PORT OF PALM BEACH DISTRICT
REQUEST FOR DISCUSSION AND
COMMISSION ACTION

CONSENT AGENDA
ITEM G-9

PREPARED BY: José Soler, PE Port Engineer January 5, 2018

SUBJECT: **Request to Advertise for Proposals**
Berth 1 Bulkhead Underwater Repairs

BACKGROUND:

During the October Meeting, the Board approved a Work Order to CH2M for the Underwater Re-inspection and Updates Condition Report of Berth 1. The inspection was performed on the days of 14 and 15 of November. The Final Underwater Evaluation Report was provided to the POPB on December 21, 2017. The overall condition rating of the Berth as per the inspection is Poor, due to the general deep corrosion pitting of the steel sheet piles. CH2M recommended that the Berth 1 should be replaced with a new bulkhead within the next three years. The POPB plans to initiate a bulkhead replacement project during the year of 2019, within the three years recommended.

In the short term, within the next year, repairs to the bulkhead should be performed to maintain the structural integrity of the bulkhead until its replacement. The recommended scope of work of repairs includes:

- cover ten (10) holes in the sheet pile with steel plates.
- weld steel plates to H-Piles flanges in two (2) locations to repair the severe flange lost.

ADDITIONAL INFORMATION ATTACHED: No _____ Yes __X__

FINANCIAL IMPACT:
The bulkhead repairs project will be funded by the FY18 Renewal and Replacement budget.

RECOMMENDATION: Port staff respectfully request the Board of Commissioners to approve this request to advertise for Request for Proposals for the repairs of the Berth 1 bulkhead.

Respectfully Submitted by:

Manuel Almira

Manuel Almira, Executive Director

DATE ACTION TAKEN: _____

Approved: _____ Motion By: _____
Disapproved: _____ Seconded By: _____
Deferred To: _____ Unanimous: Yes _____ No _____
Incorporated into Minutes: _____ By: _____

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Mr. Jose Soler, PE
Port of Palm Beach District
1 East 11th Street, Suite 600
Riviera Beach, FL 33404

December 21, 2017

Subject: Port of Palm Beach Berth 1 - 2017 Above Water and Underwater Inspection

Dear Mr. Soler,

On November 14 and 15, 2017 and on behalf of The Port of Palm Beach, CH2M performed an above water and underwater inspection of Berth 1 at the Port of Palm Beach in West Palm Beach, Florida.

The purpose of the inspection was to rate the overall condition of the facility and identify any deterioration or damage to the bulkhead structure. The scope of the inspection included the entire length of the Berth 1 bulkhead as well as the 60 ft long propeller wash protection wall (Prop Wash Wall) located at the north end of the site. These two structures comprise 495 lin ft of steel sheet piles, 555 lin ft of concrete pile cap, 21 steel H-Piles, 15 ship fenders, seven small vessel fenders, and eight mooring bollards.

Berth 1 was last inspected in 2015 when CH2M performed an above water and underwater inspection on behalf of The Port of Palm Beach. Berth 1 received an overall condition rating of Fair-to-Poor in 2015.

The 2017 overall condition rating of Berth 1 is **Poor** due to steel sheet piles with overall loss of thickness from general deep corrosion pitting, ten corrosion holes (several with active loss of deck fill material) in the steel sheet piles, two H-Piles on the prop wash wall with severe flange loss due to corrosion, three concrete pile cap locations (31 lin ft total) with large spalls and exposed steel reinforcing with minor corrosion, one missing ship fender, and one ship fender with a detached chain.

The overall loss of steel sheet pile thickness is in a serious state and the length of bulkhead with severe pitting (Station 0+00 to Station 4+25) should be replaced with a new bulkhead within the next three years. In the short term, the holes in the steel sheet piles and the H-Piles with severe flange loss should be repaired with welded steel plates within the next year. The corrosion on the exposed steel reinforcing should be cleaned and the large spalls along the concrete pile caps from Station 4+50 to Station 4+65 should be repaired with formed concrete within the next 5 years. The missing ship fender should be replaced and the detached ship fender reattached to the face of the wharf as soon as possible for mooring operations.

The rate of deterioration of a structure accelerates as the overall condition rating approaches a rating of serious/critical. Therefore, as current operations continue at the berth, the bulkhead should be monitored for excessive pavement or other similar topside settling until the repairs recommended in this report are completed. In addition, it is recommended the berth be inspected again from the waterside within twelve months after bulkhead repairs are completed to confirm repair integrity and to re-assess the overall bulkhead condition.

SCOPE OF WORK

The inspection included a visual and tactile (Level I effort) inspection of the exposed surfaces of the steel sheet pile bulkhead and concrete pile cap from the waterline to the mudline with particular attention given to any observed areas of deterioration or damage. In addition, the structure was visually inspected above water from the waterline to the top of the pile cap. Every 100 linear feet of bulkhead at Level II inspection effort was performed. Each Level II inspection included cleaning marine growth from a one square foot area at three locations: just below the concrete encasement, approximately mid-depth, and near the mudline. Additionally, the fender system and mooring hardware received a Level I inspection effort. Photographs above and below water taken to document general conditions and observed deficiencies.

INSPECTION METHODOLOGY

The underwater inspection was performed by a three-person team led by a licensed Professional Engineer, a Dive Supervisor, and a technician-Diver. All three members of the team are certified by the Association of Diving Contractors International (ADCI).

The CH2M dive inspection team members have successfully completed adequate structural inspection training for engineer-divers in order to accurately report structural damage & deficiencies and have significant experience performing underwater structural inspections of waterfront structures.

The members of the inspection team were appropriately equipped and trained, and the diving operations were conducted in accordance with the Occupational Safety and Health Administration Commercial Diving Operations Standard (29 CFR 1910, Subpart T), ADCI Consensus Standards for Commercial Diving and Underwater Operations, and CH2M HILL's Safe Diving Practices & Operations Manual.

Surface-Supplied Air diving mode including dive helmet with hardwire communications, a bank of high pressure air supply, and a filter rack were utilized to perform the inspection. The diving inspection was performed from the top of deck from a dive van.

Rating Criteria

The general condition assessment ratings for the inspected structure are based on a six point assessment scale developed by the American Society of Civil Engineers (ASCE). The six point condition ratings are:

- 6 – Good: No problems or only minor problems noted. Structural elements may show some very minor deterioration, but no overstressing observed.
- 5 – Satisfactory: Minor to moderate defects and deterioration observed, but no overstressing observed.
- 4 – Fair: All primary structural elements are sound; but minor to moderate defects and deterioration observed. Localized areas of moderate to advanced deterioration may be present but do not significantly reduce the load bearing capacity of the structure.

- 3 – Poor: Advanced deterioration or overstressing observed on widespread portions of the structure, but does not significantly reduce the load carrying capacity of the structure.
- 2 – Serious: Advanced deterioration, overstressing, or breakage may have significantly affected the load bearing capacity of primary structural elements. Local failures are possible and loading restrictions may be necessary.
- 1 – Critical: Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural elements. More widespread failures are possible or likely to occur and load restrictions should be implemented as necessary.

Corrosion is one of the most common deficiencies found on steel elements and the level of corrosion is defined as follows:

- Minor (or Light) – A light surface corrosion with no apparent loss of section.
- Moderate – Corrosion that is loose and flaking with some pitting. The scaling or exfoliation can be removed with some effort by use of a scraper or chipping hammer. The element exhibits measurable but not significant loss of section.
- Severe – Heavy, stratified corrosion or corrosion scales with extensive pitting. Removal requires exerted effort and may require mechanical means. Significant loss of section.

DESCRIPTION OF STRUCTURE

Berth 1 is situated at the north end of the Port of Palm Beach Turning Basin and comprises a bulkhead in north-south direction along the Intracoastal Waterway. Berth 1 extends from the north fence-line of the Port. The Bulkhead was originally constructed in 1976 and consists of anchored steel sheet piling (PZ-27) with a reinforced concrete pile cap and facing. The concrete cap is 3.5 ft wide and the top of the concrete cap is at El. +7.0 ft. The concrete facing extends to El. -2.0 ft and is 9 inches thick from the outer flange of steel sheeting.

The bulkhead was stationed along the concrete cap from north to south with Station 0+00 at the north fence-line and Station 4+75 at the south end of Berth 1. From Station 4+75 to 4+95, there is an angled transition wall from the south end of Berth 1 to Slip 1 that measures approximately 20 feet long. From Station 4+25 and extending south to Station 4+75 then along the angular transition bulkhead (chamfer) and to Slip 1, the bulkhead consists of new PZ-35 sheet piling constructed 3 feet in front of the old PZ-27 steel sheet piling. The concrete cap also extends 3 feet out into the berth (notched) at this location and the concrete facing extends 2 feet lower to El. -4.0 ft.

An approximately 52 ft long by 6.5 ft wide stairwell is located near the northern end of the Bulkhead. The stairwell platform is 3 ft $\pm$ below the adjacent apron. Six 2 ft wide by 6 in. high steps are located at the south end of the stairwell. This platform was originally used for access of small craft requiring access to the Port.

At approximately Station 0+07 a prop wash wall extends eastward perpendicularly from the bulkhead on the north side of the stairwell platform. The Prop wash wall is 61 ft long by 5 ft wide and is constructed of two rows of steel H piles with a concrete pile cap. Concrete waffle slabs were placed between adjacent steel H piles in the north row of piles.

A Vicinity Map, Location Plan, and Facility Plan are presented on Figure 1 and Figure 2

and provided in Appendix B.

INSPECTION FINDINGS

The overall condition rating of Berth 1 is **Poor** due steel sheet piles with overall loss of thickness due general deep corrosion pitting, ten corrosion holes (several with active loss of sand) in the steel sheet piles, two H-Piles with severe flange loss due to corrosion, three concrete pile cap locations (31 lin ft total) with large spalls and exposed steel reinforcing with minor corrosion, one missing ship fender, and one ship fender with a detached chain.

Photographs including the typical conditions and deficiencies at Berth 1 are provided in Appendix A. An Inspection Plan including the locations and orientations of the deficiencies at Berth 1 are presented on Figure 4 and provided in Appendix B.

Station 0+00 to 4+25

The PZ-27 steel sheet piling at Berth 1 is in overall Poor condition due to areas of severe pitting and overall thickness loss. The sheet piling typically exhibited 1/8 inch to 1/4 inch deep pitting throughout with pits measuring 1/4 to 1/2 inch in diameter. Isolated areas of severe pitting exhibited up to 3/8 inch deep pitting, including ten locations with 100% thickness loss (corrosion holes), and pitting up to 1 inch in diameter (Photo 1). A summary including the locations and dimensions of the corrosion holes is presented on Table 1.

Table 1: Steel Sheet Pile Corrosion Holes

Station	Description
1+50	Corrosion hole at -2 ft on outer flange that measured 12 in. high x 8 in. wide with heavy corrosion surrounding and active loss of backfill.
1+70	Corrosion hole at -2 ft on outer flange that measured 0.5 in. in diameter with heavy corrosion surrounding.
2+00	Corrosion hole at -2 ft on outer flange that measured 5 in. high x 1 in. wide with heavy corrosion surrounding and active loss of backfill.
2+00	Corrosion hole at -12 ft on outer flange that measured 0.5 in. in diameter with heavy corrosion surrounding.
2+18	Corrosion hole at -2 ft on web that measured 12 in. high x 5 in. wide with heavy corrosion surrounding and active loss of backfill.
2+48	Corrosion hole at -2 ft on outer flange that measured 0.75 in. diameter with heavy corrosion surrounding and active loss of backfill.
2+48	Corrosion hole at -2 ft on inner flange that measured 1 in. high x 2 in. wide.
2+48	Corrosion hole at -2 ft on outer flange that measured 1 in. diameter with heavy corrosion surrounding and active loss of backfill.
2+48	Corrosion hole at -20 ft on outer flange and web that measured 3 in. high x 2 in. wide with heavy corrosion surrounding and active loss of backfill.
2+40	Corrosion hole at -20 ft on web that measured 1 in. in diameter with heavy corrosion surrounding and active loss of backfill.

The concrete pile cap between station 0+00 and Station 4+25 is in overall Fair condition due to large spalls with exposed steel reinforcing between Station 0+60 and station 0+85.

Additionally, the concrete pile cap has random 1/16 in. wide vertical cracks and a few localized areas of deterioration (Photo 2).

Station 4+25 to 4+95 (including Angled Corner – Chamfer)

The steel sheet piles between station 4+25 and 4+95 are in overall Fair condition with only moderate deterioration. Minor to moderate pitting was observed along this portion of the berth (Photo 3). Typically the areas of pitting cover approximately 35% of the steel sheeting and measure 1/8 in. deep with a diameter of 1/2 in. Isolated pitting measured up to 1/16 in. deep and up to 1 in. in diameter.

The concrete cap between station 4+25 and Station 4+95 is in overall Fair condition due to large spalls with exposed steel reinforcing between Station 4+40 and station 4+65 (Photo 4). Additionally the concrete pile cap has random 1/32 in. wide vertical cracks and a few localized areas of deterioration.

Ancillary Items– Station 0+00 to 4+95 (full length of Berth 1)

The timber curbs along Berth 1 are in overall Satisfactory condition. However, the timber curbs were missing from Station 4+13 has impact damage (Photo 5). The ship fenders are in overall Fair condition. The lower chain link connections are generally broken from the fender connection hardware and hanging from the fender hardware as a result of heavy corrosion and abrasion. The upper fender chains and connection hardware typically exhibit light to moderate corrosion. The fender chains at Station 2+60 and Station 4+03 are detached (Photo 6) and the ship fender at Station 3+00 is missing (Photo 7).

Prop Wash Wall

The Prop wash wall is in overall Poor condition. The steel H-piles typically exhibit light corrosion along the flange edges with minor pitting up to 1/16 inch deep. Localized areas exhibited 1/8 inch deep pitting on approximately 5% of the flange faces. However, Piles 1S, 2S, 3S, 4S, 5S, and 10S have severe deficiencies. Refer to Table 3 below for a list of Prop wash wall pile defects. The concrete deck exhibited longitudinal cracks up to 1/18 inch wide with rust staining along the face and soffit. The concrete waffle slabs between the north steel H-piles were intact with no major deficiencies.

Table 3: Prop wash wall Defects

Pile No.	Description
1S	Severe corrosion of south flange with 100% missing from Elev. +1 ft to -2 ft. In addition, web was missing 20% (Photo 8).
2S	Severe corrosion of south flange with 100% missing from Elev. +1 ft to -2 ft. In addition, web was missing 20%.
3S	Advanced corrosion of south flange with 25% missing from Elev. +1 ft to -2 ft.
4S	Advanced corrosion of south flange with 25% missing from Elev. +1 ft to -2 ft.
5S	Moderate corrosion of south flange with 10% missing from Elev. +1 ft to -2 ft.
5S	Southwest flange cut out 16 inches high at Elev. -11 ft.
10S	Southwest flange cut out 16 inches high at Elev. -11 ft.

CONCLUSIONS AND RECOMMENDATIONS

The steel sheet piling from Station 0+00 to 4+25 has continued to deteriorate since the 2015 inspection and exhibits more localized areas of corrosion holes. The overall loss of steel sheet pile thickness is approaching a serious state and the length of bulkhead with severe pitting (Station 0+00 to Station 4+25) should be replaced with a new bulkhead within the next three years. The replacement bulkhead should tie into the new portion of bulkhead that begins at Station 4+25.

In the short term, the holes in the steel sheet piles are allowing loss of fill material and if allowed to continue severe undermining of the deck could result. Therefore the holes on the sheet piles should be repaired with welded steel plates within the next year with grout injections into the void areas. The missing ship fender should be replaced and the detached ship fender reattached to the face of the wharf within the next 12 months.

The H-Piles with severe flange loss should be repaired with welded steel plates within the next thre years. The corrosion on the exposed steel reinforcing should be removed (cleaned) and the large spalls along the concrete pile caps from Station 4+50 to Station 4+65 should be repaired with formed concrete within the next 5 years.

The rate of deterioration of a structure accelerates as the overall condition rating approaches a rating of serious/critical. Therefore, as current operations continue at the berth, the bulkhead should be monitored for excessive pavement or other similar topside settling until the repairs recommended in this report are completed. In addition, it is recommended the berth be inspected again from the waterside within twelve months after bulkhead repairs are completed to confirm repair integrity and to re-assess the overall bulkhead condition.

CH2M appreciates the opportunity to provide professional engineering services to The Port of Palm Beach and we look forward to continue to work with you on any subsequent phases of this project. Should you have any questions or require further assistance please don't hesitate to contact Mr. Jim Moore or the undersigned.

Respectfully Submitted,

James D. Moore
Senior Project Manager

Matthew Grice, PE
Senior Project Manager
Senior Engineer-Diver

CH2M Project Number: 698551

\\nyc-fs-01\Projects\PROJECTS\I - Inspection & Rehabilitation\698551 - Port of Palm Beach Berth 1 2017 Inspection\20 Investigations\28 Reports\28.2 Draft

APPENDIX A – PHOTOGRAPHS

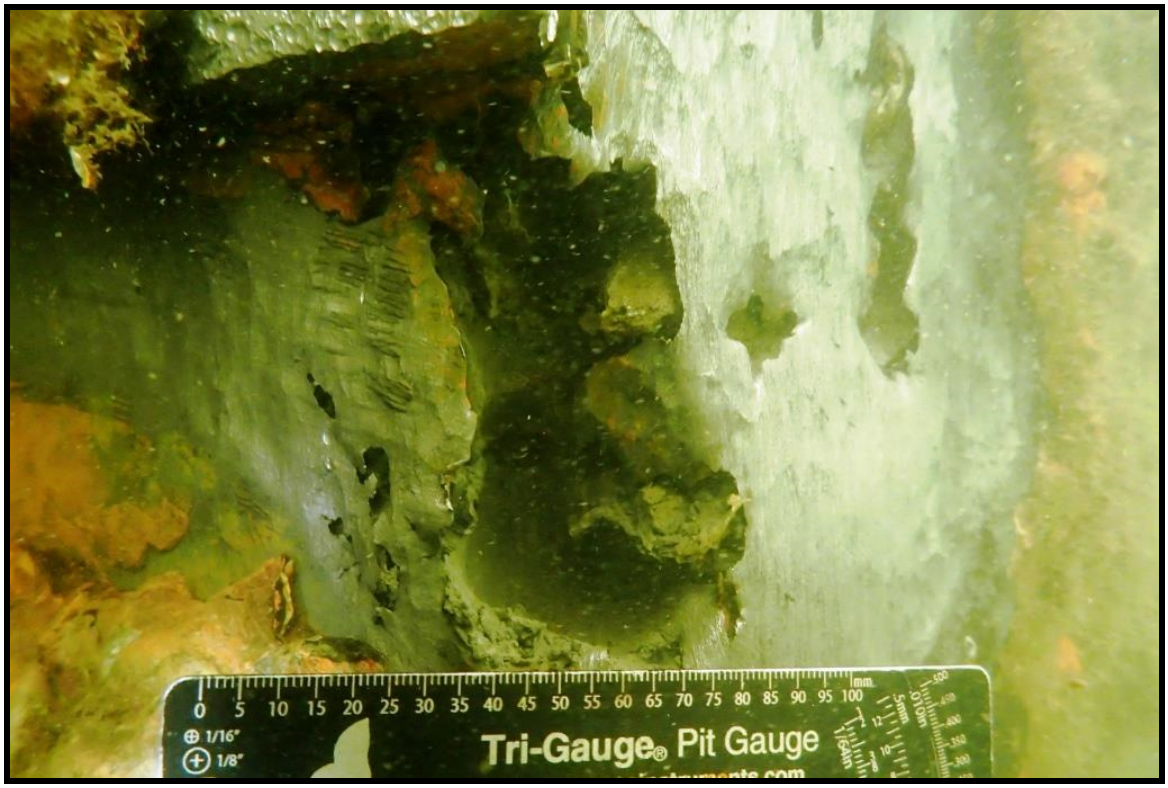


Photo 1. Station 2+48 corrosion hole in outer flange and web of steel sheet pile.

Photo 2. Station 3+85 Typical Concrete pile cap.

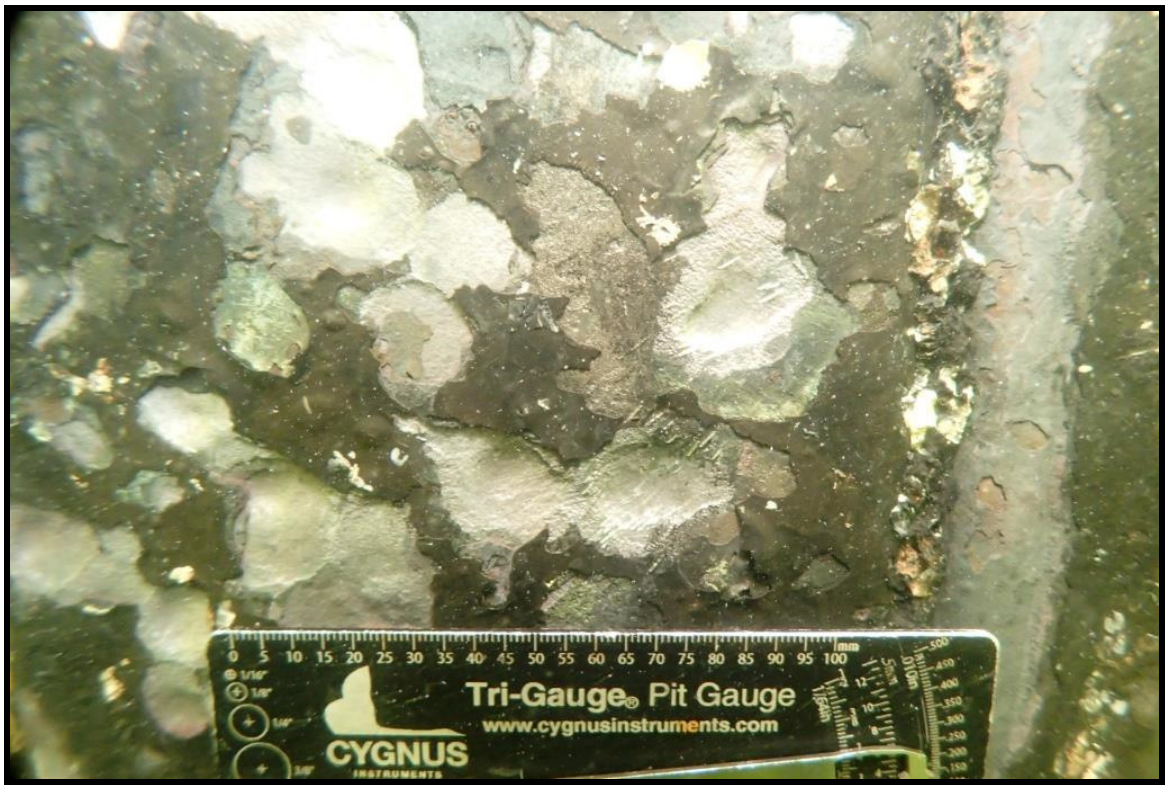


Photo 3. Station 4+58 typical steel sheet pile with minor to moderate pitting.

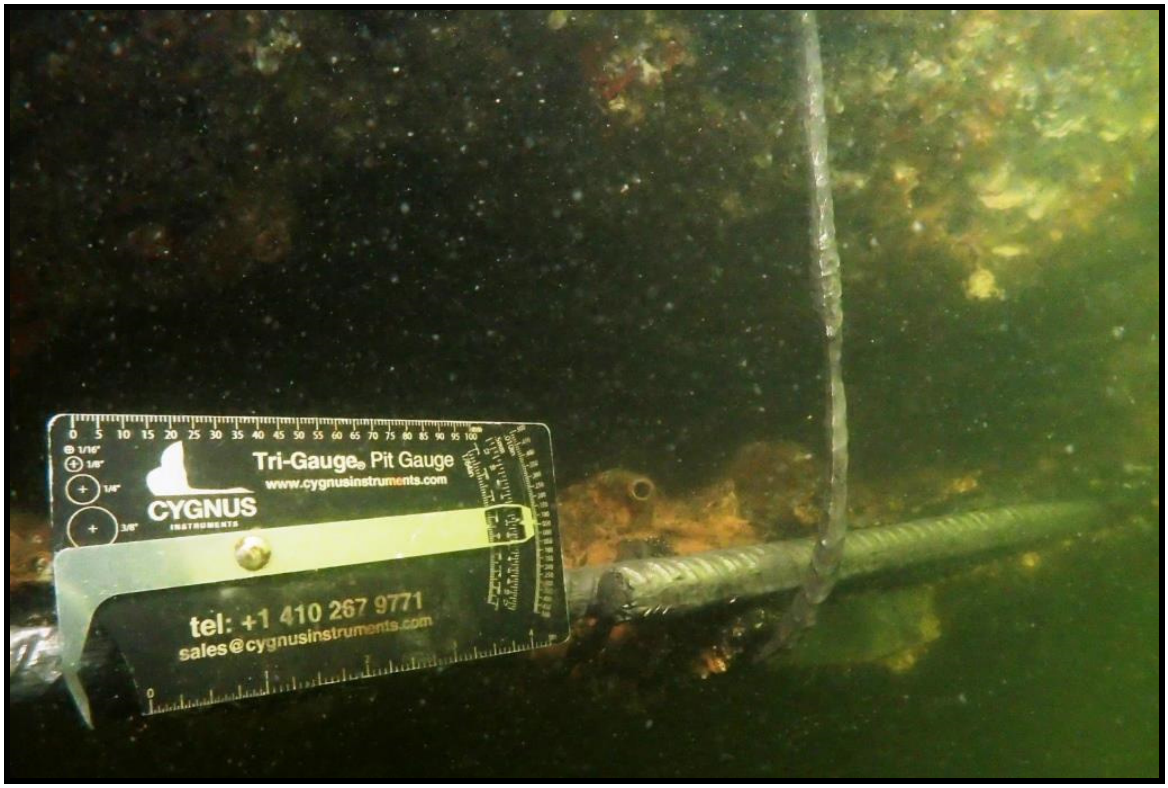


Photo 4. Station 4+55 Concrete pile cap with large spall and exposed reinfocing.

Photo 5. Station 4+13 timber curb with impact damage

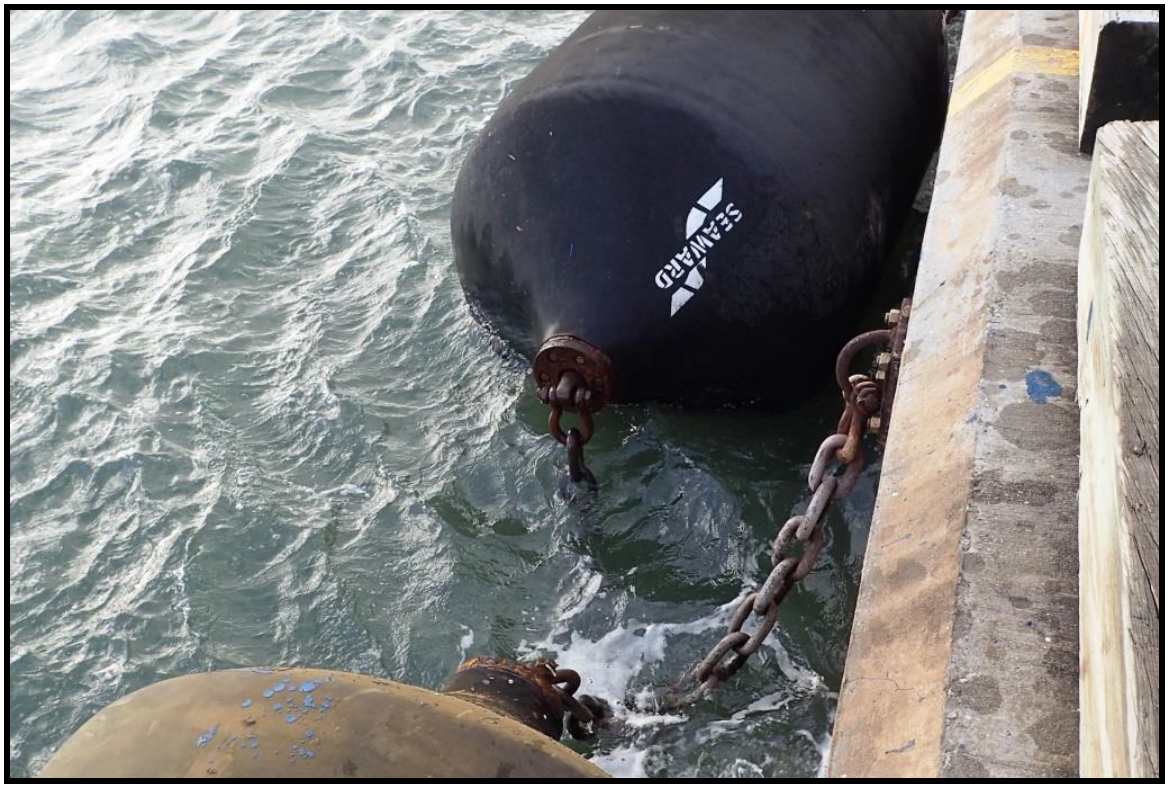


Photo 6. Station 4+03 Ship fender with detached fender chain.

Photo 7. Station 3+00 Missing ship fender.

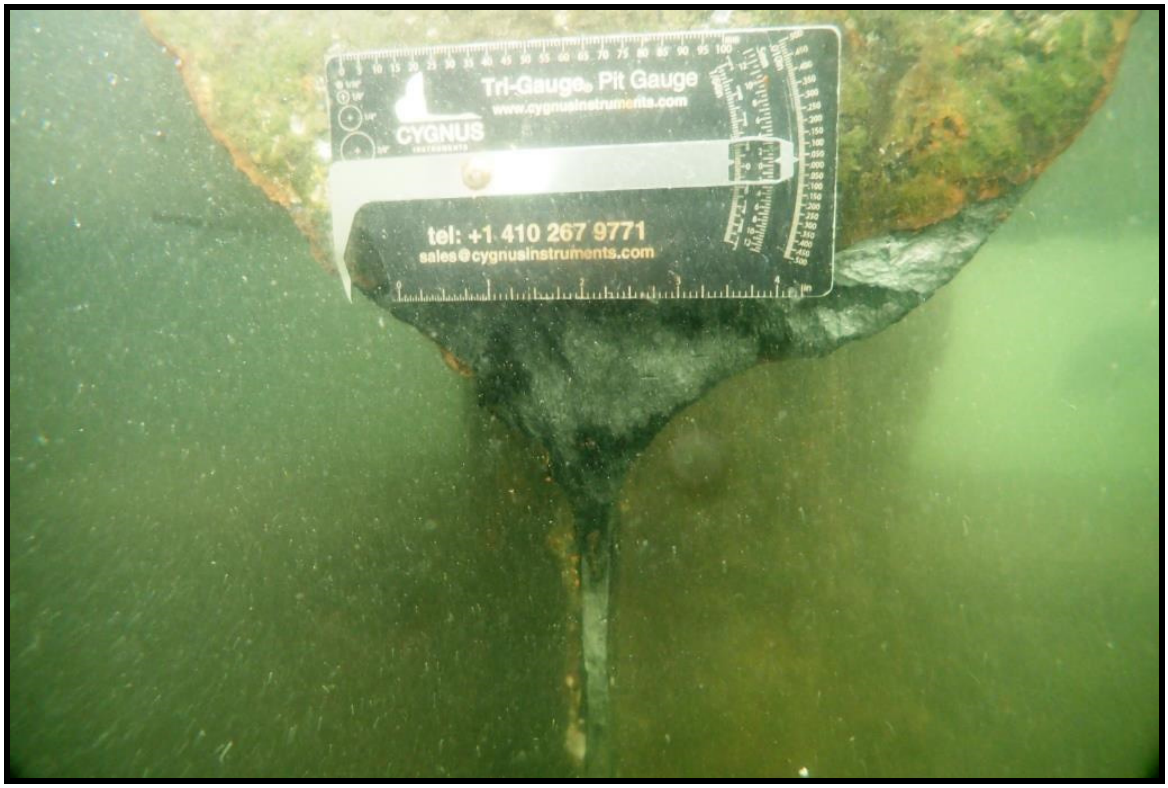


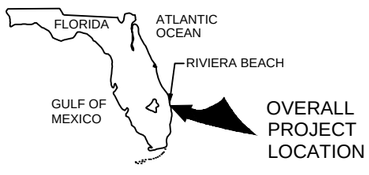
Photo 8. Prop wash wall Pile 1S 100% loss of south flange.

APPENDIX B – FIGURES

NOT FOR ISSUE

Port of Palm Beach
Berth 1 Bulkhead 2017 Inspection
Port of Palm Beach District
Riviera Beach, Florida

PORT of Palm Beach
IMPORT • EXPORT • YOUR PORT



VICINITY MAP
NTS

INDEX OF DRAWINGS

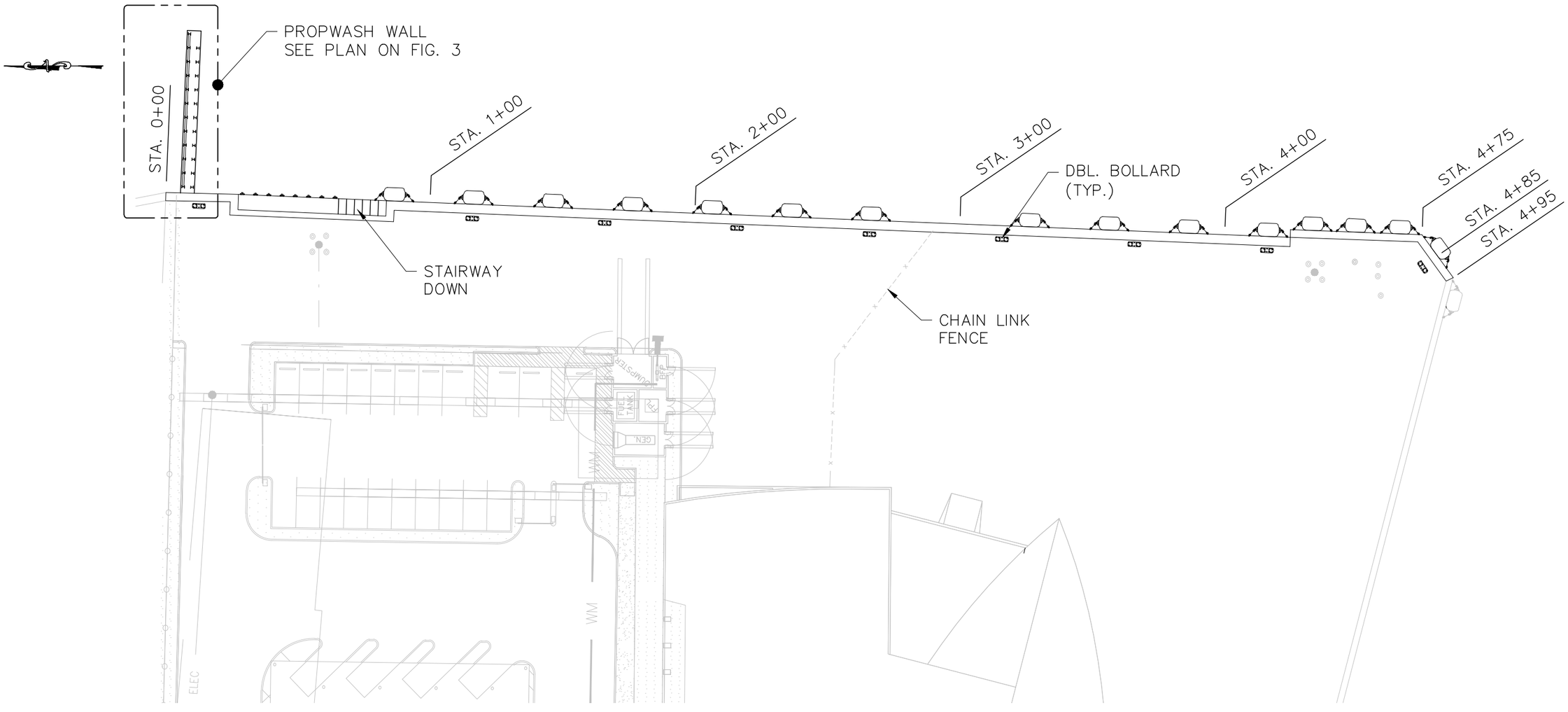
GENERAL

FIGURE 1	COVER SHEET AND INDEX OF DRAWINGS
FIGURE 2	BERTH 1 FACILITY PLAN
FIGURE 3	BERTH 1 INSPECTION PLAN
FIGURE 4	SECTIONS AND DETAILS

CH2MHILL

DESIGNED BY	STRUCTURAL CONDITIONS SURVEY PORT OF PALM BEACH DISTRICT RIVERA BEACH, FLORIDA	SCALE	REVISION
DRAWN BY J. PRUITT		DATE	
CHECKED BY	COVER SHEET AND INDEX OF DRAWINGS	DRAWING NO.	
PROJECT ENGR M. GRICE		FIG 1	

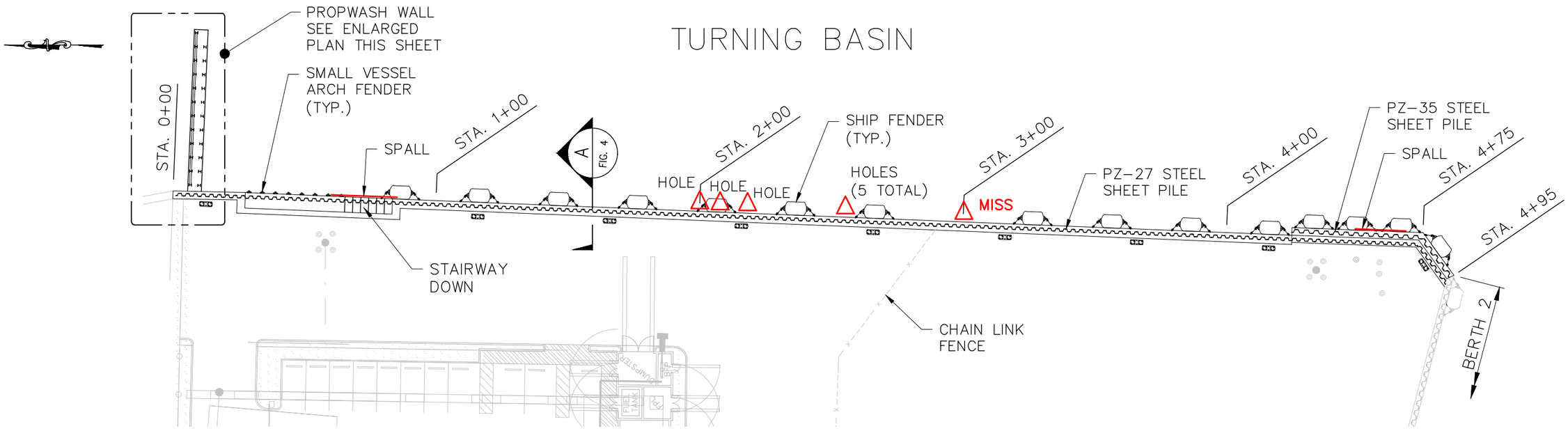
NOT FOR ISSUE



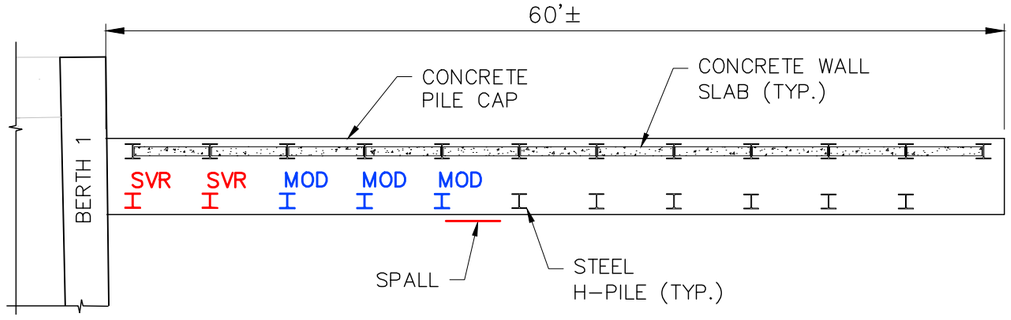
FACILITY PLAN
1"= 40'-0"

CH2MHILL	DESIGNED BY	STRUCTURAL CONDITIONS SURVEY PORT OF PALM BEACH DISTRICT RIVERA BEACH, FLORIDA	SCALE	REVISION
	DRAWN BY J. PRUITT		DATE	
	CHECKED BY	BERTH 1 FACILITY PLAN	DRAWING NO.	
	PROJECT ENGR M. GRICE		FIG 2	

NOT FOR ISSUE



INSPECTION PLAN
1"= 40'-0"



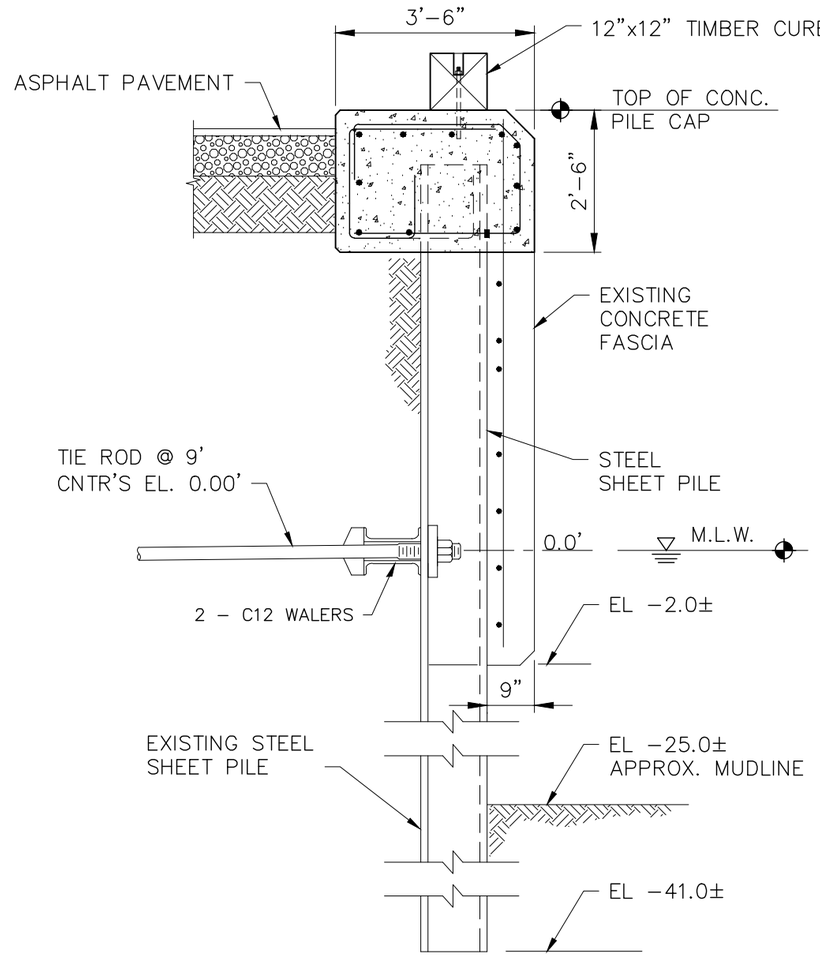
PLAN - PROPWASH WALL
1"= 10'-0"

LEGEND

	PZ-27 STEEL SHEET PILE WITH ADVANCED TO SEVERE PITTING.
△ HOLE(S)	STEEL SHEET PILES WITH CORROSION HOLE(S).
SPALL	CONCRETE PILE CAP WITH LARGE SPALL AND EXPOSED STEEL REINFORCING.
T SVR	STEEL H-PILE WITH SEVERE LOSS OF FLANGE WIDTH ALONG UPPER 6' OF PILE.
△ MISS	MISSING SHIP FENDER
I MOD	STEEL H-PILE WITH MODERATE LOSS OF FLANGE WIDTH ALONG UPPER 6' OF PILE.

CH2MHILL

DESIGNED BY	STRUCTURAL CONDITIONS SURVEY PORT OF PALM BEACH DISTRICT RIVERA BEACH, FLORIDA	SCALE	REVISION
DRAWN BY J. PRUITT		DATE	
CHECKED BY	BERTH 1 INSPECTION PLAN	DRAWING NO.	
PROJECT ENGR M. GRICE		FIG 3	



A / FIG 3 TYPICAL SECTION AT BERTH 1

3/8"= 1'-0"

CH2MHILL	DESIGNED BY	STRUCTURAL CONDITIONS SURVEY PORT OF PALM BEACH DISTRICT RIVERA BEACH, FLORIDA	SCALE / REVISION
	DRAWN BY J. PRUITT		DATE
	CHECKED BY	SECTIONS AND DETAILS	DRAWING NO. FIG 4
	PROJECT ENGR M. GRICE		