west.

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While the surrounding marsh is high in organic matter and likely nutrient rich, the coarser alluvial sands are more likely to be nutrient starved, thus establishing marginal growing conditions for protective vegetation. These larger particles are unconsolidated sands, which make them subject to the erosional forces of storm driven waves that strike the Island from the eastern side. The position of Mad River and Arcata Sloughs, which converge on the west side of the island, direct the principal deposition of the coarser particles of the sediment load in the north end of the bay. In other words, this deposition would be found closer to the course of the channel, while the finer particles that comprise the Coquilla clay loam (characteristic of the tidal flats) would be deposited elsewhere in the bay.

It is interesting to note that, in 1852, the general area of the midden deposit extended further into the bay. At that time, the island's configuration at the location of the cultural deposit appears to have been relatively stable with respect to the shoreline. Since then, however, the midden deposit has retreated from the active low tide shoreline and has developed into a nearly vertical cutbank. The protection of this vertical cutbank is the prime focus of the considerations presented here.

ADVERSE FORCES AFFECTING CA-HUM-67

Historically, the cultural deposit has been impacted by the development of the boatyard, whose remnant building and pier are still present on the site. Additional adverse impacts likely date to the island's use as a dairy farm, but little evidence of the agricultural impacts was present when we visited the site in late July 2000. Narrow channels dug on the northern and western ends of the island are still present. These may represent remains of the dikes (Figure 3) that were used to keep the marshy soil sufficiently dry for dairy farming. These historic elements must be considered as a part of the site's total fabric as a National Historic Landmark.

Active and ongoing, culturally derived adverse impacts appear to be more directly related to the use of the periodically maintained boating channel that lies between the island and the mainland, but these impacts are secondary. Wave activity and transport of the coarse sands that form the midden deposit seem to be the primary cause of continuing erosion of the deposit's eastern portion. Boat generated waves can impact the base of the vertical face of the midden, as can storm driven waves. Boat generated waves have the greatest impact on the cultural deposit during periods of high tide when water levels in the bay reach nearly to the base of the cutbank. Storm driven waves, however, are the most destructive to the cutbank.

Several factors increase the impact of these waves as they strike the shoreline. Waves initiating in shallow water travel easterly across the bay, which is almost two miles wide during high tide and more than a mile wide when the tide is out. As the waves move across this stretch of open water, they are diverted by the topography of the bay floor into the deeper channels on either side of the island. Sediments across the bottom of the bay to the east and northeast of the island are fines and provide less erosional damage than would be the case if the bottom sediments were coarse. Submerged forces that are confined to the channel southeast of the island remove erodible materials from the area of the cultural deposit rather than allow progradation to occur. In essence, wave generated forces follow the alignment of the channel and carry sediments away from the cultural deposit rather than allow them to accumulate and form a protec-

tive barrier against further erosion. Clearly, erosional effects would be greater during periods of high tide when water levels are deeper and the length of the wave fetch is greater.

Aquatic grasses on the bottom of the bay absorb some of the submerged wave force, but the grass beds are not dense enough to fully reduce the impact on the cultural deposit. Since the sands of the midden deposit are unconsolidated, they offer little, if any, resistance to the erosion caused by storm driven waves. While some of the submerged waves are diverted from the face of the cutbank, those on the surface reach the shore, dislodge additional sands, and subsequently move them away from the beach fronting the site. Once dislodged, and under normal meteorological conditions, the sands are also removed from the beach zone by tidal changes. Garrett (1983:38) correctly points out that tidal changes cause rapid flow through the deeper channels as the tide recedes, and unstable sands and other sediment become part of the sediment load. The force of incoming waves, regardless of their source, is unabated since the beach-like area in front of the cutbank is unvegetated with no physical barriers to dissipate incoming waves (Figure 4).

CONSIDERATIONS FOR THE PROTECTION OF CA-HUM-67

We went to the island twice during our July 2000 visit—first at low tide and again at the peak of high tide. Figure 5 depicts the relationship between the water level and the base of the midden at low tide, while Figure 6 shows the water level at the highest point of the tidal rise. On a calm day at maximum normal high tide, the base of the sand deposit containing the cultural material is above the tidal line. We also noted that the slow-moving pontoon boat used for our site visit at high tide did not generate enough wave activity to reach the base of the deposit. This further supports the suggestion that major destructive forces are generated during periods of stormy weather.

Figure 5 is particularly useful both in understanding the conservation problems that must be addressed and in providing an appreciation for the protection work that has already been completed. It shows that the beach zone between the base of the cutbank and the water's edge is completely bare of any vegetation that could break the force of incoming waves. Further, it is evident that the shoreline has eroded to the consolidated soils of the bay's bottom. Wave energy, rather than being absorbed, is rebounded upward and toward the bankline.

Wave forces loosen and subsequently transport the sands at the base of the cultural deposit. Abatement of these forces is the key to protecting the archeological materials higher in the soil column. Several approaches may be considered for cutbank protection. The success of each ultimately depends on reducing wave forces while working to rebuild the shoreline. Rebuilding the shoreline will in turn become the critical element in the long-term protection of this portion of the island. Three options for rebuilding are possible:

1. The shoreline can be rebuilt artificially and then a revegetation program can be initiated to provide buffering from wave activity.

2. A revegetation approach can be taken that will aid in the collection of waterborne sediments that can lead to shoreline rebuilding.

3. A wood or steel piling bulkhead can be installed at the front of the cutbank to protect it from incoming waves.

Artificial Rebuilding

The most cost-effective and practical way to protect the site is to rebuild the portion of the island that has been lost to erosion. This could be accomplished through the use of dredge spoils or shell.

Dredge Spoils Barrier

The placement of dredge spoils material removed from the Mad River Slough Channel would require coordination with a variety of state and federal agencies for the necessary permits as well as with the Corps of Engineers to insure that the dredge spoils are not discarded elsewhere. This material can be pumped into place on the eastern side of the island and packed against the filter cloth already in place.

If this approach is taken, a significant feature of the project would be the retention of the existing filter cloth. The cloth can continue to serve as a protective barrier while the dredge material is being discharged against the bankline. It will also serve in the future as a marker for the eastern boundary of the original island configuration.

Once dredge materials are in place, a revegetation program must be established that will ultimately provide sufficient cover to preclude both wind and water erosion. In consultation with a botanist, a vertically stratified planting progression, including appropriate local water and salt tolerant species, should be implemented. Grasses would be the most appropriate choice for the tidal fluctuation zone. An increasing number of woody species should be added to the area inundated for the shortest period. A mix of more xeric grasses and woody species would be best for the fill above high tide.

Artificial Shell Rake

Another approach to rebuilding the island to it original configuration would be through the use of available marine shell, particularly oyster shell recovered from the beds located in the immediate vicinity. This technique was successfully used at Cumberland Island National Seashore (Ehrenhard and Thorne 1991). It consists of bagging marine shell in burlap sacks and stacking the sacks in a semicircular pattern around the area to be protected. Over a relatively short period of time, the burlap deteriorates and the shell slumps into an artificially constructed shell rake. As the bags deteriorate and the shell slumps, the individual shells become interlocked with one another.

An incoming tide will cover the shell and form a slack water pool that serves as a stilling basin for the deposition of waterborne sediments and organic detritus that is moved by tidal action. Through time, the area behind the ring of shell builds to a higher elevation and plant materials trapped in the deposit ultimately provides a source of natural marsh redevelopment. As marsh grasses mature, wave activity is abated and the vertical level of the tidal flat continues to slowly rise as a consequence of the deposition of sediment within the grass bed.

The filter cloth covering the site would have to be more firmly anchored, as described in the next section on natural attrition. It would have to be left in place so as to provide continued protection to the cutbank until the rake begins to fill with sediment and the grass bed becomes

established through natural processes. Establishing a protective marsh in the forefront of the cutbank could be completed more rapidly through a proactive program of selective planting as noted in the discussion on dredge spoils.

Sediment accumulation within the confines of the artificial rake would be a relatively long-term process since the sediment load of the bay in the vicinity of the site appears to be low and the water column sediment starved. In essence, any sediment redeposited behind the rake would be available for the short period of time that affluent is carried into the bay during the periods of heaviest rainfall. Storm surges would also dislodge sediment from the bay's bottom and additional deposition can be predicted. Pumping in dredge spoils to complement this process could rapidly increase the rate of attrition. This would require approval by the Corps of Engineers.

Natural Attrition

Although appropriate for shoreline redevelopment, natural attrition of sediment would be a much slower process. This is because the primary sediment load in the bay waters on the eastern side of the island is composed of clays and silts that are transported from within the bay. If the site were located on the western side near the Mad River Slough and Arcata Slough Channels, coarser materials might be available for natural attrition of the shoreline. If, however, natural shoreline development is ultimately selected, several things will need to be accomplished as part of the process.

1. The face of the cutbank must continue to be protected to insure against further loss during storms. The filter fabric placed during earlier protection stages must be pinned down with rebar along the base and top of the cutbank and at various points in between so that it fits the cutbank's configuration as closely as possible.

2. The timbers used to help secure the cloth will continue to function as breakwaters. They must, however, be anchored so as not to wash against the cutbank and either puncture the fabric or pull it away from the bankline. Anchoring can be done with lengths of rope staked near the base of the cutbank, but the rope's slack length should be just long enough to allow the logs to float to the surface when the water is at mean high tide. If care is not taken during the anchoring process, storm driven surges can convert the protective logs into battering rams, further damaging the cultural deposit.

3. A botanist should be consulted so that appropriate salt- and water-tolerant species can be selected to establish a colony of grasses and woody stemmed species in front of the cutbank. Dense stands of grass can abate incoming wave activity by as much as 90 percent (Keown et al. 1977). Grasses maturing to several different heights are preferred. They can thus abate the force of incoming waves at various water levels and trap sediments encouraging the shoreline's vertical development. Techniques for transplanting marsh grasses can be found in publications by Fonseca and his coauthors (1985a, b).

Bulkhead

Of the three options, building a bulkhead is the least desirable for a number of reasons. Clearly, any mechanical approach will involve either working from the water or barging in the neces-

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sary machinery and working during periods of low tide. This would obviously shorten the work day and extend the duration of the project. Such an installation would also require backfilling the voids between the bulkhead and the cutbank face. To insure that a bulkhead would successfully protect the cutbank, metal sheet piling would have to be driven deep enough so that incoming waves would not wash under it. A wooden bulkhead would also have to be trenched in to a similar depth. In either case, revetment installation would be expensive, and the associated backfilling would increase the ultimate cost even more. In addition, the method has a high potential for adverse impact to the midden. The risk to the cultural deposit would be disproportionate to the potential protection provided.

It is singularly important that any process of shoreline building be combined with a revegetation program to add a significant element of protection to the otherwise bare shoreline.

FINAL THOUGHTS

There are some sedimentary issues that we are unsure of, and further study is recommended. In some of our conversations with locals, we were told that during periods of heavy rainfall in the mountains, the water in Humboldt Bay turned brown. This transported material is an important source of sediment for any natural attrition that would help rebuild the island. However, it appears that the western side of the island has not grown any over the last 150 years (see Figure 2). What is happening to the sediment? Is it falling out of the water column before it reaches the island, or is it simply being flushed through the channel and out into the open ocean? This is a critical issue since a lack of deposited sediment may account for the relatively long periods of time between dredging episodes in the navigation channel.

Although beyond the scope of this report, three other issues should be taken into consideration.

1. Clearing a portion of the higher ground for a ceremonial area could result in a resurgence of surface erosion and perhaps attract the curious to the site.

2. The National Register form does not mention the significance of the historic European period occupation of the island. This is, nevertheless, important in defining the fabric of the cultural landscape. Most important, recognition of these historic sites could be a reinforcing factor in protecting prehistoric and early cultural deposits and burial sites.

3. If historic structures continue to be removed, revegetation issues for this part of the site will need to be addressed.

In conclusion, knowing that the Wiyot have a sacred relationship with the land, any site stabilization venture must respect their cultural priorities. Consultations with the tribe is a prerequisite to a successful outcome.

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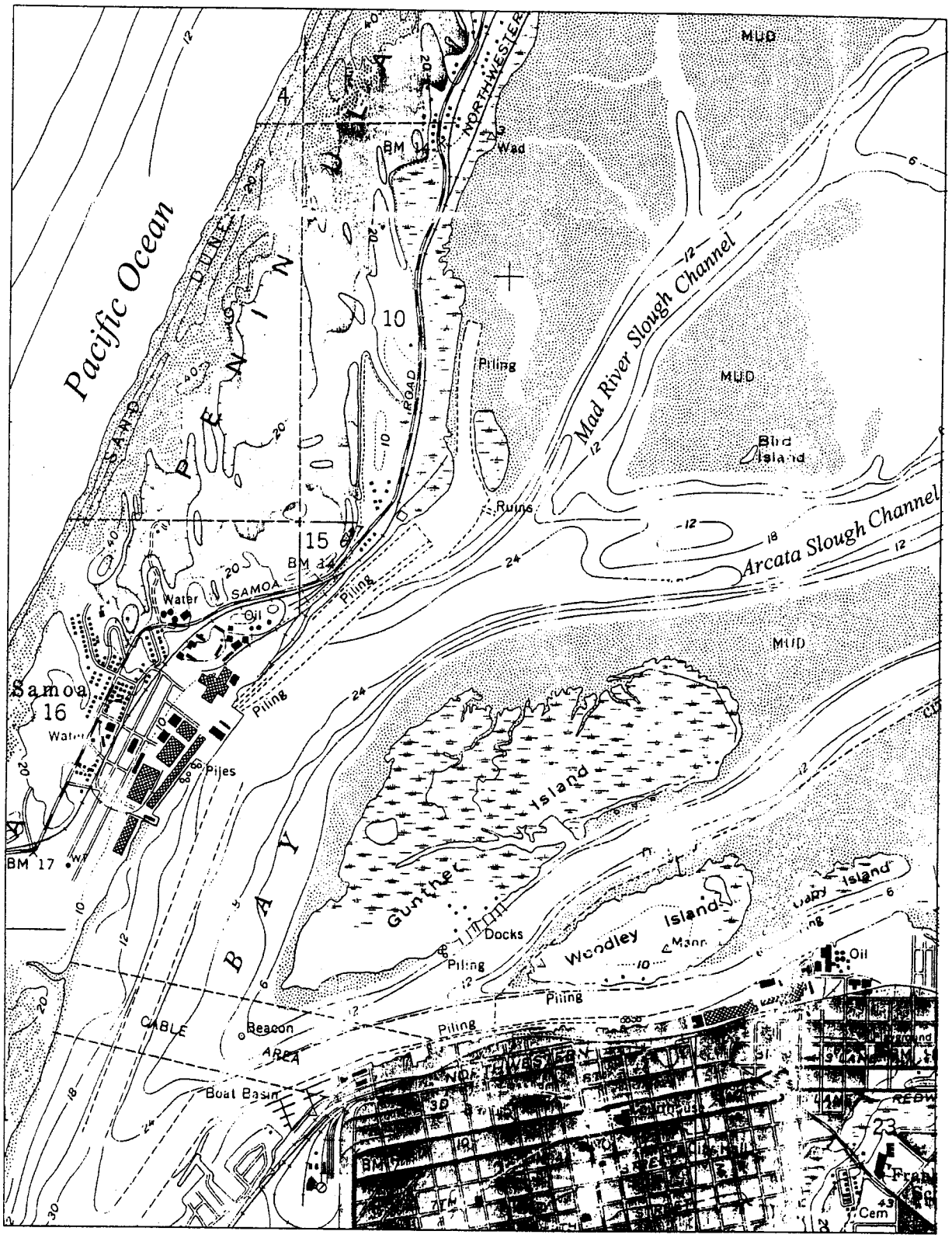

Figure 1 — Map of Gunther (Indian) Island showing convergence of the Mad River Slough and the Arcata Slough Channels to the north of the island (from 1958 U.S.G.S. Eureka Quadrangle, Humboldt County, California).

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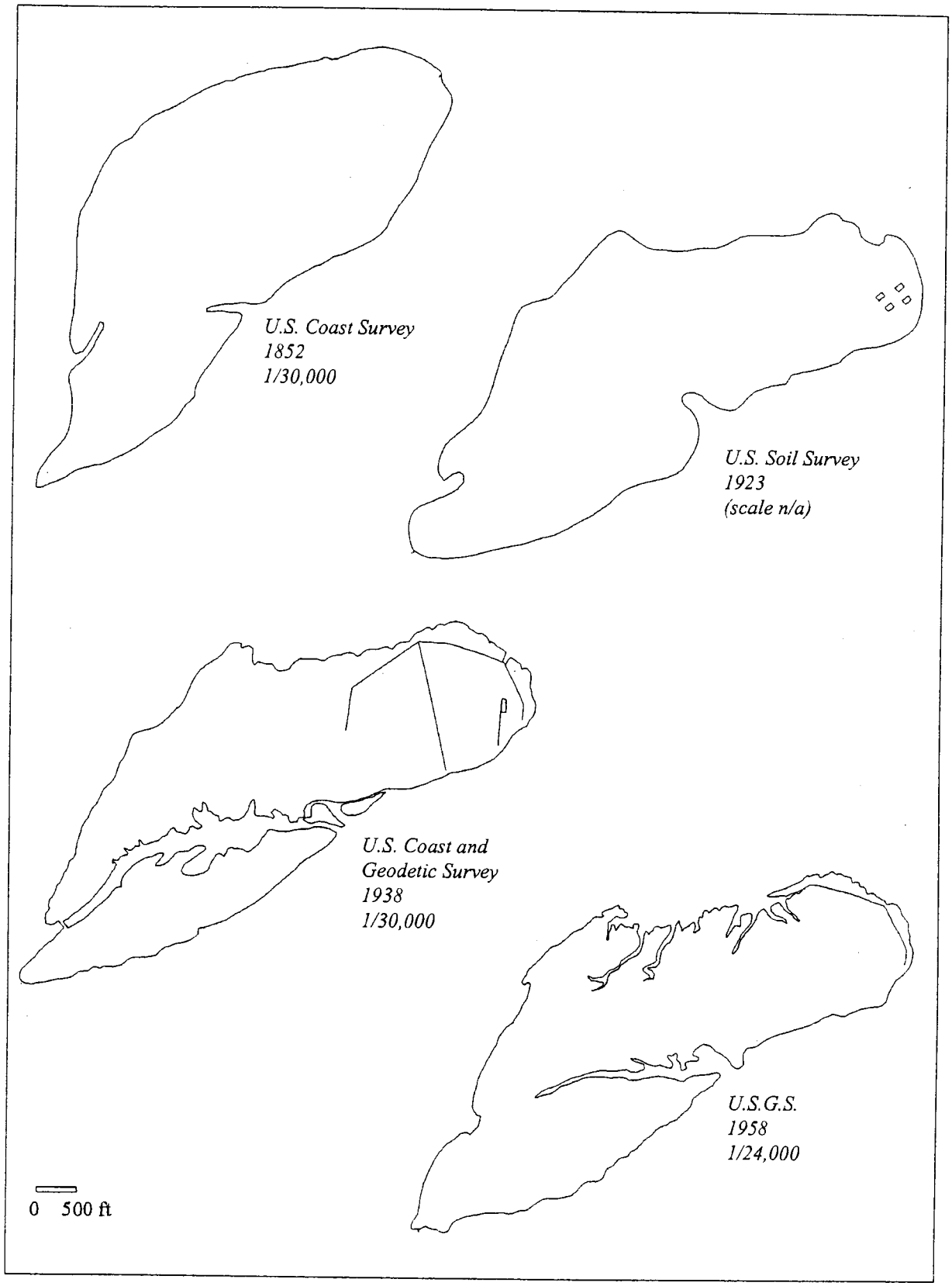

Figure 2 — Changes in Indian Island's configuration between 1852 and 1958.

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Figure 3 — Drainage canal and dike remnants on northeastern tip of island (photo by Mark Rudo).

Figure 4 — Beach zone along base of cultural deposit at CA-Hum-67 (photo by Mark Rudo).

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Figure 5: Beach zone width at maximum low tide at CA-Hum-67 (photo by Mark Rudo).

Figure 6: Normal high tide level at base of the cultural deposit at CA-Hum-67 (photo by Mark Rudo).

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TECHNICAL MEMORANDUM

Humboldt Water Resources
Attn: Mike Wilson
PO Box 165
Arcata, California 95518

Re: Geotechnical Review
Indian Island Shoreline Protection Project, Eureka, California

INTRODUCTION

At the request of Humboldt Water Resources, a Geotechnical Review has been undertaken for the shoreline restoration/erosion control project on the northeast portion of Indian Island in Humboldt Bay. The purpose of this Geotechnical Review is to provide commentary and recommendations regarding the geotechnical elements of the proposed project. The services included a surficial review of the site, examination and limited testing of the boring samples obtained by HWR, analysis of the proposed sheet pile system, review of project geologic literature, and preparation of this memorandum. For completeness, I have also transcribed the draft boring logs which were provided, and added the laboratory test data to them.

SURFACE & SUBSURFACE INVESTIGATION

Subsurface conditions for the site were evaluated using regional geologic descriptions, nearby project data, and site specific test borings. According to the geologic and background literature, Indian Island is predominantly composed of alluvial soil consisting of silts, silty sands, and sands, and shell remains. The site is a low lying tidal marsh subject to high seasonal rainfall, tides, wave action, and storm flooding. Historic use has resulted in a substantial shell and debris deposit known as a midden, adjacent to the apparent normal high water line. More recently, a portion of the site has been used as a shipyard; permanent structures near the waterline included timber piles and concrete retaining cells used for the docks and shipways.

Several boring logs prepared for the Eureka-Samoa Bridge were provided for review. The bridge and highway embankment are located several hundred feet south of the shipyard area. According to these logs, subsurface materials encountered were silts, silty sands, and uniform sands. Generally the upper 10 to 20 feet of soil were in a loose to medium dense condition.

In November 2002, HWR conducted five exploratory borings at the site. Borings were drilled using hollow stem auger to depths ranging from 15 to 40 feet below ground surface. Surface and ground water levels during drilling were very high, resulting in generally saturated conditions. During the drilling operation, sampling and testing were performed at regular intervals using a

split spoon apparatus driven by a 140 pound hammer. The testing is known as a Standard Penetration Test; the number of hammer blows required to drive the sampler in 6-inch increments was recorded on the field logs. The blow count is correlated with shear strength and relative density for different soil types. Samples recovered from the sampler were classified using visual-manual procedures for the Unified Soil Classification System. The USCS classes soils into groups having similar engineering characteristics. A portion of each sample was retained for further observation and laboratory testing to determine unit weight. The in-situ and laboratory test results, classifications, and narrative descriptions are presented on the Boring Logs appended to this memorandum.

Subsurface conditions encountered within the site test borings consist of loose to medium dense uniform sand and silty sand, with occasional lenses of fine grained soils. The soils were saturated at the time of drilling, and are expected to remain saturated nearly to the surface due to the proximity to the water line.

SHEET PILE ANALYSIS

As part of the proposed shoreline restoration and protection project, plastic sheet piles have been specified to retain portions of the midden, and provide scour protection. According to our conversations with HWR, the sheet pile will be placed along the 8.0 foot contour, with a pile top maximum elevation of 10.0. It is anticipated that the sheet piles will be placed using vibratory driving equipment. Backfill conditions are expected to included 1 to 2 feet of sandy soils and shells. Where necessary to support the midden pile the backfill will be sloped at 2H:1V. Up to 2.0 feet of bayside scour was considered.

For the analyses of the sheet piles, the SPT values and unit weights from Borings 1 through 4 were converted to design parameters using published correlations. Stability of the sheet piles were then calculated with the added scour and backfill loads. Sheet pile depths for two installation cases are as follows:

Case	***Minimum Embed Depth***	***Total Length***	***Description***
A	5.0 ft	9.0 ft	>1.5 feet of backfill or supporting a slope
B	4.0 ft	7.5 ft	<1.5 ft of level backfill

Coordination with the sheet pile manufacturer, contractor, and design engineer will be necessary to select a section capable of withstanding the installation and additional service stresses, which I anticipate are much greater than the backfill loads.

The site is located in an active seismic region, and the saturated granular deposits are susceptible to earthquake induced seismic liquefaction. The effects of a large earthquake would likely include sand boils, bearing capacity failure, settlement, and lateral spreading of the near surface soils. As the sheet pile system is generally less than 10 feet in depth, the system remains subject to these seismic hazards.

LIMITATIONS

Explorations performed for this study are intended to provide a reasonable picture of underground conditions for design purposes. Variations from the interpreted conditions, not indicated by our observations are possible. These variations are sometimes sufficient to necessitate modifications in the design. If unexpected conditions are observed during construction, or if the size, type, or location of the structures should change, we should be notified to review our recommendations.

The professional judgments expressed in this report meet the current standard of care of our profession. The services have been performed in accordance with generally accepted engineering and consulting standards in effect at the time services were performed. No other warranty is offered, expressed or implied. I hope this information is sufficient for your present needs. If you have any questions regarding this report, please contact me through HWR.

Sincerely,

William A. Smith, P.E.

Randy Klein, Hydrologist *Watershed Hydrology; Erosion and Sediment Control*

June 6, 2003

MEMO

TO: Mike Wilson, HWR
FROM: Randy Klein, Hydrologist
RE: Indian Island restoration, littoral drift, and sand supply

As requested, I am providing this discussion of potential effects of the erosion control measures planned for protecting the midden on Indian Island from further erosion. Shoreline erosion along the eastern shore of Indian Island has resulted in loss of materials of cultural and archaeological significance. The position of the shoreline has retreated an estimated 50-75 feet along a length of about 300 feet on the eastern part of the midden. Erosion control will consist of a low retaining wall made of sheet piling.

Sand Supply and Littoral Transport

Midden materials consist primarily of shell fragments that have no cohesion and are consequently easily eroded. In recent years, temporary erosion control measures have been implemented that have slowed or stopped erosion. Prior to this, wave action (breaking waves at high tide levels, wave runup at low tide levels) and tidal currents removed material from the base of the midden scarp, undermining the overlying materials and causing them to slide down to the beach level, temporarily forming talus deposits. The talus was then quickly incorporated into littoral transport processes, as evidenced by shell fragment accumulations on the downdrift (southward) area of the beach. Based on field observations, the primary transport direction is consistent with ebb flows: drift materials have accumulated preferentially on the northern sides of the old boat ramp and other features that protrude outward (toward the bay) from the shoreline. The beach consists of a mixture of shell fragments from the midden and sand from updrift sources. Sand is the primary component of the beach deposits.

In my opinion, the midden erosion control facilities will not appreciably affect littoral transport processes or sand supply for the following reasons:

1. As designed, the retaining wall will not protrude outward much farther than the present position of the midden scarp. In fact, the wall will be placed considerably farther inland than the position of the shoreline prior to erosional retreat. Consequently, littoral materials will easily pass the site to downdrift areas. This would be true regardless of transport direction.

2. The erosion control work will not affect sand supply to the beach and littoral zone because the midden material is composed of shell and other culturally-derived materials. There is no sand incorporated in the midden. Sand supplied to the beach comes other source areas, predominantly from areas to the north (updrift side) of the project site. As mentioned above, the retaining wall will not affect sand movement past the site in either direction.

Scour Potential at Retaining Wall Ends

Scour at the ends of shoreline structures is a frequent phenomenon, but one that can be avoided by design. The retaining wall planned for Indian Island incorporates features to avoid end scour. Specifically, the ends will curve landward and be securely keyed into existing, higher ground, creating a smooth transition that will avoid the erosion-causing turbulence that commonly affects such structures.

Large Woody Debris and Cobbles Fronting the Retaining Wall

Large woody debris (LWD) and cobbles will be placed in front of the retaining wall to provide a more natural appearance that mimics existing and adjacent shoreline areas. These materials will be gathered locally, but some may be brought in to supplement the local supply if required. No anchoring methods are proposed, as this material appears to be quasi-stable on the project site and adjacent shorelines. Cobbles will be of similar size to those that have remained stable at the site for a long time, thus their stability (and mobility) will be the same as those already in place. Large, infrequent storms may rearrange or move the LWD and cobbles from the site, but this is a naturally-occurring process in the bay and is not considered detrimental. However, a monitoring and maintenance program is proposed that will include measures to identify and deal with significant movement of this material that may be considered detrimental to the proposed structure.

Please let me know if you need further assistance.

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