Report for **San Mateo County Harbor District Pillar Point Harbor**

DRAFT Condition Survey for West Trail

Prepared by

CLIENTS PEOPLE PERFORMANCE

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- *were limited to those specifically detailed in the Scope of Work presented in Section 1, Executive Summary, of this Report;*
- *did not include materials testing or identification of hazardous materials;*
- *did not include dismantling components of the structures, and only visible and accessible portions of these structures were surveyed.*
- *did not include the preparation of detailed design drawings or construction specifications.*

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- *existing structures were originally engineered, designed, constructed and permitted per the requirements of governing codes and regulations applicable at the time of construction*
- *no unforeseen conditions exist at the project site.*

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1. EXECUTIVE SUMMARY

Introduction

This report presents the results of a visual condition survey of an approximately 700 foot long portion of the Pillar Point Harbor "West Trail," located on the west side of Pillar Point Harbor in El Granada, San Mateo County, California. Portions of the trail directly adjacent to the water line are eroding, resulting in places in an approximately 6-foot high near-vertical slope encroaching into the trail width. Hillside erosion has also occurred in portions of the land-side of the trail. GHD Inc. (GHD) was retained by the San Mateo County Harbor District (District) to provide a condition survey of the site for subsequent development of necessary repair and/or maintenance alternatives.

The topographic survey was performed by GHD in early February 2012. The survey produced a CADD drawing of the site showing existing conditions.

The visual condition survey was performed by GHD on the morning of February 16, 2012 during low tide conditions. Low tide was about -1 foot MLLW and occurred at about 12:35 pm.

Coast & Harbor Engineering, Inc. (CHE) performed a coastal engineering analysis for the site, resulting in a wave design criteria for the development of long-term design and/or maintenance alternatives.

Scope of Work

GHD's scope of work was to perform a condition survey of 700 linear feet of the West Trail, beginning at a point 500 feet south of the West Point Avenue parking lot. The objective of the survey was to assess the condition of the trail and identify specific areas of significant degradation and/or damage. The trail is presently open to the general public.

The condition assessment process is subjective but serves as a basis for determining the integrity of the trail and the need for subsequent repair and/or maintenance. Repair concepts and budgetary-level cost estimates are presented for the damage along the trail.

Results of Survey

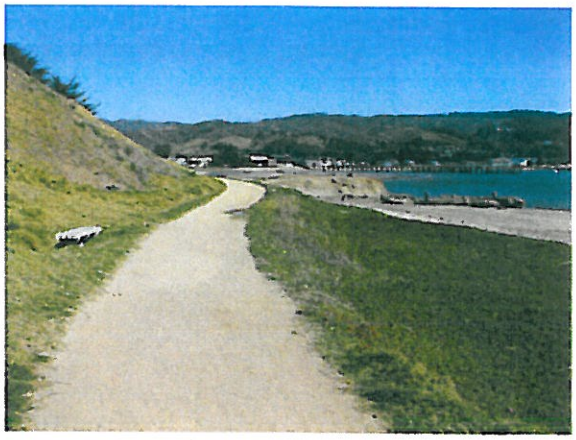
The visual survey of the West Trail path resulted in the following observations:

1. The path is an unpaved, densely compacted dirt pathway that is actively used by the public. Generally the path is well defined and in good condition. Portions of the path directly adjacent to the harbor are being eroded by wave action. In select locations, this erosion is encroaching directly into the path. This erosion is on-going.
2. Several large pieces of concrete rubble are strewn on the beach.
3. An unvegetated portion of the hillside above the path is eroding onto the pathway.

2. GENERAL DESCRIPTION AND BACKGROUND

The West Trail begins at the public parking area off West Point Avenue, and extends approximately 2,300 feet south along the edge of the harbor shoreline, ending at the beginning of the western outer harbor breakwater. A station line was traced out on the trail, beginning at Sta 0+00 at the trailhead beginning in the parking lot. The project site begins 500 feet south of the parking lot, near where the path first meets the water's edge (Sta 5+00). The project site continues for 700 feet along the trail, ending at an existing bench (Sta 12+00). See Appendix A for trail layout including station line. The 700 foot length of the path described above (from Sta 5+00 to 12+00) is defined as the project site.

The path is an unpaved, densely compacted dirt pathway cleared of all vegetation, varying in width from 8 to 18 feet. The edges of the path are generally clearly well-defined by a line of vegetation, although there are some areas where the pathway bleeds directly onto adjacent rocky or sandy areas. Within the project site, the path is generally at or near the water's edge, varying in elevation from 5 to 10 feet above mean higher high water. On the landside adjacent to the path, the land slopes immediately upwards to over 100 feet in elevation above the trail. This slope is varied in its vegetated cover, including a heavily wooded portion with many dense cypress trees, a mostly bare unvegetated portion, and a portion lightly vegetated with small grass. The steepest portions of the hillside above the project site are sloped up to 1.5H:1V. The Pillar Point Air Force Station is located on the top of the hillside. Photos 1 and 2 show typical conditions.



Photos 1 & 2 – West Trail, typical conditions

3. CONDITION ASSESSMENT

The conditional assessment of the West Trail is based on our visual observation conducted on February 16, 2012. The survey was conducted during a low tide cycle to allow greater access and observation. The weather was exceptionally mild, and many people were walking on the trail and the adjacent beach, including several school groups and off-leash dogs.

Date of Survey:	February 16, 2012
Time of Survey:	10:00 am to 12:00 noon
Tide (low):	-1.0 feet (MLLW) at 12:35pm on February 16, 2012
Weather:	Sunny, clear and approximately 60 degrees

3.1 Northern Portion of Path

The harbor-side of the northern portion trail is seeing erosion from wave action. In several areas, the erosion has resulted in an approximately 6-foot high near-vertical slope that is within a few feet of the trail edge. Below this 6-foot high drop-off are areas of natural rocks of various size, and assorted pieces of concrete rubble. At Mean Higher High Water, the water comes up close to the bottom of this drop-off. In a few areas, the erosion has begun to encroach directly onto the trail. Photos 3 through 6 show eroded portions of the edge of the trail. At Station 8+00, a 30-foot section of 14" outer diameter pipe is exposed in the eroded portion of the drop-off (Photo 5). The harbor-side erosion can be assumed to be on-going. No unstable areas of imminent additional failure were observed.

Photo 3 – Looking South, showing eroded areas encroaching into path, Sta 5+50 to 6+00

Photo 4 – Looking South, showing eroded areas encroaching into path, Sta 7+00 to 8+00

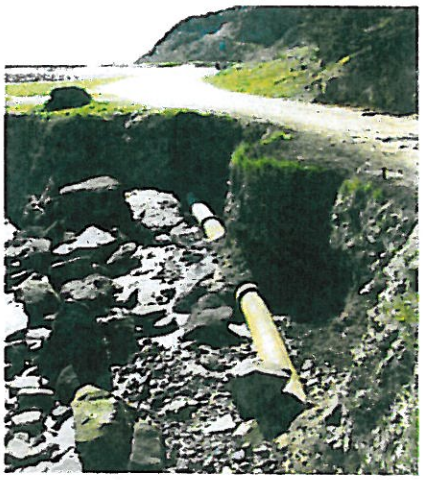


Photo 5 – Looking South, showing eroded areas encroaching into path, Sta 7+50 to 8+00

Photo 6 – Pipe exposed at Sta 8+00

3.2 Path Erosion at Stacked Culverts

Erosion at two existing stacked culverts near Sta 6+00 has created the most severe encroachment into the pathway along the project site. The void missing from the trail is 3' wide, with a 3.5' drop-off (to the bottom of the top culvert). The upper culvert is a 12" Corrugated Metal Pipe (CMP). The lower culver is an 18" inner diameter, 23" outer diameter concrete pipe that is broken into many segments. Both culverts are clogged with debris, and it can be assumed that they are not functioning. This location was taped off with yellow "CAUTION" tape on the day of the visual condition survey. The bench at this location is undermined, and is unsafe.

Photos 7 & 8 – Sta 6+00, showing severe erosion at stacked non-functioning culverts.

3.3 Concrete Rubble on Beach

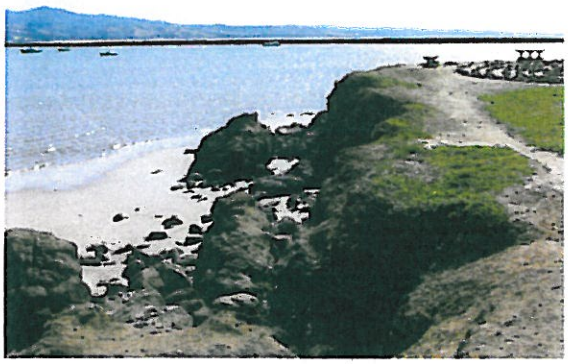
There are several large pieces of concrete rubble mixed in with the rocky material at the water's edge. The area from Sta 7+50 to 8+50 appeared to have the most rubble. Additionally, pieces of the broken concrete culvert at Sta 6+00 are strewn along the beach, including a piece that was only visible during low tide.

Photo 9 – Concrete rubble on beach, Sta 6+00

Photo 10 - Concrete rubble on beach, Sta 8+00. There are several other pieces of smaller rubble in addition to the large piece indicated.

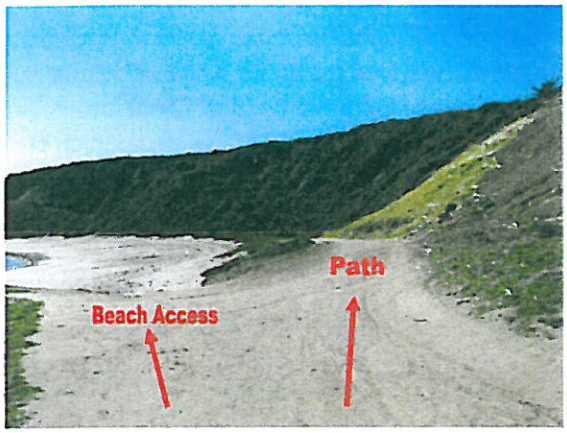
3.4 Path Bulb-Out and Beach Access Point

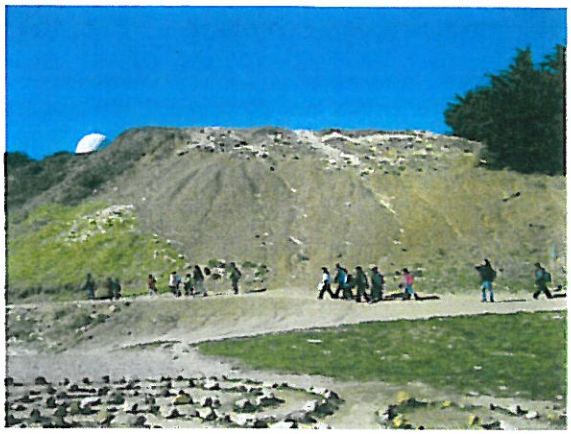
From Station 8+50 to 9+50, there is a bulb-out between the pathway and the water's edge. Generally this area is about 10 feet higher than the beach below. There are large rocks on the beach. The edge of this bulb-out appears to be eroding in a similar manner to the edge of the pathway from Sta 5+50 to 8+00, but this is less of a concern because the pathway does not pass directly adjacent to the bluffs.



Photos 11 & 12 – Bulb-out, seen from pathway and from the beach.

Beginning at Sta 9+25, an off-shoot of the trail forks down to the beach. Several people were observed using this off-shoot as beach access.





Photos 13 & 14 – Beach access point.

3.5 Southern Portion of Path

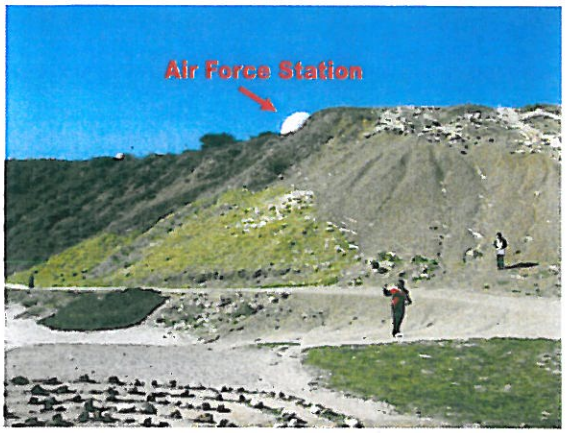
From Sta 10+00 to 12+00, the path is generally separated from the water line by a band of vegetation. There are a few narrow "desire paths" through the vegetation that people have used to walk through the vegetation and access the beach. No erosion is seen, except for a 25-foot section from Sta 10+00 to 10+25, which is shown in Photo 15.


Photo 15 – Southern portion of path, taken from Sta 9+75. Eroded area indicated.

Photo 16 – Southern portion of path, taken from Sta 11+25

3.6 Path Erosion – Hillside

The hillside above the pathway generally appears to be stable in the vegetated areas. The hillside from Sta 5+00 to Sta 8+50 is heavily covered with cypress trees and brush. From Sta 9+75 to 12+00 the hillside was covered in newly sprouted grasses. We have been informed that the unvegetated portion of the slope (from Sta 8+00 to 9+75), has been eroding on to the pathway. This portion of the hillside is sloped at approximately 1.5H:1V. The Pillar Point Air Force Station is located on the top of the hillside. Storm water run-off from that site, combined with the lack of vegetation and underlying geotechnical conditions, may be contributing the erosion of the hillside.



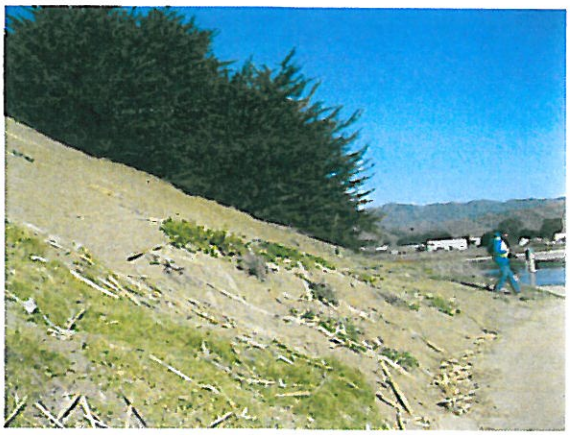


Photo 17 – Erosion of hillside above path, centered on Sta 10+00. Both vegetated and unvegetated portions of the hillside are shown.

Photo 18: Hillside erosion, looking North from Sta 10+00

4. REPAIR ALTERNATIVES

4.1 Repairs for Harbor-side Erosion along Northern Portion of Path

4.1.1 Alternative #1 - Riprap

Riprap can be placed along the embankment from Sta 5+35 to Sta 8+25 to minimize future erosion from wave action (Figure 1). We recommend placing the rip rap at a slope of 1.5H:1.0V (Figure 2). The rip-rap size, as determined by the 100-year significant wave height of 2.5 feet as listed in the Coastal Engineering Analysis, should be 3.5 feet diameter placed over smaller stones and grouted in place.

The riprap should be placed along the embankment from Sta 5+35 to Sta 8+25. This is the portion of the path affected by wave action erosion. The average embankment height is approximately 6.5 feet along this expanse. The beach is currently sloping at approximately 12% away from the bottom of the existing embankment. Therefore, if the new riprap is placed at a slope of 1.5H:1.0V, the new riprap would extend approximately 12-feet horizontally from the top of the embankment. The total volume covered by riprap would be approximately 420 cubic yards.

The installed riprap would look similar to a breakwater, and would be more uniform and somewhat less natural looking than the rocks that are currently strewn on the beach. As discussed above, the new riprap would extend approximately 12-feet horizontally from the top of the embankment. Therefore, some beach area would be lost due to the installation of the riprap. Most of the area that would be lost is currently rocky, and not sandy. Currently, the beach is generally mostly inundated during higher tide conditions, and this condition would be made more acute with the placement of riprap; it would be expected that the riprap would extend to the waterline at mean high tide (and higher water) conditions. In addition to aesthetic concerns, there may be environmental concerns with the loss of the tide pools/tidal habitats that would be covered by the new riprap.

The existing pipe that runs parallel to the trail that is exposed at the toe of the existing embankment at Sta 8+00 (the function of this pipe is unknown) would be buried by the riprap.

In the event of significant future sea-level rise, additional rip rap could be placed at some point in the future, increasing the height of the protection. The riprap would also extend further on the beach (which would be already decreased in width due to sea-level rise).

4.1.2 Alternative #2 – Sheet Pile Retaining Wall

A properly designed sheet pile retaining wall installed along the edge of the current embankment could be expected to stop additional erosion at the area in question. Additional soil would be backfilled between the current edge of embankment and the new wall. A sheet pile retaining wall would preserve more of the existing beach than a riprap repair.

The wall would either be pile-driven or vibrated into place, depending on geotechnical and environmental concerns. Attention would have to be paid to the existing pipe that is exposed at Sta 8+00. The wall could be consistently installed on the outboard side of this pipe (Figures 3 and 4, similar). Or, if it is determined that this pipe is not functioning, the pipe could be partially removed if its location conflicted with the proposed sheet pile wall.

A sheet pile wall would have an industrial look that may not be appropriate for the site, if aesthetic concerns are a high priority.

The sheet pile retaining wall could be designed so that it could be extended in height at a later date to address the issue of sea-level rise.

4.1.3 Alternative #3 – Retaining Wall of Other Materials

Depending on the importance of aesthetic concerns, a retaining wall of other materials can be designed to prevent further erosion at the site. A soldier pile and lagging wall is one good alternative that uses vertical steel piles with horizontal lagging of wood, steel or concrete panels. Concrete panels would be the material of choice due to its better corrosion resistance. This wall could be designed solely by a structural engineer. Other options include a stone, concrete or wood wall, and we would recommend that a structural engineer work with another designer (architect or landscape architect) to develop a design that is complimentary to the site, if the Harbor District is interested.

4.2 Repairs at Stacked Culverts

Both of the two culverts at Sta 6+00 appeared be clogged and we assume that they are non-functioning. We did not observe an inlet that led to these culverts, so we do not know what area they are meant to drain. The 24" corrugated metal pipe (CMP) on the hill-side of the path, which is fed from a concrete swale, does not appear to connect to either of the culverts, although it might be expected that these converts would be used to convey water from the 24" pipe to the harbor. We assume that the discharge from the 24" pipe currently ponds on the hill-side of the path and sheet-flows towards the harbor. This discharge is most likely causing the erosion on the water-side of the path at the culverts. The 24" pipe most likely drains a large portion of the hill-side above the path, and we should assume that it is at capacity under the most severe rainfall events. .

We recommend coordinating with the Harbor District to investigate the design intent of the existing culverts. If they were installed to convey water from the 24" pipe, why are they no longer functioning? Is it desirable that they are repaired? Why are there two stacked culverts, whose combined capacity is still less than that of the 24" pipe? This coordination and investigation will help determine what repair is appropriate. The following repair alternatives are available. Regardless of the repair, coordinate this work with the repairs for the harbor-side erosion at the north portion of the path.

See Appendix D for diagrammatic images of the Alternatives described below:

4.2.1 Alternative #1 – Direct Connection of 24" CMP to Culverts

This alternative recommends a direct underground connection from the 24" pipe to the culverts. A box structure (for example, a junction structure topped by a catch basin or a manhole) would be constructed on the hill-side of the path. The 24" pipe would discharge directly into this structure and the existing culverts would convey the flow under the path to the Bay. This alternative would be the most sound, as it would deliver all stormwater flows to the harbor without the risk of flows over the existing trail.

We would need to investigate and ensure that the existing culverts are structurally sound if they are to be retained, and connected to the new junction structure. If they are to be retained, remove existing debris, and investigate upstream structural integrity. The pipes would need to be extended towards the waterline to ensure proper outflow.