Chicken Ranch Beach Restoration Plan
Scoping Document

Prepared for

Environmental Action Committee of West Marin

Prepared by

Philip Williams & Associates, Ltd.

April 2005

PWA REF. #1761

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Chicken Ranch Beach and its associated wetlands are a valuable ecological resource with a mosaic of littoral, tidal wetland and riparian wetland habitats in close proximity. The area is also a recreational asset with access to a wide beach. In the last 150 years there have been considerable natural and human changes in the watershed and to the beach that have had a considerable impact on its evolution and functioning.

The Environmental Action Committee of West Marin (EAC) is concerned about the long-term management of the Chicken Ranch Beach and would like to realize opportunities for resolving a number of conflicting issues related to ecological resources, flooding, recreation and water quality. EAC requested PWA to develop a scoping document intended to outline the process and products necessary to develop a comprehensive restoration plan. This scoping document is not a definitive report but an overview of critical issues.

Background information, including an understanding of the recent evolution of this site is described in Section 2. Opportunities and constraints presented by the site are discussed in Section 3. Restoration alternatives are described in Section 4. The steps required to develop a restoration plan and the information that is required at each step are described in Section 5.

A number of reports have been written about the area with analysis addressing specific issues and these have provided valuable information (Krone 1998, Hydrologic Systems 2003).

2. BACKGROUND

Third Valley Creek drains a small watershed of about 360 acres of the Inverness Ridge in West Marin. It enters Tomales Bay at a small embayment north of Inverness called Chicken Ranch Beach. Steep slopes and soils of coarse sandy loam in the watershed have potential for rapid erosion. Wet winters characterize the area; the average rainfall at Inverness is about 38 inches. The past 150 years has seen major modifications in the watershed and at the mouth of the creek that have fundamentally changed the way that water and sediment move from the watershed to the Bay.

2.1 THE NATURAL SYSTEM

The 1862 topographic map shows a long, narrow spit running parallel to the shoreline and stretching southwards towards Inverness. Behind the spit was a small shallow lagoon, into which Third Valley Creek flowed. The lagoon was connected to the bay by a channel running behind the spit.

The spit and lagoon formed as a result of rising sea levels. As sea level rose the shoreline moved landward, flooding Third Valley and creating an embayment. This embayment is typical of tributaries along the shoreline of Tomales Bay. Winds blowing down the length of Tomales Bay generate waves that move sand along the beaches of the bay. When this sand reaches a discontinuity in the shoreline, such as the embayment at Third Valley, a spit will tend to form.

Spits require a constant resupply of sediment if they are to remain stable. If there is no resupply then it will continue to elongate by eroding sediment from the northern end of the spit, causing the neck of the spit to narrow. The southern end of the spit tends to curve towards the shoreline. This feature, known as a recurve, is formed by waves approaching from the southeast, generated by winds from that direction, and by the refraction of waves along the length of the spit. Recurves tend to form as distinct features. If more sediment becomes available the spit may elongate more rapidly and the existing recurve may be abandoned in favor of a new recurve further downdrift.

During this period the watershed was forested and sediment supply into the creek would have been quite low. During floods the creek would have overtopped its banks and flooded the floodplain. Flow velocities would have slowed and sediment would have been deposited on the floodplain. The flood discharges of water and sediment experienced at the mouth of the creek would therefore be relatively low, compared with today.

The lagoon was formed by the spit separating the flooded part of the Valley from the bay. Third Valley Creek flowed into the lagoon rather than directly into the bay. As the creek entered the lagoon the slope of the bed flattened and the velocity of the flow decreased. As a result sediment transported by the creek would be deposited in the lagoon, rather than the bay. The lagoon would therefore act as a buffer between the creek and the bay, reducing flood velocities and trapping sediment.

The lagoon was connected to the Bay by a tidal channel behind the spit. The tidal prism of the lagoon (the volume of water flowing in and out of the lagoon on each tide) would have kept the channel open during dry periods. Deposition along the channel resulted in the establishment of wetlands behind the spit and between the abandoned recurves. This is the channel alignment shown in the October 1979 aerial photograph (Figure 1).

2.2 CHANGE TO THE NATURAL SYSTEM

In the last 150 years there have been major changes to the watershed. Activities in the watershed such as logging and road construction have increased both the erosion of soils and runoff of water into the creek. The sediment supply and magnitude of floods have therefore increased.

The creek has also become a more efficient conveyor of water and sediment. Channelization of the creek has separated it from the floodplain and increased its conveyance; water and sediment bypass the floodplain and are carried straight to the creek mouth. The slope of the creek has also increased due to aggradation of the bed.

At the same time the lagoon has filled and the creek now flows directly into the bay. The buffering effect of the lagoon, capturing sediment and dissipating flood flows, has been lost. The filling of the lagoon has also reduced the tidal prism of the channel behind the spit making it less stable.

As a result, today more sediment is available to be transported by the channel, floods are of greater magnitude, and the channel has become a more efficient conveyor of both water and sediment.

2.3 THE PRESENT SYSTEM

The present system functions in a fundamentally different manner to that of the natural system. It accommodates the increase in water and sediment discharges by changing its alignment. A change in alignment occurred during floods in 1982 when Third Valley Creek cut a new northern channel. Large amounts of sediment were deposited in a delta associated with the new channel that fed the spit, causing it to elongate and create new recurves. Such extreme events have occurred several times since 1982, each time bringing more sediment.

During periods of high creek discharges, backwater conditions occur upstream of the long hydraulically inefficient channel and the creek may flow over the low and narrow neck of the spit. The creek abandons the channel behind the spit and cuts a channel further north across the beach. The new channel is straighter and takes a more direct and hydraulically efficient route to the bay. The short channel can be seen in the aerial photographs of 1972, March 1998 and November 2002 (Figure 2, Figure 3 and Figure 4 respectively). Large volumes of water and sediment are discharged into the bay during these flood events. As the channel reaches the bay the flow velocity decreases and the coarser sediment is deposited as a delta; the finer sediment is carried farther into the bay where they are distributed by tidal currents. The delta can be clearly seen in the aerial photographs of March 1998 and November 2002 (Figure 3 and Figure 4).

The coarser sands and gravels that form the delta are reworked by wave action to resupply the spit. A wide beach builds up on the northern side of the delta. Since the channel and delta act as a barrier to longshore transport the beach tends to orientate itself more parallel with the waves. In Figure 3 and Figure 4, the orientation of the beach north of the channel can be seen to be quite different to that of the south. South of the delta the spit continues to elongate and a new recurve forms. The former recurve is abandoned behind the spit. Comparing an aerial photograph taken in 2002 (Figure 4) with one taken in 1998 (Figure 3), the 2002 photograph shows three additional recurves added to the end of the spit by separate flood events.

During periods of low creek discharge, the creek channel may switch its previous alignment behind the spit. This will become increasingly inefficient due to the frictional resistance of the long, shallow channel and the small tidal prism. The bay side face of the spit will become one continuous beach. There will be no resupply of sand to the spit from the creek yet the longshore movement of sediment will continue to elongate the spit. This elongation is achieved by eroding the neck of the spit, narrowing and lowering the beach in this area.

2.4 IMPLICATIONS FOR FUTURE MANAGEMENT

In the past the spit developed as a response to rising sea level and low sediment supply. The formation of a large delta and a northern channel alignment is a response to larger flood and sediment discharges caused by disturbance of the watershed. The presence of the delta appears to be altering the existing processes along the spit - storing sediment at the northern end of the spit, altering the refraction pattern of waves along the spit, making mouth closure less likely and reducing the rate at which the spit elongates. This has resulted in the northern end of the spit, and the northern alignment of Third Valley Creek, becoming more stable.

This change in the functioning of the system has important implications for the long-term management of Chicken Ranch Beach.

Wetlands: the channel flowing through the existing wetlands, behind the spit, is only occupied intermittently. If the channel remains in its northern alignment there may be opportunities to extend these wetlands, increasing their tidal prism and enhancing their drainage.

Drainage: the Third Valley Creek bed elevation is too high to drain the adjacent properties and so an alternative drainage channel is required. Drainage is therefore routed in a separate channel to the bay. This smaller channel is liable to closing with consequent impacts on water quality.

Recreation: the beach has become more stable due to the presence of the delta. However, the beach is now bisected by the creek channel and 'B' channel.

While the switch of mouth location has helped the previously eroding beach to stabilize, this may be to the detriment of the wetland behind the spit. In addition, the location and form of the creek has an impact on potential for flooding of properties immediately behind the beach.

3. OPPORTUNITIES AND CONSTRAINTS

3.1 OPPORTUNITIES

Existing site conditions provide opportunities and constraints for achieving the project objectives. Given the existing physical setting and ecologic functions of the study area, we have identified the following opportunities:

- Restore and enhance filled wetlands on the SLC parcel.
- Increase the tidal prism of Third Valley Creek, increasing its size and stability.
- Reduce the requirement for dredging of Third Valley Creek downstream of the culverts.

- Divert existing drainage channels through the restored wetland channels.
- Improve water quality by regular tidal flushing of the drainage channels
- Improve access by reducing the number of channels flowing across the beach.
- Beneficial re-use of suitable fill material excavated from the SLC parcel.
- Reduce existing mosquito habitat by reducing the quantity of small pools of standing water with dense vegetation.

3.2 CONSTRAINTS

Constraints arise from the multiple and sometimes competing objectives, as well as the physical setting of the site. The following constraints were identified and would be used to refine the project objectives:

- The project site is surrounded by different adjacent property ownership and land use.
- The filling of the SLC parcel and modifications to the back beach has resulted in an unnatural morphology.
- Site grades of the SLC parcel are above existing marsh plain elevations, and will need to be graded to lower elevations to allow tidal action to be restored.
- Removal of fill from the SLC parcel will require the disposal of a large volume of material.
- Previous channels connected to Third Valley Creek have silted in during high flood flows.
- The bed elevation of Third Valley Creek is too high to allow tidal flow.
- Potential for tidal flooding of Keller's property.
- Potential for migration of the mouth of Third Valley Creek to a more southerly position during dry periods.
- Infrastructure, such as the footbridge, will have to accommodate a larger channel.
- Sediment quality of the SLC parcel has not been determined.

4. POTENTIAL RESTORATION ALTERNATIVES

Three potential restoration alternatives are outlined below together with a discussion of options for the recycling of beach sand and the disposal of excavated fill material. These are preliminary ideas and further investigation will be required to determine their feasibility.

4.1 TIDAL WETLAND RESTORATION – 'B' CHANNEL CONNECTION

This alternative would restore tidal action to the SLC parcel. Ground elevations need to be lowered sufficiently for tidal inundation to occur and vegetation to colonize. The site would be graded to an elevation below that of pickleweed colonization. A channel network within the wetland would also have to be excavated. The creation of wetlands in the SLC parcel will create a large amount of material, most of which originated in Tomales Bay. The amount of fill to remove is a tradeoff between the cost of fill removal and the achievement of desired wetland functions within a given period. It is suggested that ground elevations are lowered to at least one foot below colonization elevation to allow the natural sedimentation form a suitable substrate for plant growth. In addition the berm between the SLC parcel and the beach would be lowered to allow inundation across the beach at the highest tides.

Third Valley Creek has aggraded considerably and its bed elevation is probably too high to allow a tidal connection from the SLC to the bay. It would also be preferable to separate Third Valley Creek from the wetland to prevent rapid siltation of the wetland channels during flood events, as occurred in the past with the cross-channel. The 'B' Channel has a lower elevation and the restored wetland would be connected to this channel. This would increase the conveyance of the 'B' channel and improve its flushing. However, this would create a second channel across the beach.

4.2 TIDAL WETLAND RESTORATION – THIRD VALLEY CREEK CONNECTION

In this alternative the tidal wetland restoration of the SLC parcel would be the same as described above. The grading of the wetlands would be very similar.

In this alternative the connection to the bay would be by a channel cut through the beach and joining the Third Valley Creek downstream of the footbridge. This junction of the channels would be at an elevation sufficiently low to allow tidal inundation of the wetland. This alternative avoids the potential deposition of sediment from Third Valley Creek during flood events. In this alternative the 'B' channel flows would be diverted into the wetland and discharged to the bay through the Third Valley Creek. This again requires a second channel across part of the beach.

4.3 RIPARIAN WETLAND RESTORATION

A third alternative is to realign the channel of the Third Valley Creek to meander through the SLC parcel, and then back on to its present alignment across the beach. The 'B' channel would be connected to the realigned creek channel. Ground elevations and berms would be lowered to create a floodplain on either side of the channel. However, since the wetland would not be tidal, the deposition of sediment from the creek during floods is not a critical issue. In addition, the berm between the SLC parcel and the beach could be lowered to allow inundation across the beach at the highest tides.

This alternative would mean that the present delta would remain in its present position, supplying the spit with sand as before. All the flows would be contained in a single channel across the beach, improving recreational access.

4.4 OPTIONS FOR RENOURISHING NORTHERN BEACH

Options for recycling beach material to the northern beach should be investigated in conjunction with the alternatives described above. The reorientation of the northern beach due to the presence of the delta makes a more stable beach, however there appears to be very little feed from beaches to the north of the beach. Sediment from the delta or from the spit could be recycled to the northern beach. This would probably be most effective after a large flood, when the delta would have been recently recharged with sediment from the creek and would minimize impacts on the southern spit.

4.5 OPTIONS FOR DISPOSAL OF EXCAVATED FILL MATERIAL

Options for the disposal of the excavated fill material should be explored in conjunction with the alternatives described above. The fill material in the SLC parcel was dredged from Tomales Bay by suction dredger in conjunction with the laying of a telephone cable in the early 1950's (Tom Gaman, pers comm.). The material is probably not suitable for renourishment of the beaches.

5. PROJECT TASKS

5.1 ESTABLISH PROJECT GOALS AND OBJECTIVES

It is essential the stakeholder process develop consensus on the project goals and objectives prior to the start of the development of alternatives. These goals and objectives have to take account of, and be in harmony with, other plans for the area. An ideal sponsor for this project would appear to be the Tomales Bay Watershed Council which brings together many of the key stakeholders and which already has formulated a framework for restoration with the Tomales Bay Watershed Stewardship Plan. A Project Management Team (PMT) should be selected from the larger group to manage the project.

A provisional project goal has been used for this scoping document. The provisional project goal is to accommodate the changing alignment and channel form, which is a natural part of the creek morphology, within environmental, flood control and recreational objectives. This goal would need to be refined and agreed through the stakeholder process.

The project goal can be translated into specific objectives used to guide the restoration planning and design. The following provisional objectives for the restoration plan have been used for this scoping document and would need to be refined and agreed through the stakeholder process:

- create a functioning, self-perpetuating wetland;
- maintain an accessible swimming beach;
- maintain and, if possible, improve the property drainage to reduce the need for channel dredging;
- address the potential water quality problems that exists at Channel B.

A rigorous planning methodology requires that these objectives be made ‘operational’ by defining measurable indicators of their performance. These evaluation criteria provide the metrics for comparing the merits of alternative restoration plans, the outcome of the selected restoration design, as well as the basis for a monitoring and adaptive management program. They also provide the ability to compare expected with actual performance.

Milestone: *Agreed Project Goal and Objectives*
Timing *Month 1.*

5.2 DATA COLLECTION

It will be necessary to gather and review existing documents and data to assess both existing and historic ecologic, geomorphic, and hydrologic conditions related to Chicken Ranch Beach and Third Valley Creek.

- Physical setting (soils and substrate, topography, creek hydrology, water quality)
- Biological resources (vegetative communities, birds, fish, invertebrates, sensitive / endangered species, non-native species)
- Cultural resources
- Public access
- Land use issues (utilities, easements, access)

A Data Gaps analysis should be performed to identify any additional data collection required to allow characterization of the site. This is expected to include some, or all, of the following:

- Ground elevations of the SLC parcel, Keller’s property, Chicken Ranch Beach, existing wetland and spit.
- Long sections and cross-sections of the existing channels.
- Sediment samples to characterize the texture of the beach, spit and creek.
- Sediment samples to characterize the quality and suitability of fill material in the SLC parcel for re-use in wetlands or as beach recharge.
- Coring to estimate depth of fill on SLC parcel.

***Milestone**: Data Gaps analysis and additional Data Collection.*
***Timing** Month 1 to 3.*

5.3 CONCEPTUAL MODEL OF PAST AND FUTURE EVOLUTION

A physical and environmental description of the project area will be developed in the form of a conceptual model. This explains the past evolution of the area, its present functioning and its likely future evolution.

A well-constructed conceptual model need not be complex. In fact, unnecessary complexity obscures key management and ecosystem links. Rather, the purpose of a conceptual model is to make explicit the implicit beliefs held by those involved in restoration about how various actions might improve ecosystem conditions. Such models are seen as '*an intellectual map*' and '*a frame of reference for understanding complex and difficult processes and interactions*'.

A conceptual model of the evolution and ecologic functions of Third Valley Creek and Chicken Ranch Beach is a tool to integrate science and stakeholder-derived visions for the future of the project area. The lack of such an explicit model may result in unnecessary conflict between stakeholders, unfocused technical studies, or failure to address critical impacts until late in the process.

Conceptual models provide many benefits:

- Suggest restoration actions to meet project objectives,
- Highlight key uncertainties,
- Identify potential impacts, and
- Facilitate communication between stakeholders.

They focus the planning effort on characterizing relevant ecologic processes and appropriate analytic tools, instead of open-ended scientific research.

***Milestone**: Conceptual model of Past and Future Evolution*
***Timing** Month 1 to 2.*

5.4 OPPORTUNITIES AND CONSTRAINTS ASSESSMENT

Data collected in Tasks 1 and 2 provides a valuable description of the site. However, to be useful in the planning process, it must be translated into a format that facilitates subsequent development of project alternatives. To accomplish this, there is an interim step of translating the data into an "Opportunities and Constraints" format. This process links the Existing Conditions data with the Goals and Objectives and identifies where and how the site conditions support or constrain attainment of the Goals. This would typically cover:

present infrastructure; current land uses; environmental factors; opportunities for restoration; flood protection; water and sediment quality; sediment; public access; existing plans; land ownership; phasing of restoration; funding; short-term versus long-term costs; adjacent land use; interim management

The results of this assessment will be used to guide the development of restoration objectives and restoration alternatives. Potential opportunities and constraints have already been identified in Section 3 of this Scoping Document. This assessment will benefit from the input of specialized and local knowledge through the stakeholder group.

Milestone: *Refined Opportunities and Constraints*
Timing *Month 3*

5.5 DEVELOP AND EVALUATE PROJECT ALTERNATIVES

Once detailed project objectives and evaluation criteria have been defined, a range of restoration alternatives can be developed.

At least three project alternatives should be defined to address competing objectives and different resolutions of project opportunities and constraints, while also providing a reasonable range for impact evaluation consistent with NEPA/CEQA requirements, if necessary. Possible alternatives have been discussed in Section 4.

Comparison with the no-action alternative will form the basis for developing and analyzing restoration alternatives. It will be necessary to agree the appropriate assumptions used in defining the 'no-action' alternative. For example, these will include ongoing geomorphic changes (affected by changing sediment supply and sea level rise), frequency of extreme events, flood management actions, existing plans and policies.

Based on the project alternatives, a preferred project alternative will be selected which best meets the evaluation criteria and satisfies the project objectives.

Milestone: *Preferred Restoration Alternative*
Timing *Month 3*

5.6 ANALYSIS AND REFINEMENT OF THE PREFERRED PROJECT ALTERNATIVE

Evaluation of the above alternatives will result in one preferred alternative for more detailed analysis and refinement. These analyses will address: Hydro-geomorphic analysis, and engineering analysis.

Hydro–geomorphic analysis will include:

- An assessment of rates of marsh evolution and acreages of habitat development;
- An estimate of potential restored tidal prism and associated effects on the spit;
- The design of channel geometries to accommodate flood flows and tidal prism;
- An assessment of beach evolution and spit development;
- An assessment of flooding potential;
- An assessment of water quality impacts;

Engineering analysis to identify:

- One or more off-site disposal sites for fill material excavated from the SLC parcel.
- Beach recharge options for excavated fill material;
- Likely construction costs.

Milestone*:* *Technical Evaluation of Preferred Restoration Alternative*
Timing *Month 4*

5.7 PREPARE PRELIMINARY DESIGN REPORT

A Preliminary Design Report (PDR) will be prepared that addresses the primary elements of the project design including: a vision of restored habitats, a target tidal regime, functional geomorphic features, general channel locations and forms, target vegetation types, interactions with surrounding upland and estuarine systems, and earth moving issues. Specifically, the PDR will:

- document preliminary design tasks
- describe the preferred alternative in detail
- refine estimates of likely construction costs based on final design documents
- verification that construction estimates are within funding limits

The preferred alternative should be described in sufficient detail to be submitted to the appropriate permitting agencies. An administrative draft should be provided for PMT review with comments addressed in the final draft.

Milestone*:* *Preliminary Design Report*
Timing *Month 5*

5.8 PERMITTING

It is anticipated that several permits would be required, including Section 10 permit from the Corps of Engineers, Section 404 permit from the Regional Water Quality Control Board and permits from the Coastal Commission and Department of Fish and Game. It is assumed that the PMT would manage and direct the permitting process. Allowance should be made for presentations to interagency meetings arranged through the Corps of Engineers' Inter-Agency Meeting Process and Design Review Group (DRG) meetings.

5.9 FINAL DESIGN

The final design will require preparation of the technical portion of the construction documents for the project. The Construction Contractor will provide estimates of construction costs and constructability review. A consistent set of technical documents (drawings, technical specifications, and estimates of construction quantities and costs) will need to be developed. The PMT will then develop the construction contract documents, using the technical portion described above, and including general provisions and special provisions, and instructions to bidders.

It is anticipated that the following construction drawings will be produced:

- Title Sheet (including technical specifications)
- Site Plan
- Grading Plans
- Restoration Details (channel excavation, beach recharge, etc.)

These drawings or other similar drawings would be provided for Agency review.

Specifications will likely consist of notes on the construction drawings. Technical specification will include environmental protection, demolition, clearing, earthwork, dredging, planting plans and specifications. Preliminary documents for review by the PMT would be required at completion levels approximated as 60%, 90% and final (stamped and signed by a Professional Engineer). About five hard copies would be required at each progress submittal; in addition to one hard copy reproducible at the final submittal.

Engineer's estimates of quantities and costs will be required, in tabular format. This will include estimates of construction costs and for planting.

Milestone: *Final Design*
Timing *3 Months after permitting*

5.10 MONITORING PLAN

A monitoring plan will be developed to define pre-existing conditions and to evaluate the success of the restoration project.

Physical process monitoring will include site morphological evolution (channels, marsh plain etc). Surveys for biological resources of water quality will be designed to provide quantifiable measures of biological integrity and function in restored areas. Physical integrity of restored areas will be monitored through measures of sediment accretion, channel bank stability, and hydraulic parameters.

The monitoring plan will be adaptive in structure, so that monitoring results will be used to refine the program over time. Both the specific monitoring parameters and the monitoring frequency will be subject to refinement over time. This program will also provide a key element of any adaptive management.

Milestone: *Monitoring Plan*
Timing *3 Months after permitting*

6. COSTS

Budget costs for each of the tasks described in Section 5 are shown in Table 1.

Table 1. Budget Costs

	Cost
Tasks 1 to 4 Establish Project Goals and Objectives, Data Collection, Conceptual Model, Opportunities and Constraints Assessment	$10k
Tasks 5 to 7 Develop and Evaluate Project Alternatives; Analysis and Refinement of the Preferred Project Alternative; Prepare Preliminary Design Report	$25k
Task 8 Permitting Support	$5k
Task 9 Final Design	$35k
Task 10 Monitoring Plan	$5k
Total	$80k

7. REFERENCES

Hydrologic Systems (2003). “Chicken Ranch Beach – Creek Restoration and Realignment”. Prepared for Marin County Open Space District.

Krone R.B. (1999). “Sand Supply and Loss at Chicken Ranch Beach, Tomales Bay, California”. Prepared for California State lands Commission.

8. LIST OF PREPARERS

This report was prepared by the following PWA staff:

Philip Williams, Principal
Jeremy Lowe, Associate Principal

Figures

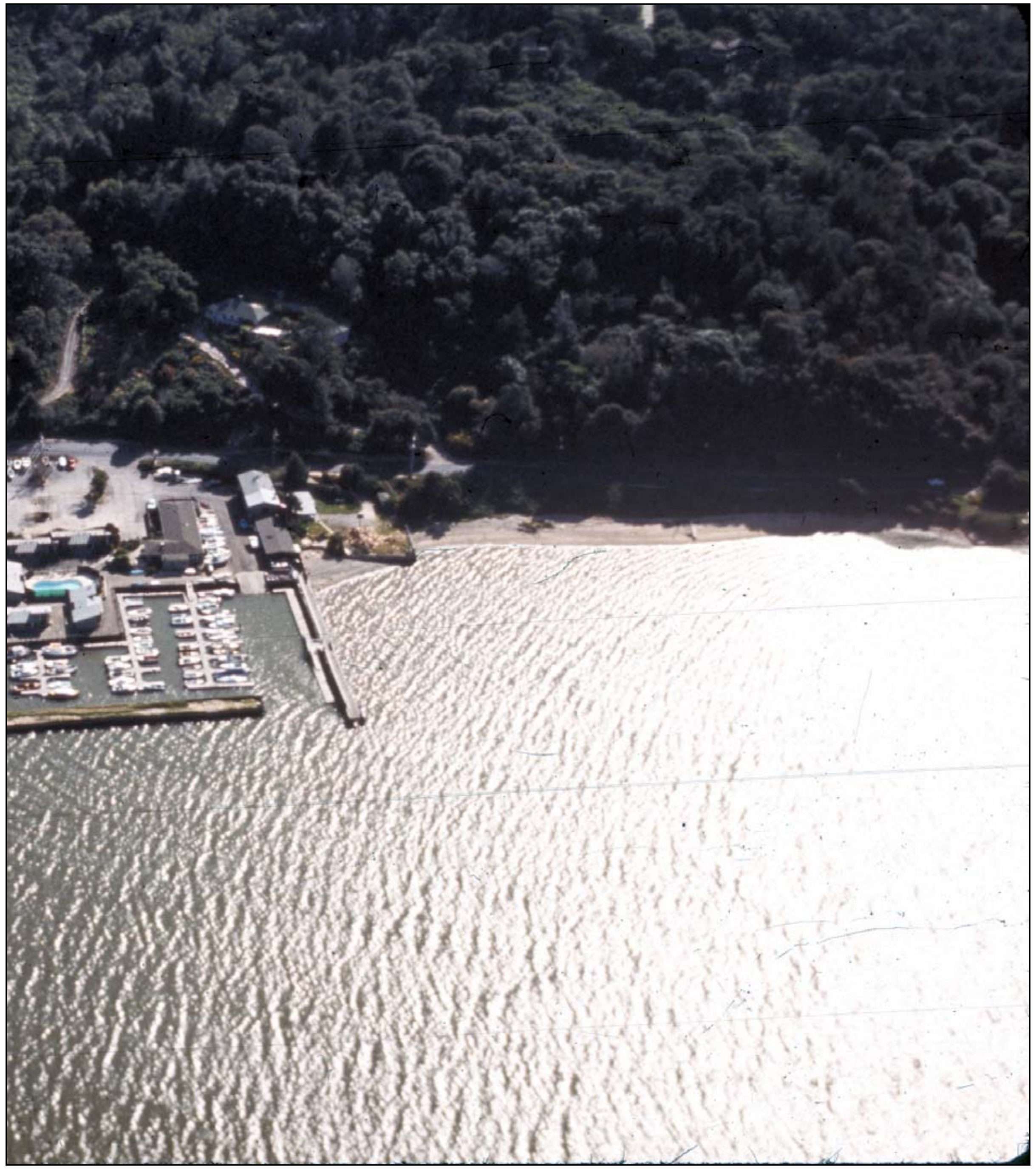
Photograph taken October 10, 1979 at 12:25. Tidal elevation is about 2.8ft MLLW (2 hours after Low Water of 2.1ft MLLW)

figure **1**
Chicken Ranch Beach

Oblique Aerial Photograph of Chicken Ranch Beach, October 1979

PWA Ref# 1761

PWA



Photograph taken in 1972.

figure **2**

Chicken Ranch Beach

Oblique Aerial Photograph of Chicken Ranch Beach, 1972

PWA Ref# 1761

PWA

Photograph taken March 30, 1998 at Low Water (–0.7ft MLLW)
Source: Krone (1999)

figure **3**
Chicken Ranch Beach

Oblique Aerial Photograph of Chicken Ranch Beach, March 1998

PWA Ref# 1761

PWA

Photograph taken November 14, 2002 at 14:39. Tidal elevation approximately 1.6 ft MLLW (1 hour before Low Water of 1.5ft MLLW)

figure **4a**
Chicken Ranch Beach

Oblique Aerial Photograph of Chicken Ranch Beach, November 2002

PWA Ref# 1761

PWA

Photograph taken November 14, 2002 at 14:39. Tidal elevation approximately 1.6 ft MLLW (1 hour before Low Water of 1.5ft MLLW)

figure **4b**

Chicken Ranch Beach

Oblique Aerial Photograph of Chicken Ranch Beach, November 2002

PWA Ref# 1761

PWA