Draft Report

Condition Assessment

Options for Repair or Demolition

Mitchell Field Pier

Harpswell, ME

February 21, 2013

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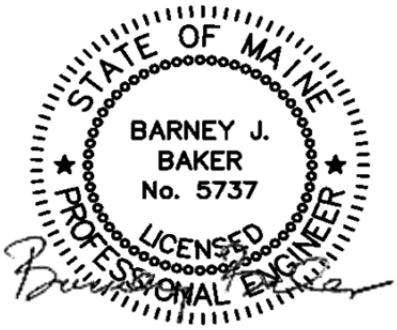

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1. Executive Summary

1.a. Project Background

The Mitchell Field property is a 120 acre shorefront parcel that was transferred to the Town of Harpswell in 2001 by the US Navy. The site was the location for a marine fuel terminal and tank farm that was constructed in the 1950's to serve Brunswick Naval Air Station.

The pier (see Figure 1) comprises an armored Causeway that extends from shore to low water, a 250-ft steel pile supported Approach Pier, a central Breasting Platform comprised of multiple stone ballasted steel sheet pile cells, and North and South Mooring Dolphins each comprised of a single circular filled steel sheet pile cell. The North and South Mooring Dolphins are accessed from the Breasting Platform by steel Catwalks. A small boat dock also exists near the shore on the south side of the pier that reportedly provided a station for a small support vessel that was used to surround the docking tanker barge or ship with a spill containment boom.

Figure 1 – Mitchell Field Pier Aerial View

The pier has not been used since the Fuel Depot closed in 1992. Today the shoreside tank farm is gone and the site has been rezoned with areas set aside for commercial use, housing and open space. The Town has deferred all maintenance on the marine pier structure while seeking a development opportunity for the site.

In February 2012, a structural review of the pier was completed by TEC Associates that was limited to an intertidal inspection of the pier substructure. TEC recommended that all pier access be halted because of the deteriorated condition of the structure. This condition assessment was endorsed in April 2012 when the entire North Mooring Dolphin and Catwalk connection collapsed (See Figure 2). The Town subsequently hired a contractor to remove the North and South Catwalk connections. Plans to remove the remnants of the North Dolphin (still visible at high water) were unsuccessful for lack of environmental permit approval. Signage restricting access to the entire pier facility was added and pier access gate on the causeway was locked to prevent access.

In early January 2012, Baker Design Consultants (BDC) and MER Assessment Corporation (MER) were retained to further investigate the condition of the structure and to make an assessment of options for demolition or rehabilitation for consideration by the Town. The timing of the this structure condition survey and February 2013 report submittal allow the Town to consider action to address the pier condition at the March 2013 Town Meeting.

Figure 2 – Rear Face of Breasting Dolphin (Jan 2013)

1.b. Snapshot of Facility Condition

The pier facility is now 60 years old. It has been 32 years since any significant maintenance was done on the facility. It has been 20 years since the pier was actively used and operated as a fuel terminal.

Despite a long history of deferred maintenance, the respective reinforced concrete deck of the Approach Pier and Breasting Platform remain in serviceable condition. However, a dive survey confirmed that these elements are not the weak link in the pier structure. The steel piles and sheet piling are in an advanced state of corrosion in the splash and intertidal zones throughout the structure. These elements need remedial action to avoid a repeat of the structure collapse that occurred recently at the North Dolphin.

The original construction plans indicate steel piles were coated with coal tar epoxy in the intertidal and splash zones to protect the steel. It is also rumored that an active cathodic protection system was maintained by the navy to protect steel below the low water line. However, the topside and underwater inspection surveys did not reveal any residual steel coating or any evidence of a cathodic protection system. The lack of coating or cathodic protection is consistent with the advanced deterioration in the splash zone and intertidal areas.

Figure 3 – Collapsed North Dolphin, January 2013

1.c. Summary of Options for Repair or Demolition

Several options to address pier condition are explored that include **Do Nothing**, **Full Demolition, Full Rehabilitation** and **Partial Rehabilitation.** Refer to Figure 4. A tabulated summary, together with probable cost and benefits of each option is provided at the end of this section (See Table 1).

Because of the advanced state of structure deterioration and the lack of development opportunity for the pier, the **Do Nothing Option** is considered. If the Town continues along the path of deferred maintenance in advance of a future (as yet unidentified) development partner, what are the implications of interim pier failure? Is the Town liable for navigation safety and or cleaning up the debris? These questions have been asked of the Submerged Lands Bureau of the State of Maine, the Army Corps of Engineers and the United States Coast Guard- Portland Maine Group. None of the agencies were prepared to indicate the Town was liable for removal as there is no indication that the pier construction materials contain any compounds or chemicals that are 'hazardous to the environment'. It was suggested that the site would need to be marked if it presented a 'hazard to navigation'.

All **Rehabilitation Options** include an effective replacement of the substructure steel sections for pier elements that are still intact. See Section 6 - Demolition/Rehabilitation Options.

All **Demolition Options** consider the cost benefit of dismantling and transporting the pier structure to a shoreside location where the materials can be disposed of or recycled or leaving them in place at the site. A review of the existing seabed habitat in the vicinity of the pier and the potential impact of using demolition material to build an artificial reef have been undertaken by MER Assessment and is located in **Appendix A**. This preliminary study indicates that a reef formed with demolition materials could provide a diverse and beneficial habitat for many marine species.

The minutes of a regulatory preapplication meeting to review environmental implications for the range of options is located in **Appendix B**. The meeting included representatives from the Maine Departments of Environmental Protection and Marine Resources, Army Corps of Engineers and the National Marine Fisheries Service. While additional work is required to confirm favorable environmental impacts associated with reef building at this site, this option has been included in the demolition options considered.

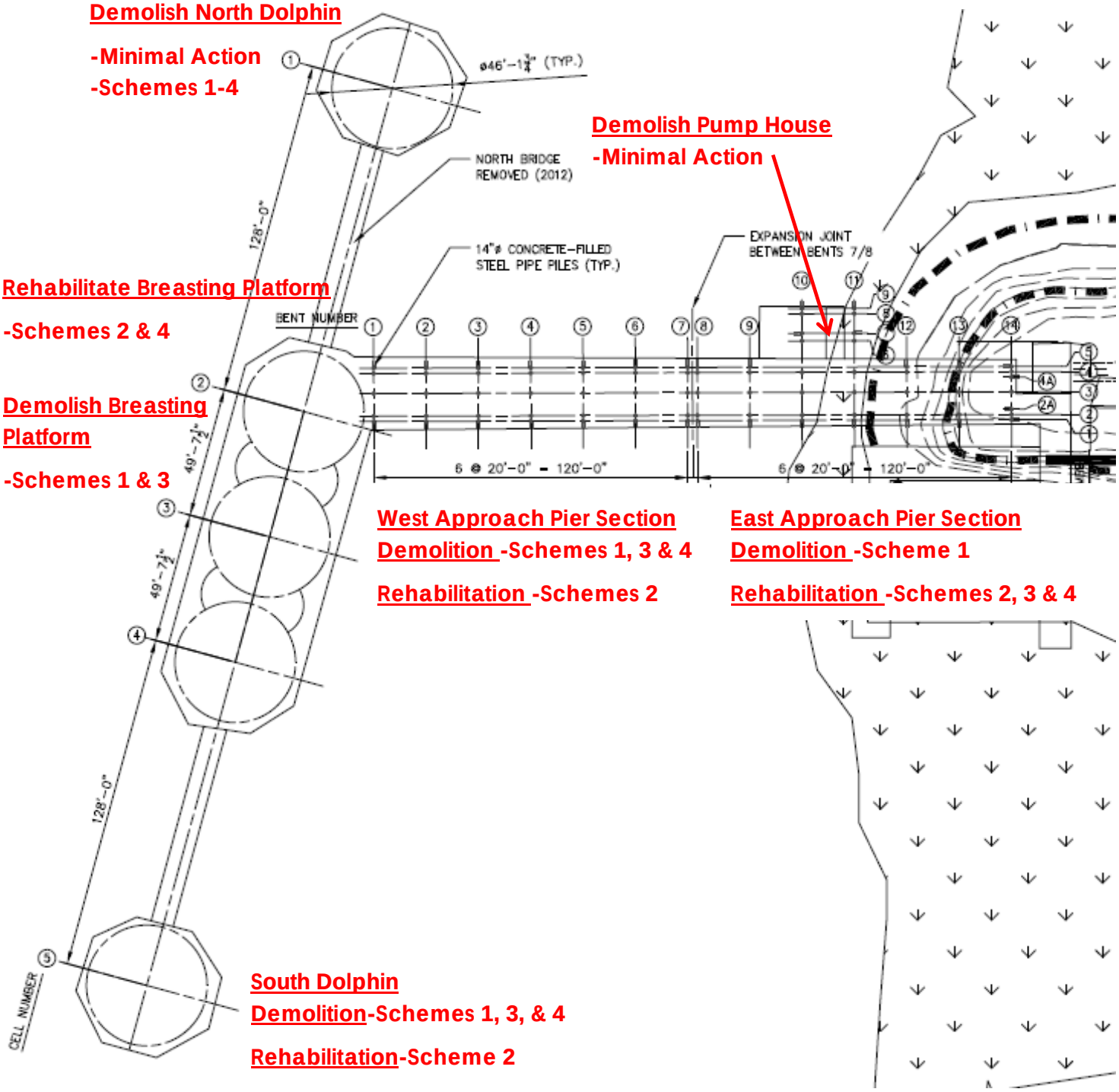


Figure 4 – Demolition and Repair Schemes

Option	Work Description (See Figure 4)	Cost Range $ (see Notes)		Benefits
Do Nothing (No Action)	No Demolition or Rehabilitation	$0	$4.1M	**Positive** Minimal immediate cost to Town. No Permits required. MAY buy time for development opportunity. **Negative** Potential Long-term Cost for site cleanup or to allow for another development opportunity.
Minimal Action	**Demolish** Pump house, North Dolphin debris and South Dolphin.	$450k	$900K	Similar to **Do Nothing** (No Action)
Scheme 1 Full Demolition	**Demolish** all pier elements. Lower cost range for demolition material used in reef construction.	$3.1M	$4.1M	**Positive** No Safety or navigational hazard **Negative** Minimal return for funds expended.
Scheme 2 Full Rehabilitation	Full Rehabilitation to include Breasting Platform, Approach Pier and South Dolphin.	$3.5M	$4.8M	**Positive** Structure reinstated. Now find User. **Negative** High Cost without identified user.
Scheme 3 Partial Demolition	**Demolish** all pier elements with exception of 50 % of Approach Pier. **Rehabilitate** 50 % of Approach Pier for use as deep water pier extending from causeway.	$3.0M	$4.1M	**Positive** Cost effective solution and structure reuse. On scale for Town Landing. **Negative** High Cost.
Scheme 4- Partial Demolition	Same as Scheme 3 with added **Rehabilitation** of Breasting Platform for Wave Protection.	$3.9M	$4.8M	**Positive** Cost Effective Solution and Structure reuse. On scale for Town Landing. **Negative** High Cost. Wave study required to show cost benefit of Breakwater.

Table 1 –Options for Repair or Demolition-Cost Benefit Summary

Notes

1. Refer to detailed costs development in Appendix C for each scheme.
2. The high cost associated with **Do Nothing** assumes a future cost for site cleanup or to allow for another development opportunity.
3. Lower demolition costs in range assume inert material can be used for reef construction on site or transferred ashore for use in boat ramp construction.
4. Approach Pier rehabilitation costs consider use of new piles or rehabilitation of existing with an FRP pile wrap.

1.d. Next Steps and Recommended Action

The Town needs to make a decision that will determine the long term status of the existing pier facility at Mitchell Field. There are three choices available.

1. Do Nothing (and continue to defer maintenance while the structure deteriorates to a point where rehabilitation is not an option and cleanup potentially more expensive).
2. Proceed with one of the options for rehabilitation or demolition of the existing pier structure (in the absence of a defined development program at the site).
3. Develop a design for the facility that considers the future municipal use of the site. Prepare and seek the necessary permits. (This delays action in favor of design development and permitting to ensure that a rehabilitation program is compatible with future use of the site.

This report is intended to facilitate consideration of the first two choices by outlining the costs and benefits (positive and negative) of a range of options for demolition or rehabilitation. Refer to the summary presented in Table 1 and the detail discussion within the body of this report. Sections of the report consider programs for rehabilitation and demolition of the pier, the viability of leaving material on site and the regulatory response if the structure is left to deteriorate. A section of the report provides comparison costs for other development at other municipal facilities.

For consideration of the third choice, the list below outlines key issues that should be considered in the future design and development of the facility.

Design Development Issues

- The most efficient configuration for the Mitchell Field Waterfront has yet to be determined by the Town. Rehabilitation of existing structures is only cost effective if the use and footprint of the improved structure is compatible with future use at the site.
- The cost of all demolition and rehabilitation options is significant. Final rehabilitation costs will depend on additional design development, regulatory requirements for artificial reef construction and the potential for material reuse on site.
- A wind wave analysis for the site is needed to show if the Breasting Platform (alone or in combination with other structures) might function well as wave barrier protection for a pier located at the end of the causeway.
- The regulatory agencies will require additional survey of the seabed to determine the 'functions and values' of the existing seabed habitat and the impact of reef building.

Permitting Issues

- The regulatory agencies have not indicated that the Town is liable for removal of the structure form the site.
- Permits will be required from state and federal agencies for future activity on the site. With the exception of full demolition, the time required to develop the engineering design, complete the necessary fieldwork and permit the projects is likely to be 9-12 months. Permit applications should include the cumulative impact other projects pending on the Mitchell Field Waterfront such as the causeway boat ramp.

Funding Issues

- There is currently no funding in place for pier demolition or rehabilitation.
- A plan for the waterfront improvements (including demolition and rehabilitation) would support grant applications and make them more competitive.

RECOMMENDED ACTION

- **Proceed with a Program of Design Development and Permitting** – The assumes the Town will be in a better position to consider Grant Opportunities and a Town warrant for construction after design and permitting have been completed for waterfront improvements to the site. A scope of work would need to be defined for additional fieldwork, design development and permitting. An estimate for consideration at the March 2013 meeting is $200,000.
- **Maintain Safety Signage** - Because of the potential for further structure failure, the Town should continue to review and maintain existing signage to prevent pedestrian access from the shore and to warn boaters to avoid close proximity or contact with the structure.
- **Install Navigational Markings** (when required)- The Army Corps of Engineers, US Coast Guard-Portland Group and Maine Bureau of Submerged Lands were contacted and questioned regarding the need to maintain and monitor the pier structure deterioration. The consensus response was that the structure would need to be marked (if not removed) if it were deemed a hazard to navigation.
- **Obtain Submerged Lands Lease**- Ownership of the pier was transferred to the Town from the Navy in 1992. Since 2005, Maine law has required Owners have a Submerged Lands Lease for any structure that extends beyond the mean low water mark into property managed for the state as part of the Maine Submerged Lands program. There is no fee associated with a municipal lease.

2. Background Data Collection

A search for background data led to the discovery of original pier construction and rehabilitation plans in the Town archives. Information collected for the pier assessment also included reports and past studies undertaken on the Mitchell Field property, web based data of the environmental and physical characteristics of the site and correspondence between the Town and regulatory agencies regarding material removal/disposal requirements. A summary list of references is provided below:

- "Rehabilitation of Fuel Pier" Plans by Morrissey-Johnson Consulting Engineers, New York, NY, 1/3/1980
- "AVGAS & Jet Fuel Storage Facilities Fuel Pier" Plans by Thomas Worcester Inc. Arch. & Engr., Boston, MA, 8/7/1952
- "Inspection of Navy Fuel Pier" by TEC Associates, South Portland, ME, 2/10/2012
- "Mitchell Field Boat Launch Facility, Feasibility Study and Recommended Layout" by Baker Design Consultants, Yarmouth, ME, 12/29/2011
- Regulatory Correspondence between Town of Harpswell, Maine DEP, and US Army Corps of Engineers, provided by the Town, 1/14/2013

3. Construction & Condition Review

Field inspections were conducted by BDC and MER during January 2013 to assess the existing condition of the pier. Conditions above low water were assessed by visual inspection by boat. A dive inspection was conducted to document conditions of the pier below the water line. The following sections provide a summary of specific elements of the pier condition.

3.a. Approach Pier

The approach pier consists of a reinforced concrete deck superstructure with integral pile caps, supported by concrete-filled steel pipe-piles. There are 14 pile bents containing a series of vertical and battered piles.

The concrete deck superstructure is in fair condition. The structure is showing signs of deterioration typical of similar age construction, including isolated cracking/spalling of face concrete and rusting of exposed rebar. The superstructure condition is believed to be adequate to support pedestrian and limited vehicular loading, ***provided the structure is adequately supported from below (this is not currently the case due to poor pile condition).***

The concrete-filled steel pipe piles supporting the pier are in very poor condition. In the 2012 report by TEC Associates steel section loss of 100% is documented in almost half of the piles at the low water mark, of these many have also lost most or all of their concrete section. A review of dive survey video confirmed the piles are most deteriorated at the low water mark. In the current condition the pier is not adequately supported and is unsafe for any type of loading.

The pump house extension on the north side of the approach pier at bents 10 and 11 is in very poor condition and appears to be cantilevered from the existing deck because the support piles are no longer effective. The concrete deck at the building will likely be the first element to collapse. Priority should be given to removal or re-support.

3.b. Breasting Platform

The central Breasting Platform consists of three connected sheet pile cells filled with select rock and gravel. Each cell has four (4) concrete-filled steel pipe piles within its core. The cells are capped with a reinforced concrete deck slab approximately 2-ft thick.

The 1952 construction plans indicate that the method involved:

- First dredging the entire area to refusal (dredge material was disposed in a designated area to the northeast of the pier),
- installing the cells,
- placing a concrete tremie seal within the interior of the cells and placing heavy rip-rap around the outer circumference of the cells. The top elevation of the rip-rap and tremie concrete was approximately at the original mudline.
- The dredged area around the cells was filled in (whether this was done during the construction or allowed to occur naturally is unknown), and the rip-rap was buried beneath the seabed.

The Breasting Platform is currently in very poor condition. The steel sheet pile is badly deteriorated with holes completely through in many areas. Through the holes, voids are visible within the cells indicating that some amount of material has spilled out of the cells and onto the seabed. The size of voids is unknown. Currently, there are various birds living within the voids of the cells.

Historically, a fendering system consisting of steel I-section walers and timber piles was present around the east and west sides of the Breasting Platform. Today, these components are mainly gone, with only a few timber piles remaining on the southeast corner of the platform. A significant amount of debris was observed on the seabed, indicating that much of the historic fendering failed and dropped into the water at some earlier time.

3.c. North and South Mooring Dolphins

The North and South Mooring Dolphins each consist of a single, circular sheet pile cell. The construction is similar to the central Breasting Platform. Rather than a full concrete deck slab, the mooring Dolphins only have a concrete ring around the outer 4.5-ft, the middle of the Dolphins were capped with bituminous pavement. The Mooring Dolphins have no inner piles, and are filled only with rock and gravel fill.

The North Mooring Dolphin failed in April 2012. The west face of the sheet pile cell split open and the reinforced concrete ring-cap fell into the inside of the cell. Original construction plans show that the cells were filled to the top with rock or gravel. While the exact sequence of events throughout the cell failure is unknown, the fact that the concrete cap and west face of the sheet pile have fallen inward suggests that a substantial amount of the original fill material has spilled out of the cell and onto the seabed. The lack of a noticeable mound of material on the seabed suggests that the loss of material has occurred over an extended period of time (allowing the material to be dispersed over a larger area by the tidal currents) and was not a sudden occurrence.

The South Mooring Dolphin is still intact but is in very poor condition. There are holes entirely through the sheet pile in a number of locations. The cell appears to be bulging outward near the low water line. Also, daylight is visible through the holes near the top of the pier, indicating that some loss of material and/or settlement has occurred within the cell. It is likely that without any action, the South Mooring Dolphin will experience a similar failure to the North Mooring Dolphin at some point in the near future.

4. Corrosion Assessment

As discussed in the prior section, all of the components of the pier exposed to seawater have experienced significant corrosion and are badly deteriorated. In many localized areas, the steel sheet piles have completely corroded creating holes through the sheets. Roughly half of the steel pipe piles have completely corroded (including concrete infill).

The level of corrosion experienced by steel structures in marine environments depends on the type of exposure, typically defined by exposure zones as follows:

Atmospheric Zone – The area above the splash zone that experience atmospheric exposure

Splash Zone – The area above MHW that is regularly exposed to saltwater spray, and repeated wetting and drying

Tidal Zone – The area between MLW and MHW, sees wet-dry cycles twice daily

Intertidal Low Water Zone – The lowest section of the tidal range, just above MLW

Submerged Zone – The area below MLW that is continually wet

Embedded zone – The area below the mudline

These exposure zones are demonstrated for the typical pier cell in Figure 5.

A number of resources have been referenced for typical corrosion rates, a compilation of this data is provided in Table 2. Suggested corrosion rates vary widely by reference, and actual corrosion observed is tied to a number of site specific factors including temperature (ambient and water), salinity and pH of seawater, water velocity, presence of organisms, etc. For the purpose of this study, corrosion projections have been made using the ICE recommended values. It is assumed that the original bituminous coating applied to the sheet piles was retained for the first 20 years of the structure's life, and that an active cathodic protection system was maintained until the structure was turned over to the Town in 1992.

Table 2 – Typical Corrosion Rates for Steel Structures in Marine Environments

Reference	ICE		Skyline	Corus	Coffman	Uhlig	
Structure Location	**Average (mils/yr/ side)**	**Upper Limit (mils/yr/ side)**	**Average (mils/yr total)**	**Average (mils/yr/ side)**	**Average (mils/yr/ side)**	**Sheet Pile (mils/yr Total)**	**Average (mils/yr total)**
Atmospheric Zone	1.6	3.9	1.2	1.4	1 - 2	---	5.0
Splash Zone	3.1	6.7	3.5	3.0	1 - 2	4.4	10.7
Tidal Zone	1.6	3.9	2.0	1.4	4 - 6	1.7	3.3
Intertidal Low Water Zone	3.1	6.7	3.5	3.0	---	1.9	1.9
Continuous Immersion Zone	1.6	5.1	2.0	1.4	4 - 6	1.5	3.5
Embedded Below Seabed	---	0.6	1.2	0.6	2 - 4	---	3.0

Note: 1 mil = 0.001 inches.

References

Institute of Civil Engineers. ICE Briefing Sheet, Concentrated Corrosion on Marine Steel Structures (2010).

Skyline Steel, LLC. Designing for Durability.

Corus Construction & Industrial. A Corrosion Protection Guide for Steel Bearing Piles in Temperate Climates (2005).

Coffman Engineers. Port of Anchorage Expansion Project, Corrosion Control Report (2007).

Uhlig's Corrosion Handbook, 3rd Edition (2011). Table 45.4 – Corrosion Rates of Carbon Steel Pilings and Test Specimens in Different Corrosion Zones.

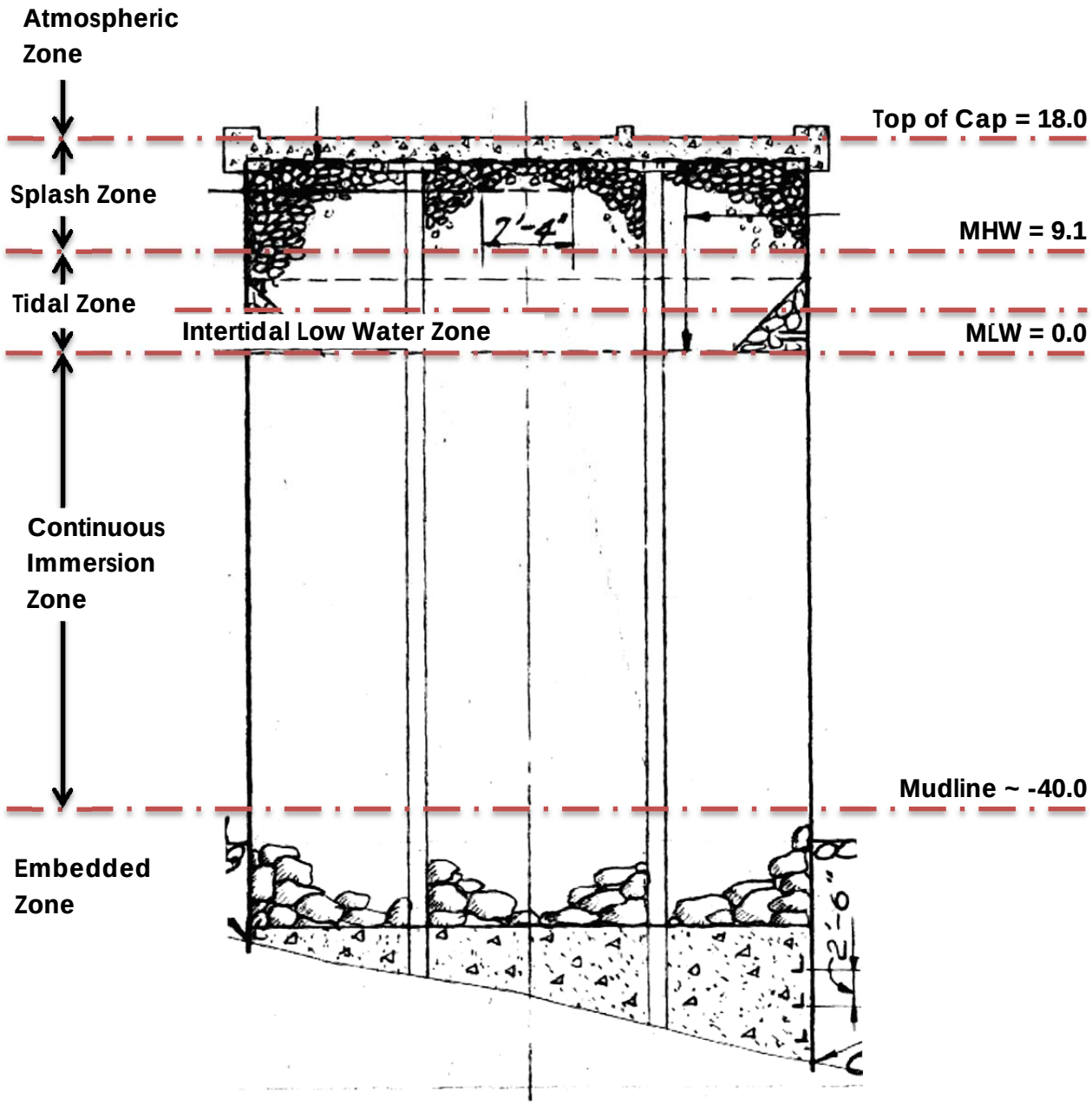


Figure 5 – Cell Corrosion Zones

The projected levels of deterioration are provided in Table 3. The current structural condition confirms the projected deterioration levels, with the greatest levels of deterioration observed within the splash zone and within the intertidal low water zone. Examples of the corrosion levels in these areas are provided in Figure 6 and Figure 7. The continuous immersion zone is heavily coated with marine growth and the structural condition is not easily examined without disturbing this habitat. It is believed that the condition within this zone is poor, although somewhat better than in the Splash Zone and Intertidal Low Water Zone, based on the projections provided in Table 3.

Figure 6 – Corrosion within Intertidal Low Water Zone (Courtesy of TEC Associates)

Figure 7 – Corrosion within Splash Zone (Courtesy of TEC Associates)

Table 3 – Projected Deterioration of Steel by Exposure Zone

CORROSION RATE OF UNPROTECTED STEEL (per year)			CUMULATIVE SECTION LOSS								
			Yrs	Interval		Yrs	Interval		Yrs	Interval	
			20	1954 to 1974		18	1974 to 1992		20	1992 to 2012	
Taken from ICE Briefing Sheet "Concentrated Corrosion on Marine Steel Structures			Original Coating -Splash & Atmospheric Zones Assumed Cathodic Protection			No Surface Coating Assumed Cathodic Protection			No Surface Coating No Cathodic Protection		
Structure Location	Average (mm)	Maximum (mm)	No of Sides	Average (mm)	Maximum (mm)	No of Sides	Average (mm)	Maximum (mm)	No of Sides	Average (mm)	Maximum (mm)
Atmospheric Zone	0.04	0.1	1	0.8	2	2	1.44	3.6	2	1.6	4
Splash Zone	0.08	0.17	1	1.6	3.4	2	2.88	6.12	2	3.2	6.8
Tidal Zone	0.04	0.1	1	0.8	2	2	1.44	3.6	2	1.6	4
Intertidal Low Water Zone	0.08	0.17	1	1.6	3.4	1	1.44	3.06	2	3.2	6.8
Continuous Immersion Zone	0.04	0.13	1	0.8	2.6	1	0.72	2.34	2	1.6	5.2
Embedded Below Seabed	-	0.015	1	-	0.3	1	-	0.27	2	-	0.6

CORROSION RATE OF UNPROTECTED STEEL (per year)			TOTAL SECTION LOSS TO DATE			
			Yrs	Interval		
			58	1954 to 2012		
Taken from ICE Briefing Sheet "Concentrated Corrosion on Marine Steel Structures			TOTAL SECTION LOSS TO DATE			
			Steel Thickness (3/8 inch) mm		9.525	
Structure Location	Average (mm)	Maximum (mm)	Average		Maximum	
			(mm)	%	(mm)	%
Atmospheric Zone	0.04	0.1	3.84	40%	9.6	101%
Splash Zone	0.08	0.17	7.68	81%	16.32	171%
Tidal Zone	0.04	0.1	3.84	40%	9.6	101%
Intertidal Low Water Zone	0.08	0.17	6.24	66%	13.26	139%
Continuous Immersion Zone	0.04	0.13	3.12	33%	10.14	106%
Embedded Below Seabed	-	0.015	-		1.17	12%

5. Underwater Survey

A dive survey was conducted to characterize existing environmental/habitat conditions at the seabed surrounding the cells, as well as to evaluate the vertical habitat provided by the cells. The results of this survey are presented in a report entitled "**Subtidal Survey Mitchell Field Pier, Harpswell, Maine**" by MER Assessment Corporation located in Appendix A of this report.

5.a. Artificial Reef Construction

A potential opportunity for reuse of the existing cell fill material is for construction of an artificial reef in front of the Mitchell Field site. Artificial reefs may be constructed to "provide and/or improve opportunities for recreational and commercial fishing, aid in the enrichment of fishery resources and ecosystem services, or achieve a combination of these objectives."[1] The proposed artificial reef would allow for placement of all of the original cell fill material on the seabed surrounding the cells.

The concept of reef construction is demonstrated in Figure 8 and Figure 9, which provide a cross section for the reef utilizing 100% of the cell fill material, and the approximate footprint of the artificial reef, respectively.

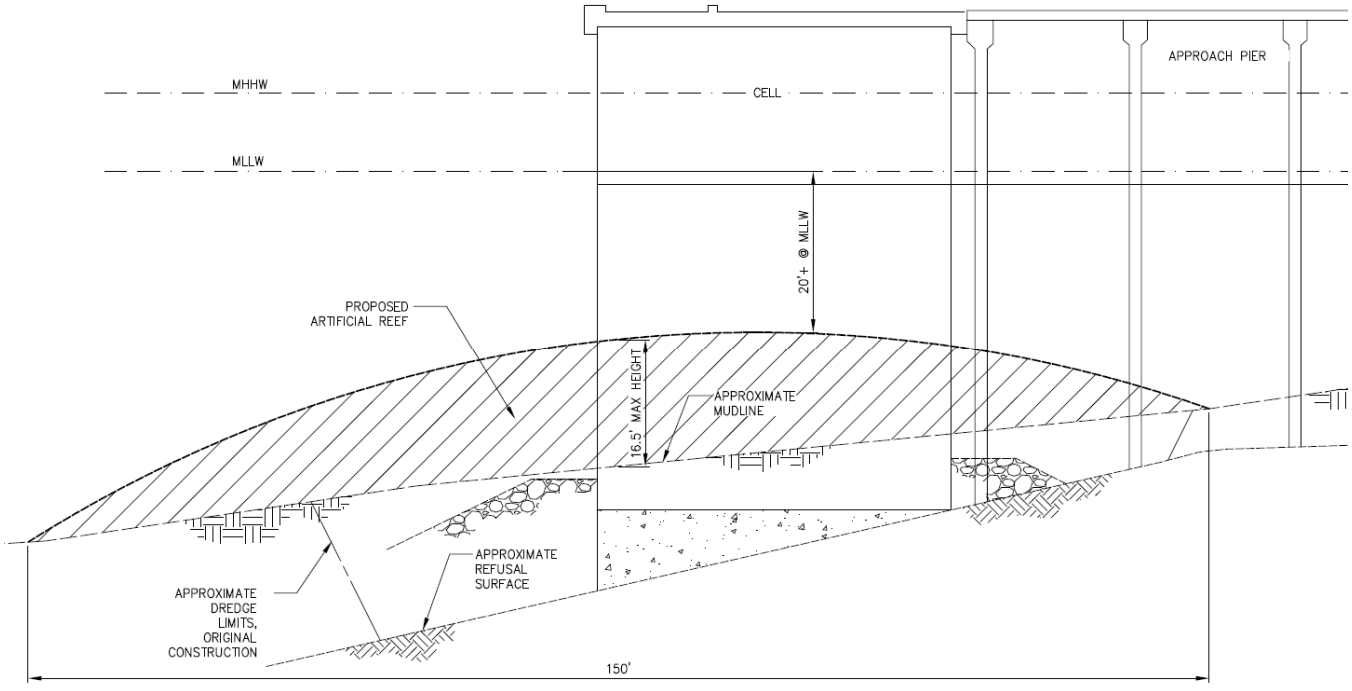


Figure 8 – Reef Building with Construction Debris

[1] Rousseau, M.A. (2008) Massachusetts Marine Artificial Reef Plan

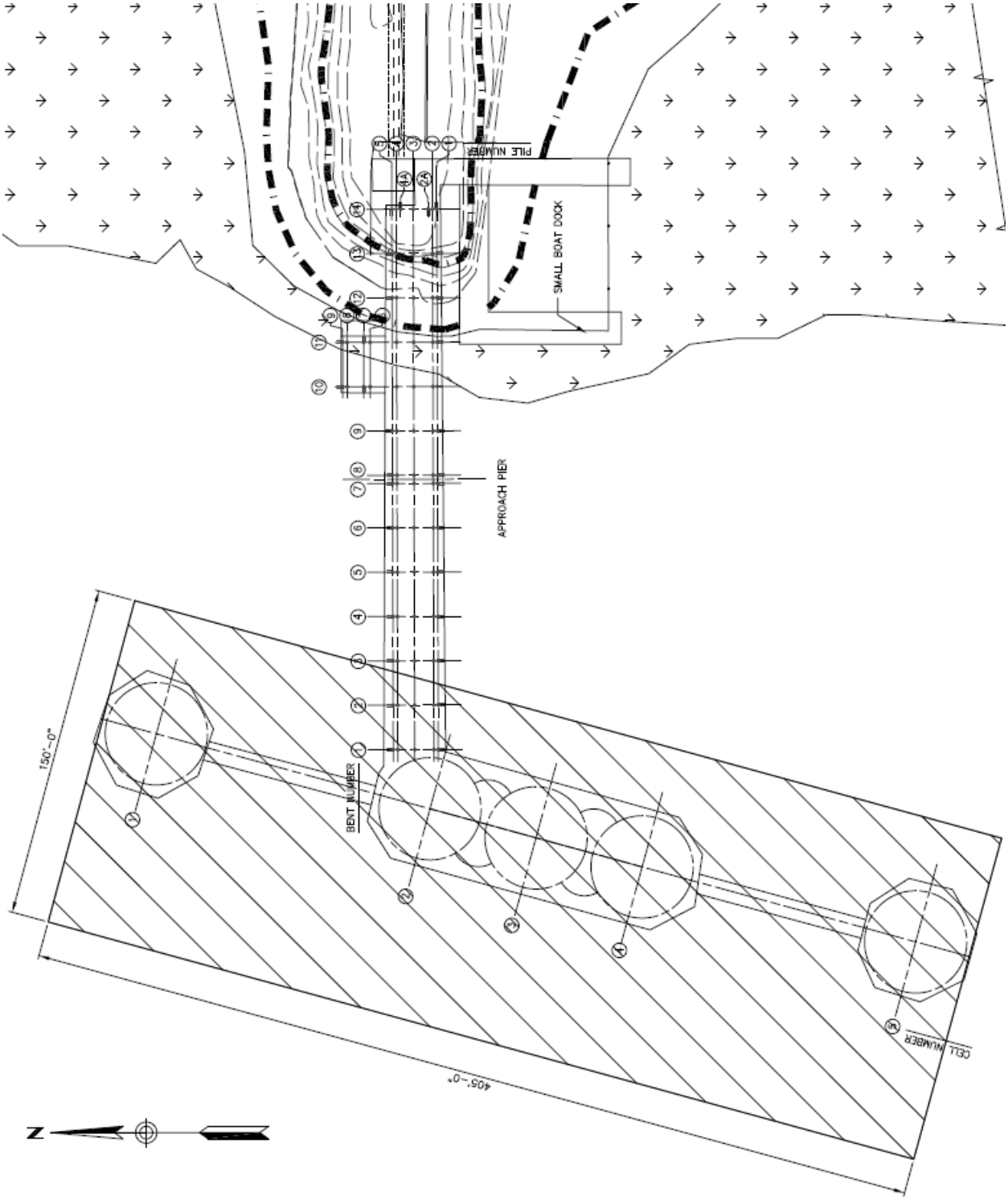
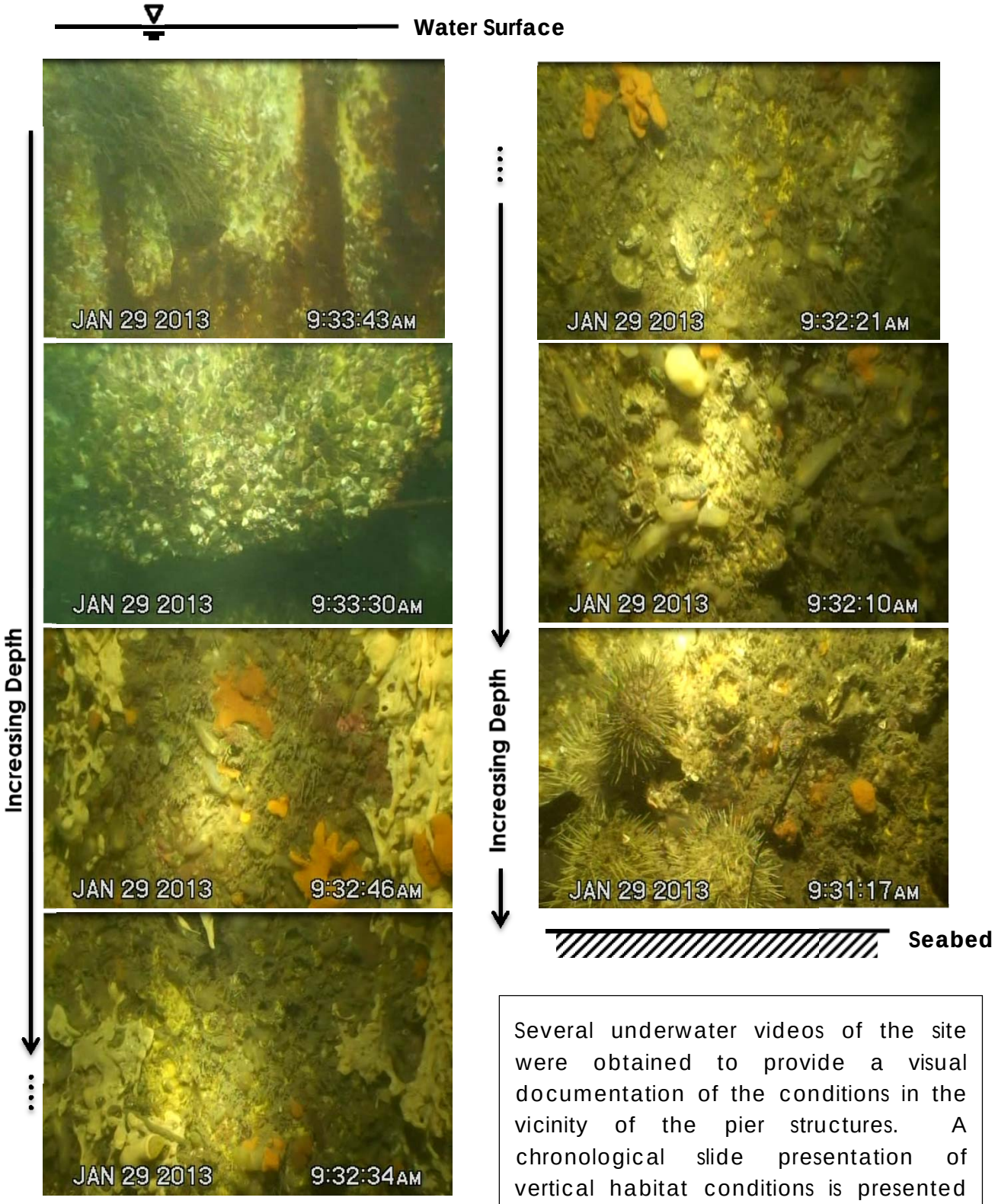


Figure 9 – Approximate Footprint of Artificial Reef

5.b. Cell Vertical Habitat



Several underwater videos of the site were obtained to provide a visual documentation of the conditions in the vicinity of the pier structures. A chronological slide presentation of vertical habitat conditions is presented

6. Demolition/Rehabilitation Options

In order to facilitate the Town's decision making process regarding an approach to rehabilitation of the existing pier, several rehabilitation schemes were prepared. Schemes were developed after reviewing the structural condition and construction method of existing elements, and discussing the project with regulatory agencies and contractors[2].

The pier was divided into 6 sections, labeled as A-F, and schemes were developed consisting of a combination of demolition or rehabilitation of each of these sections. The four schemes identified are presented in Table 4 below. A general description of the rehabilitation or demolition proposed for each section follows. Sketches of each of the proposed schemes are provided in the following pages.

Table 4 – Pier Demolition & Rehabilitation Schemes

		Scheme			
Section	**Description**	**1** ***Full Demolition***	**2 Full Rehabilitation**	**3 Partial Demolition**	**4 Partial Demolition w/ Breakwater**
A	North Mooring Dolphin	**D**	**D**	**D**	**D**
B	Breasting Platform	**D**	**R**	**D**	**R**
C	South Mooring Dolphin	**D**	**R**	**D**	**D**
D	Approach Pier, Bents 1-7	**D**	**R**	**D**	**D**
E	Approach Pier, Bents 8-14	**D**	**R**	**R**	**R**
F	Pump House Extension	**D**	**D**	**D**	**D**

Key:

D – Demolition

R – Rehabilitation

[2] Meetings were held with Peter Krakoff, Vice President & Chief Estimator, CPM Constructors, and Patrick Sughrue, Manager of Projects – Civil & Marine, Cianbro Corporation

A – North Mooring Dolphin

Demolished with all schemes because of recent collapse. No longer a candidate for rehabilitation.

Demolition: Demolish and dispose of all steel and concrete, leave rock and gravel fill in place on seabed with regulatory approval or remove from site.

B – Breasting Platform

Demolition: Demolish and dispose of all steel and concrete, including internal pipe piles, leave rock and gravel fill in place on seabed with regulatory approval or remove from site.

Rehabilitation: Drive new steel sheet pile cell around outside of existing cells, install new steel tie rods through cells to support new sheet pile, fill interstitial space with gravel, extend or replace concrete cap

C – South Mooring Dolphin

Demolition: Demolish and dispose of all steel and concrete, including internal pipe piles, leave rock and gravel fill in place on seabed

Rehabilitation: Drive new steel sheet pile cell around outside of existing cell, fill interstitial space with gravel, extend concrete cap

D – Approach Pier, Bents 1-7

Demolition: Demolish and dispose of concrete superstructure and pipe piles

Rehabilitation: Option A – Drive new support piles beneath existing superstructure either by cutting through deck or driving piles outside of existing pier and extending caps, Option B – Wrap existing pipe piles with composite sleeve and grout interstitial space.

E – Approach Pier, Bents 8-14

Demolition: Demolish and dispose of concrete superstructure and pipe piles

Rehabilitation: Option A – Drive new support piles beneath existing superstructure either by cutting through deck or driving piles outside of existing pier and extending caps, Option B – Wrap existing pipe piles with composite sleeve and grout interstitial space.

F – Pump House Extension

Demolished with all schemes due to existing poor condition.

Demolition: Proposed demolition consists of removal of all steel and concrete in the pier superstructure and pile supports.

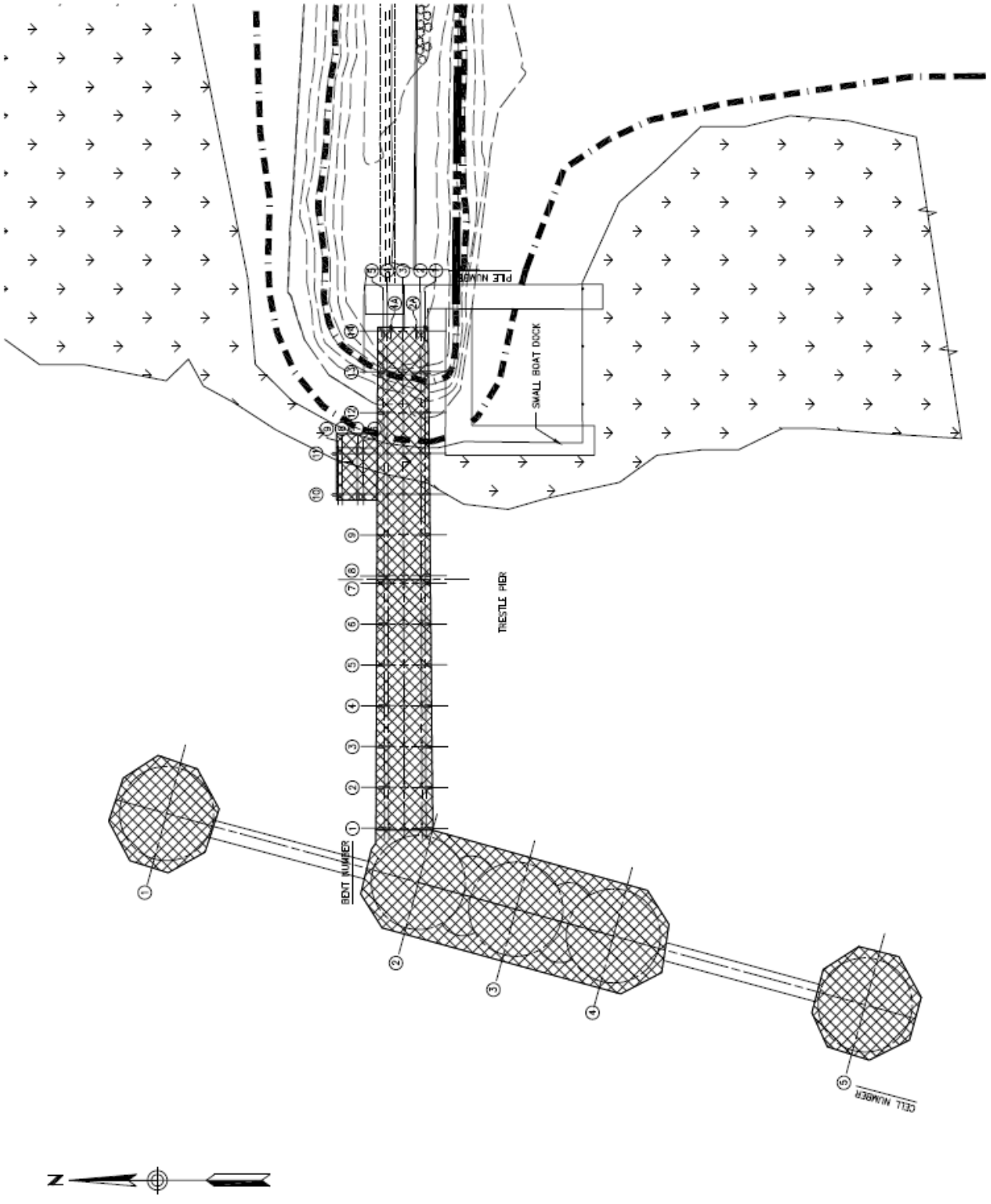


Figure 10 – Scheme 1: Full Demolition

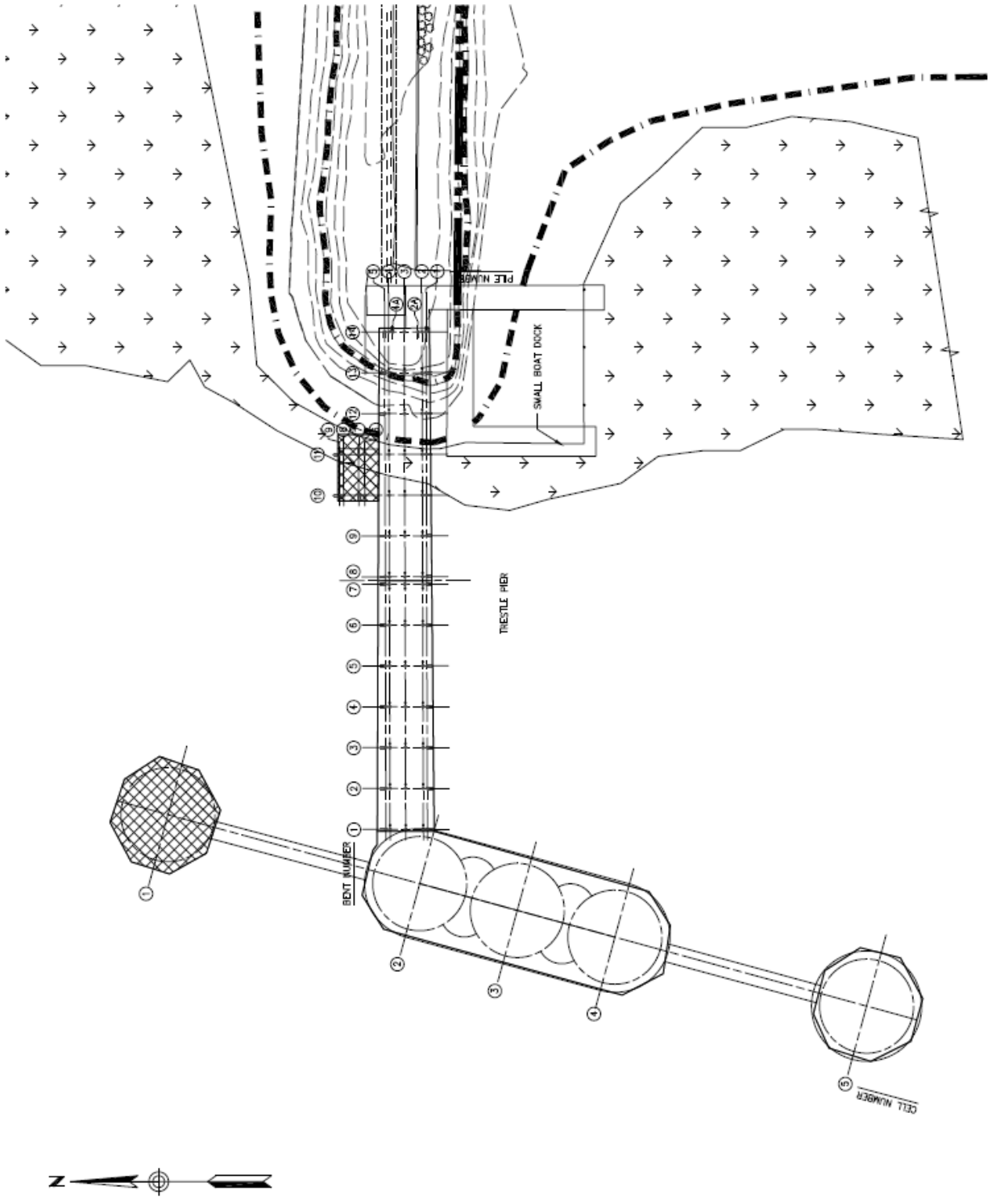


Figure 11 – Scheme 2: Full Rehabilitation

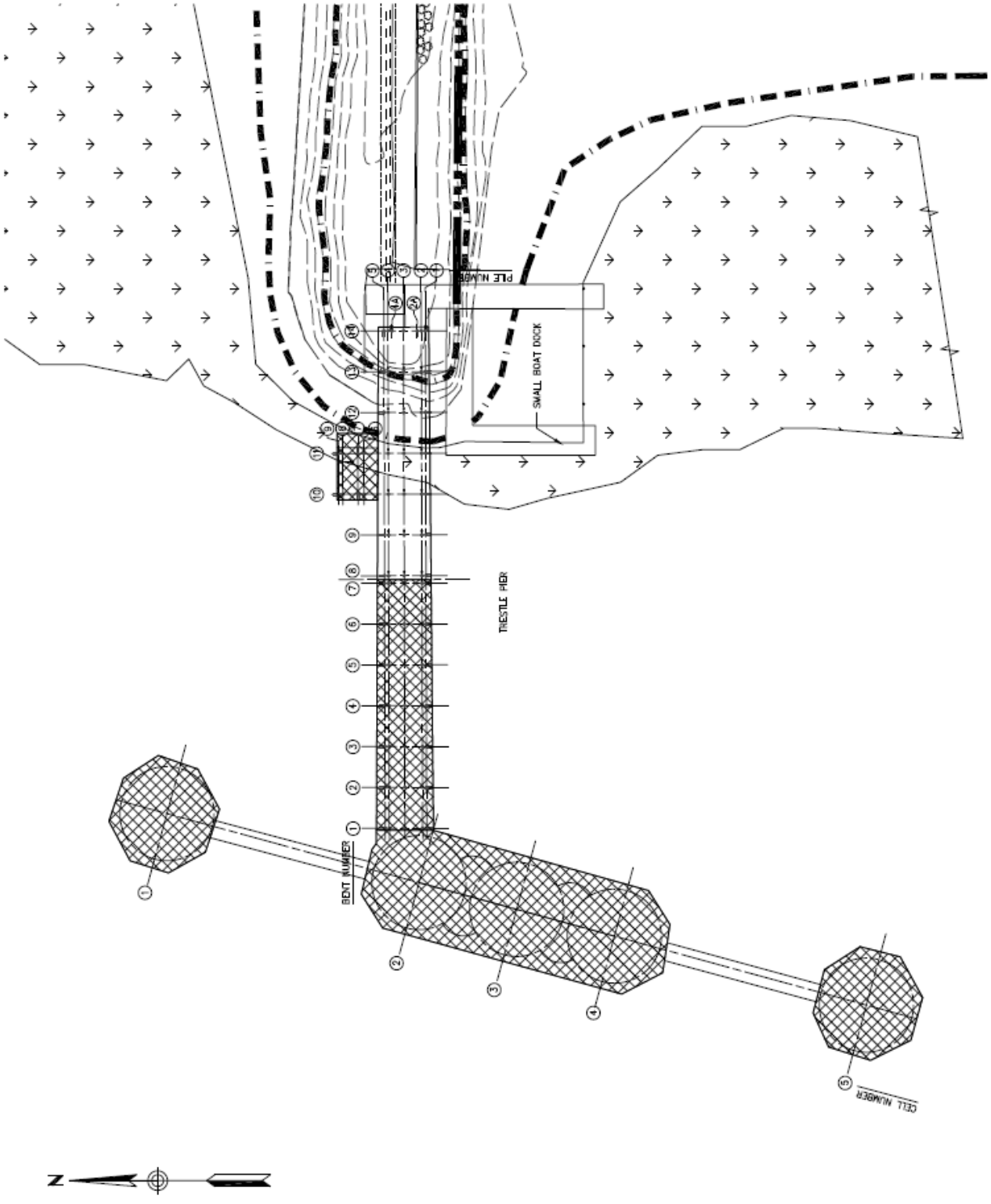


Figure 12 – Scheme 3: Partial Demolition

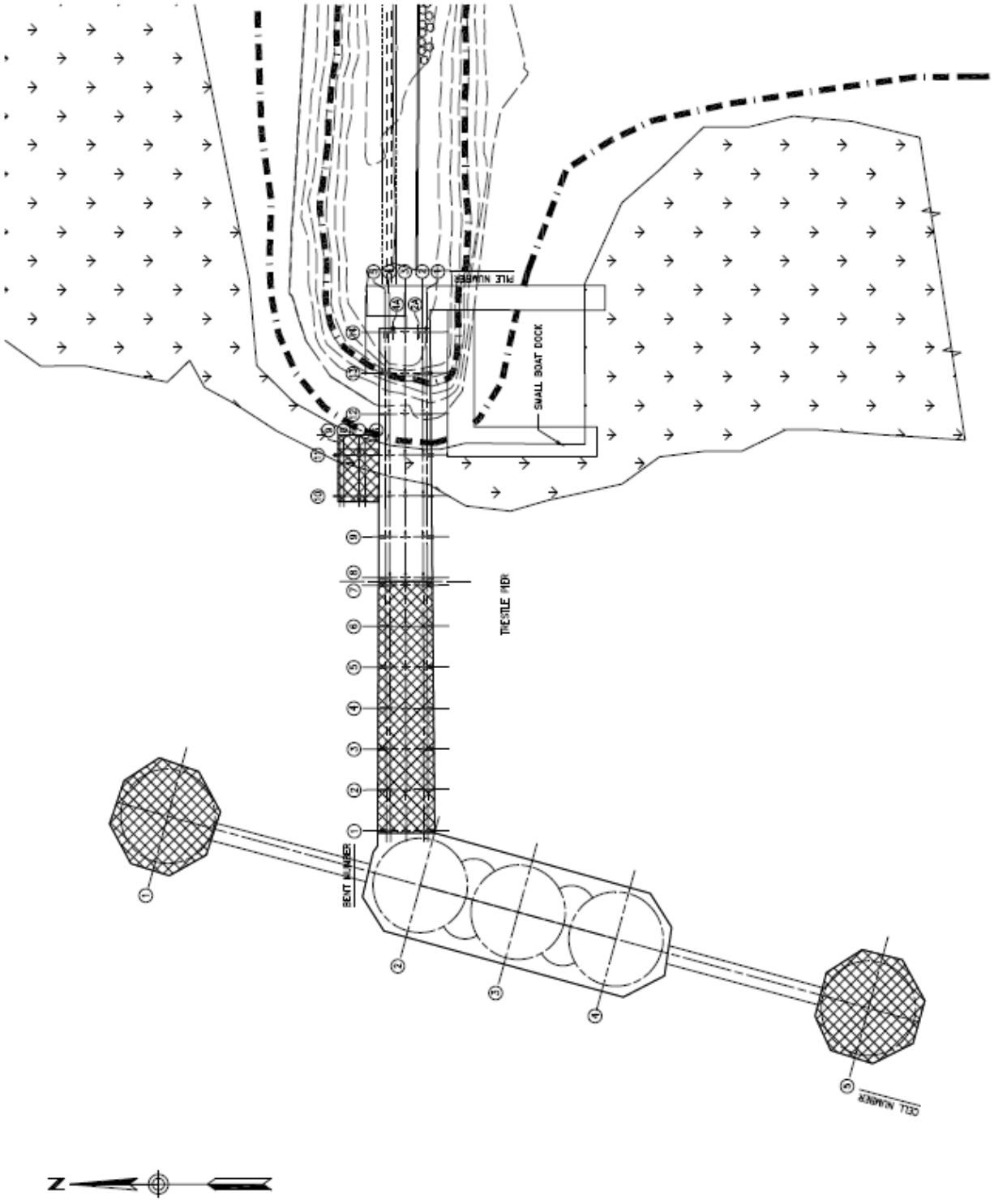


Figure 13 – Scheme 4: Partial Demolition with Breakwater

Cost estimates have been prepared for each option of demolition or rehabilitation of each of the individual pier sections. Estimates are presented below in Table 5. Based on the schemes presented in Table 4, total costs have been estimated for each of the proposed demolition/rehabilitation schemes. These costs are presented in Table 6. An additional consideration is the ongoing operation and maintenance cost for the town. Projections have not been made as to the actual cost of operations and maintenance, a relative ranking of these costs is also provided in Table 6.

Table 5 – Pier Section Demolition & Rehabilitation Cost Estimates

Section	Description	*Demolition*	Rehabilitation
	Mobilization & Demobilization	$124,000	
A	North Mooring Dolphin	$633,000	----
B	Breasting Platform	$1,500,000	$1,860,000
C	South Mooring Dolphin	$633,000	$930,000
D	Approach Pier, Bents 1-7	$582,000	$885,000 (A) $715,000 (B)
E	Approach Pier, Bents 8-12	$549,000	$621,000 (A) $521,000 (B)
F	Pump House Building	$54,000	----

Table 6 – Demolition/Rehabilitation Scheme Cost Estimates

Scheme	Total Estimated Cost	*Ongoing Operation and Maintenance Cost*
1	$4.07 M	None
2	$5.10 M (A) $4.83 M (B)	High
3	$4.14 M (A) $4.04 M (B)	Low
4	$4.80 M (A) $4.70 M (B)	Mid

Sketches of the proposed rehabilitation schemes are provided in.

Key: (A)= New Piles, (B)= Pile Wrap System

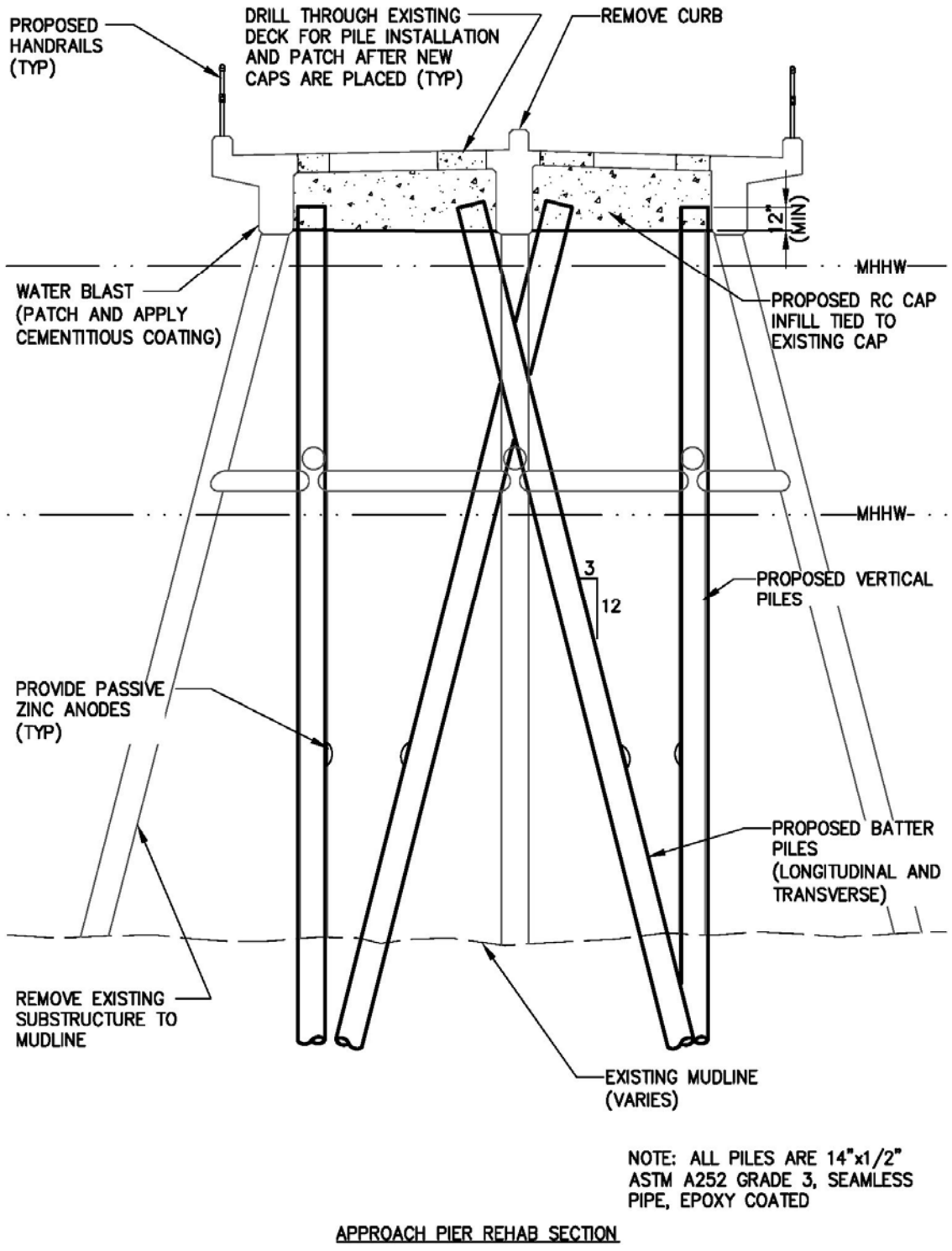


Figure 14 – Approach Pier Rehabilitation Section

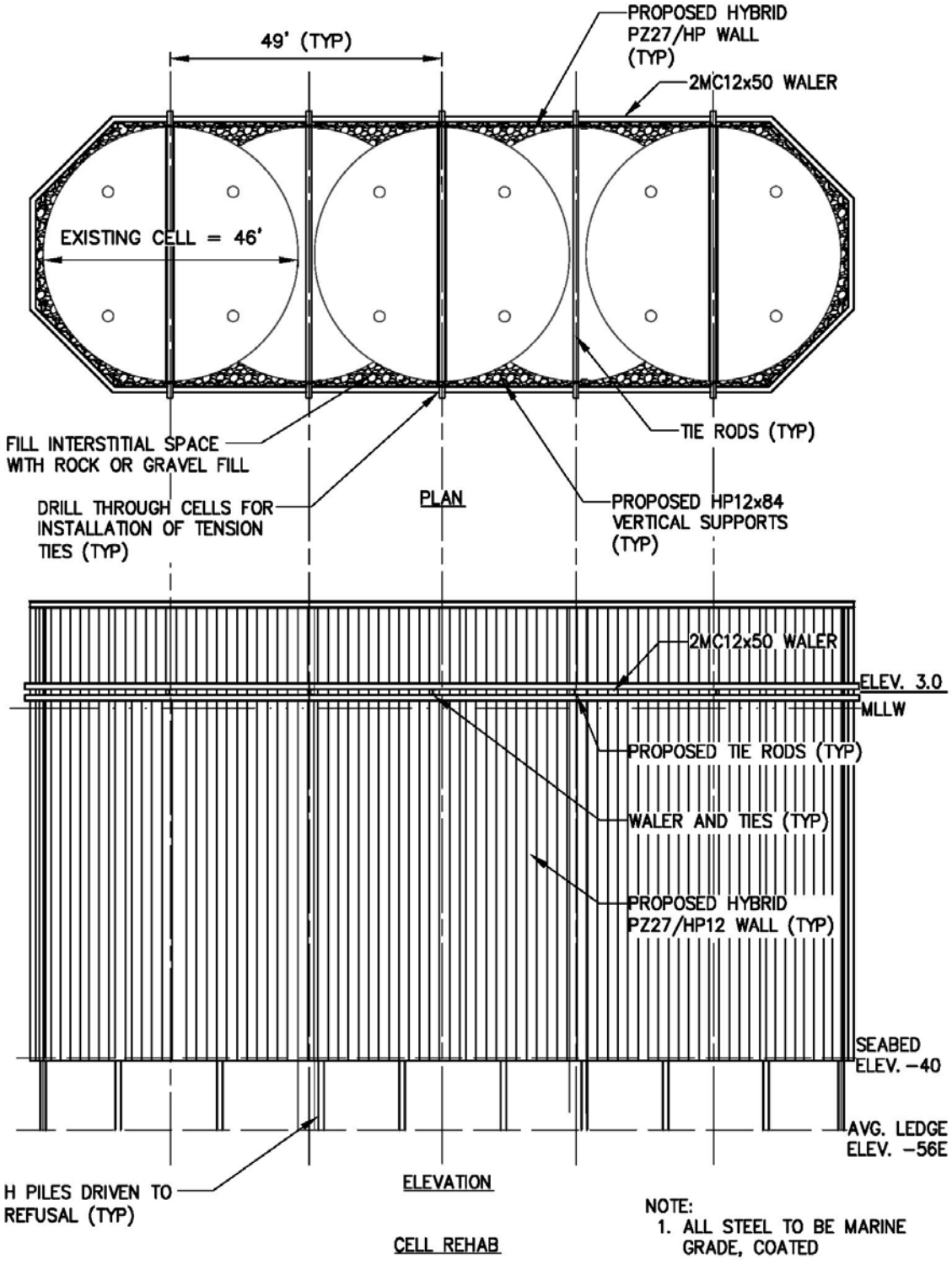


Figure 15 – Cell Rehabilitation Plan & Elevation

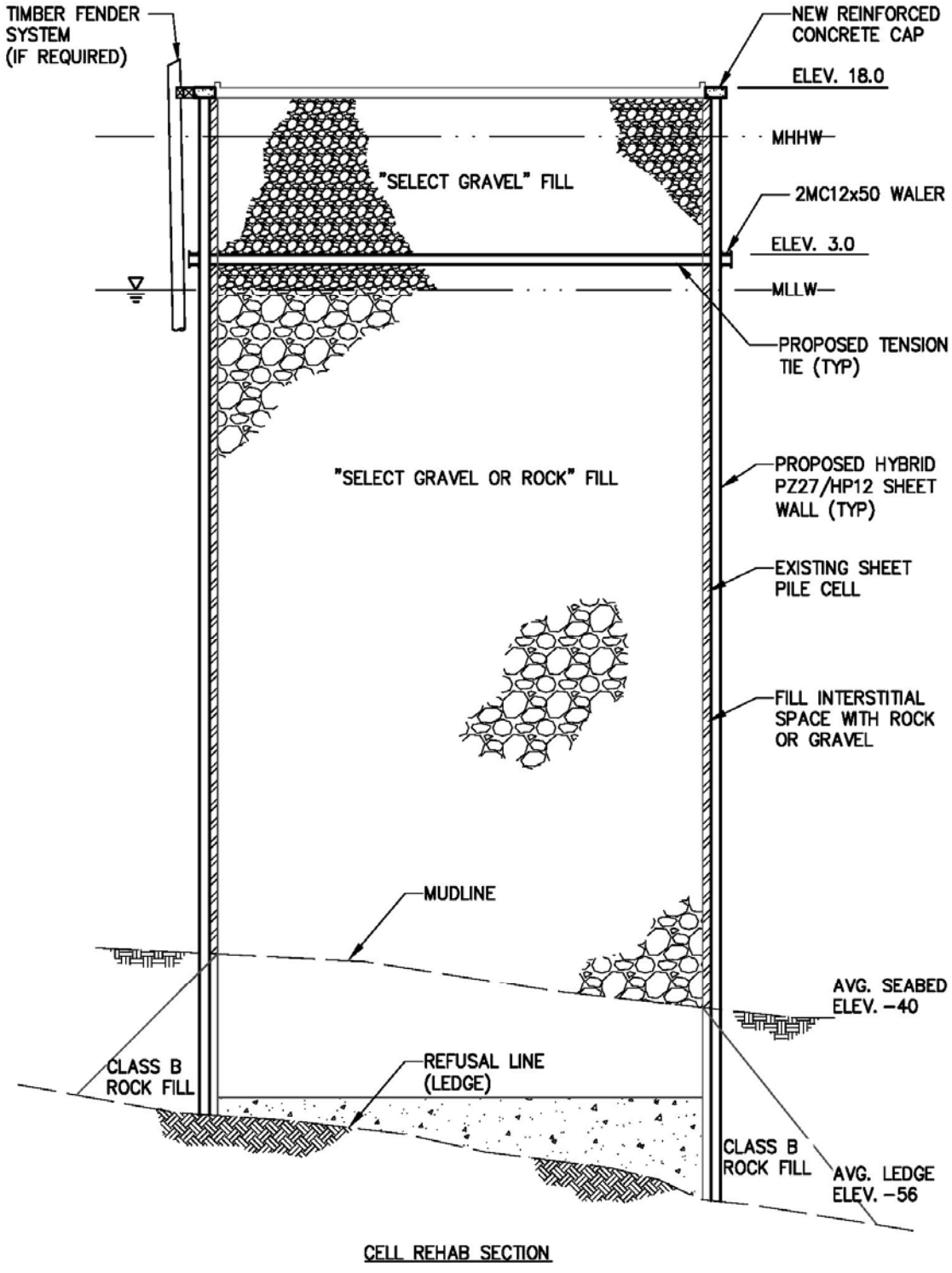


Figure 16 – Cell Rehabilitation Section

6.a. Do Nothing Option

Because of the substantial cost associated with any of the proposed rehabilitation or demolition options, the "Do Nothing" option is also worth the Town's consideration. The pier is currently in a state of severe deterioration, and the North Mooring Dolphin has recently collapsed. The South Mooring Dolphin, the central Breasting Platform, and the Approach Pier are currently at risk of failure. If no action is taken it is only a matter of time before these structures collapse.

The deteriorated state of the pier is well known by the Town and the area has been fenced off and warning signs have been added to prevent pedestrian access from the causeway. Additional signage warns boaters to maintain a safe distance from the structure. This signage needs to be maintained by the Town.

BDC has discussed the regulatory implications of a collapse of the structure with representatives from the US Army Corps of Engineers (ACOE), the Maine Department of Environmental Protection (DEP) and the National Marine Fisheries Service. Refer to the Meeting minutes in Appendix B. Calls were also made to the Maine Bureau of Submerged Lands and the US Coast Guard- Portland Group.

The US Coast Guard did reference the Statute within the Code of Federal Regulations that refers to wrecks and other obstructions that is summarized below:

Summary of Code of Federal Regulations (CFR) Title 33, Volume 3, Section 245.

Upon receiving a report of a wreck or other obstruction, District Engineers will consult with the Coast Guard district to jointly determine whether the obstruction poses a hazard to navigation. If the structure is deemed a navigation hazard by ACOE and USCG, an approach for remedial action will be determined from one of the following options:

1. No Action
2. Charting
3. Broadcast notice to mariners and publication of navigational safety information
4. Marking
5. Redefinition of navigation area (e.g. channel, fairway, anchorage, etc.)
6. Removal

Based on discussions with the regulatory representatives, it is unlikely the Town would be required to remove the structure if it did collapse. The components of the pier are not environmentally hazardous (steel, concrete, stone) and the location of the structure is not in a navigation channel. The Army Corps of Engineers and Coast Guard did indicate that the structure would need to be marked if it was deemed a navigational hazard. A collapse of the pier will however make redevelopment of the site difficult. Removing it after it has collapsed to make way for a new facility or to improve access to the area will be more expensive than demolishing it before it does collapse.

6.b. Comparison cost of Rehabilitation with New Construction

If the pier is demolished, replacement with a new, smaller pier is an option. Examples of the cost of recent piers designed by BDC are provided in Table 7 and compared with the cost of projections for rehabilitating or demolishing the first 125-ft of the existing Mitchell Field Approach Pier.

The Table shows that the cost of rehabilitating the existing approach pier is less than demotion and then replacement with an entirely new structure of the same dimensions. That said, relative savings and functionality may be better served with a smaller structure in a different orientation. A new structure might incorporate the existing small boat basin and or incorporate the proposed boat ramp on a new alignment.

Table 7 – Pier Construction Cost Examples

Pier Name/Location	Construction Type	Construction Cost	Area	Unit Cost
Mitchell Field **Approach Pier Rehabilitation**	Rehabilitate existing structure with new Substructure	$641,000	3,200 ft^2 25'6" x 125'	$200/ ft^2
Mitchell Field **Approach Pier Demolition**	Demolish existing structure. Remove from Site	$549,000	3,200 ft^2 25'6" x 125'	$171/ ft^2
Memorial Pier, Wiscasset, ME (2011)	Precast Concrete Deck, Timber Substructure	$375,000	2,800 ft^2	$134/ ft^2
Madeleine Point Municipal Pier, Yarmouth, ME (2010)	Glulam Timber Superstructure, Timber Piles	$75,000	330 ft^2	$225 / ft^2
Bowdoin College Pier, Harpswell, ME (2008)	Glulam Timber Superstructure, Steel Pipe Piles	$300,000 (Pier Portion)	1,500 ft^2	$200/ ft^2
SMCC Pier, South Portland, ME (2006)	Heavy Timber Superstructure, Timber Pile Substructure	$450,000 ($200,000 in-kind services/donations)	6,000 ft^2	$110 / ft^2
Municipal Fisherman's Pier, Machiasport, ME (1999)	Precast Concrete Deck, In-situ slab, Steel Piles	$266,000	1,915 ft^2	$140 / ft^2

APPENDIX A-Subtidal Survey- MER Assessment Corporation

DRAFT

Subtidal Survey

Mitchell Field Pier, Harpswell, Maine

Prepared for

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207-846-9724

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February 18, 2013

Introduction

Baker Design Consultants (BDC) was hired by the Town of Harpswell to assess the condition of the pier structures at Mitchell Field and to develop options the Town might consider for the future use or disposition of the facility. BDC requested assistance from MER Assessment Corporation (MER) with the assessment of the subtidal portions of the structures as well as a preliminary characterization of the subtidal marine habitat provided by the structures and the area immediately surrounding the structures.

A video survey of the South Dolphin and Breasting Platform was conducted by MER on January 19, 2013. Additional videos previously recorded independently by diver/underwater photographer Stephen Karpiak on June 22, 2011, April 19, 2012, and May 5, 2012 were also reviewed as part of the habitat characterization.

BDC held a Pre-Application meeting for the proposed project at the Maine Department of Environmental Protection (DEP), Canco Road, Portland, Maine on February 14, 2013 attended by representatives of the Maine DEP, Maine Department of Marine Resources (by phone), U.S. Army Corps of Engineers, NOAA National Marine Fisheries Service and MER.

Diver surveys and video recordings

The video recordings of April 19, 2012 and January 19, 2013 were made using an Amphibico VHHCEL57/Sony HDR-HC9 high definition digital video camera package on high definition (HDV) format tapes with lighting provided by an Amphibico VLDIG3AL 35W/50W switchable underwater arc lamp. The video recordings of June 22, 2011 and May 5, 2012 were recorded using a Nikon D90 digital camera in video mode in an Ikelite housing with light provided by a DS160 Substrobe light. Copies of the video recordings have been provided to BDC.

Habitat characterization

The subtidal seabed beneath and adjacent to the Approach Pier from the shallow subtidal area to the end of the pier at its connection to the Breasting Platform consists of gravel, coarse sand and shell hash throughout. The shallower area is at times covered with a layer of drift rockweed, *Fucus vesiculosus* and *Ascophyllum nodosum*. There are several pieces of debris including sections of railing, damaged wire lobster traps, small pieces of concrete and wooden planks along the bottom. Toward the end of the Approach Pier the bottom becomes coarser to include small to medium size stones and relic shell; this area is subject to moderately strong currents running parallel to the shoreline and length of the Breasting Platform. Fauna seen beneath the Approach Pier in include common periwinkle, *Littorina littorea*, Jonah crab, *Cancer borealis*, rock crab, *C. irroratus*, hermit crabs, *Pagurus* spp., American lobsters, *Homarus americanus*, sea stars, *Asterias* spp., and common barnacles, *Balanus balanoides*, and the orange-sheathed colonial tunicate, *Botrylloides violaceus*, and "pancake batter" tunicate, *Didemnum* sp. encrusting hard surfaces. The vertical surfaces of the pilings are also covered with tunicates, frilled anemones, *Metridium senile*, and finger sponges, *Haliclona oculata*, (see Photo 1 on page 3). During the summer the pilings are occasionally surrounded by schools of blueback herring, *Alosa aestivalis* and Atlantic Pollock, *Pollachius virens*, (pers. comm., S. Karpiak; see Photos 2 and 3, respectively, on pages 3 and 4).

Figure 1. Mitchell Field pier structures and subtidal survey areas

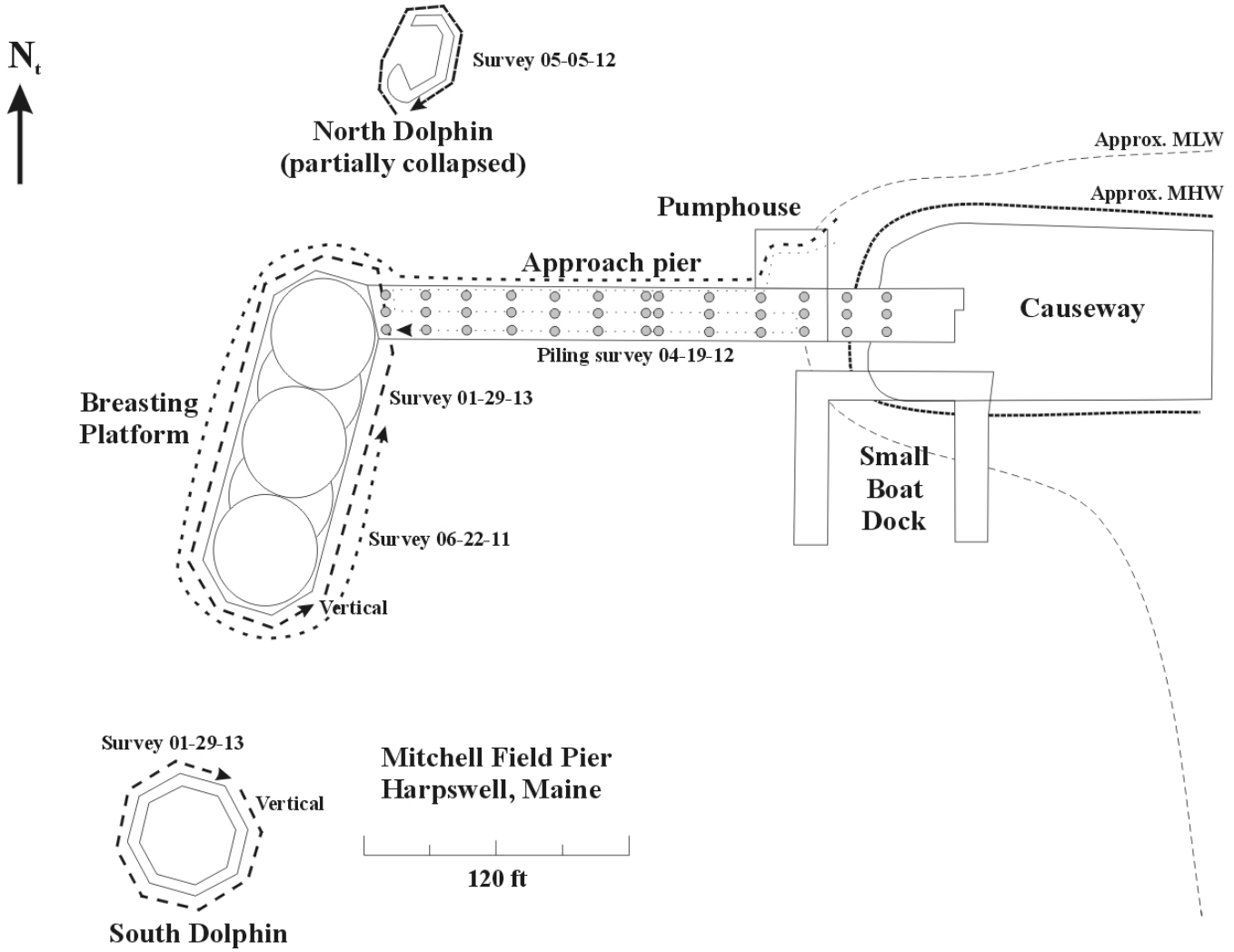
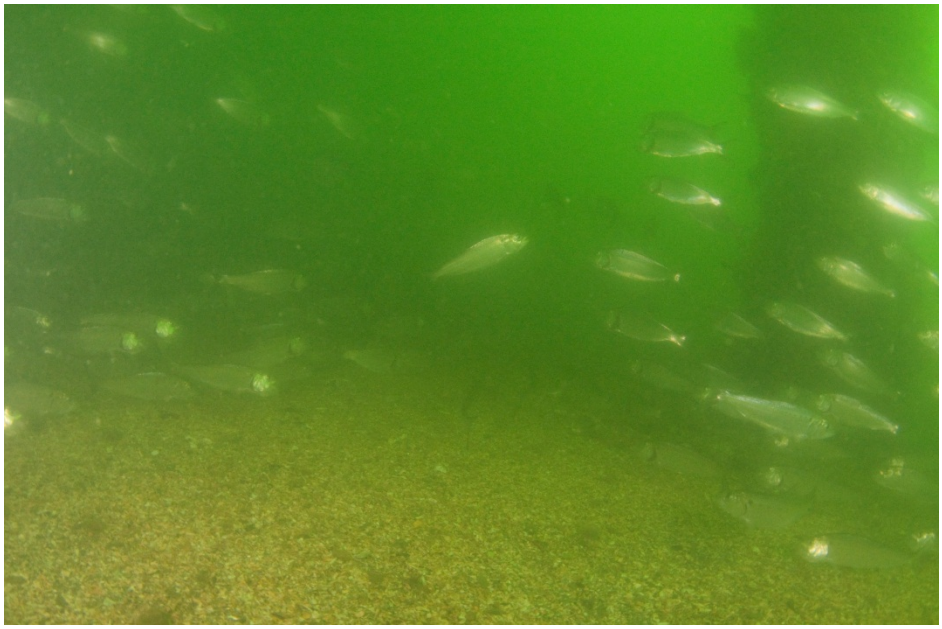


Photo 1. Mitchell Field piling

(Source: Stephen Karpiak)

Photo 2. Blueback herring school around pilings at Mitchell Field pier



(Source: Stephen Karpiak)

The seabed surrounding the Breasting Platform is generally firm consisting of fine to coarse sand and shell hash on the northern end and along the western seaward face. The substrate softens to finer sand and silt as the bottom slopes into deeper water on the western side. The substrate is also softer at the southern end of the Breasting Platform and along the eastern side facing the shore. The seabed immediately adjacent to the sheet pile base of the structure is covered with a substantial amount of debris that extends some distance (unmeasured) out across the seabed and includes sections of concrete, metal beams, steel rods, timbers and fallen pilings. These structures provide hard surfaces for the attachment of a diverse community of flora and fauna, the latter including barnacles (some large), blue mussels, *Mytilus edulis*, frilled anemones, sponges, the orange-sheathed tunicate, *B. violaceus*, and "pancake batter" tunicate, *Didemnum* sp., rock crabs, Jonah crabs, spider crabs, *Hyas* sp., and lobsters which are abundant and of various sizes (as seen on the summer 2011 and spring 2012 video recordings) occupying the interstitial spaces of the complex habitat afforded by the debris (see Photos 3 and 4); small cunner, *Tautogolabrus adspersus*, are also found in the summer. The softer substrate supports an abundant community of the burrowing silver-banded anemone, *Bunodactis stella*, and the cerianthid anemone, *Cerianthus borealis*.

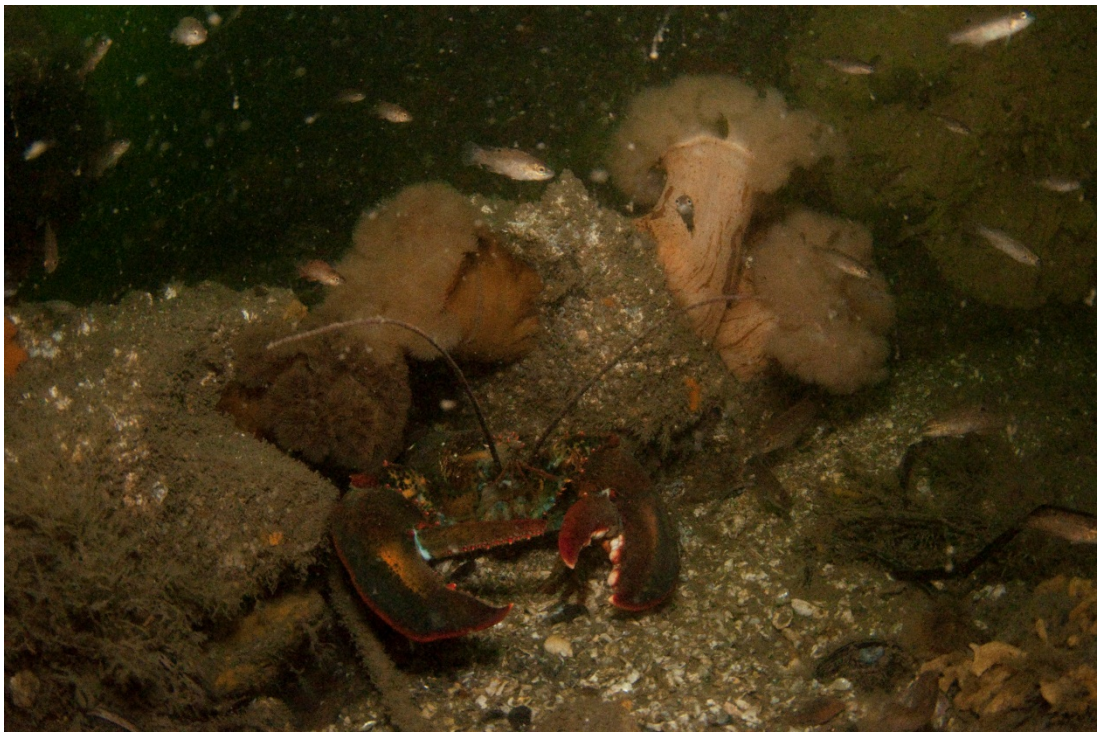
The vertical surface of the sheet pile of the Breasting Platform is covered almost in its entirety with a dense community of sessile organisms. The lower intertidal section is colonized almost exclusively by the common barnacle, *B. balanoides*. The shallow subtidal to mid-subtidal level fauna includes the aforementioned frilled anemones, encrusting sponge, *Haliclona panicea*, the orange-sheathed tunicate, *B. violaceus*, and "pancake batter" tunicate, *Didemnum* sp., and an abundance of the sea vase, *Ciona intestinalis*, particularly on the eastern face, some occasionally seen nearly covered by *Didemnum* sp.; in certain sections, the community consists nearly exclusively of tunicates. The lower subtidal epibenthic community on the vertical surfaces continues to be dominated by tunicates and includes the common sea star, *Asterias* spp., blood sea star, *Henricia* sp., Northern sea cucumbers, *Cucumaria frondosa*, and the green sea urchin, *Strongylocentrotus droebachiensis*.

The North Dolphin partially collapsed in April 2011 apparently due to the failure of the sheet pile supporting structure on its western face. The video recordings of the dolphin of May 2012 show a large opening on the seaward side that has allowed some of the stone material used to fill the cell to spread out across the seabed; some of stone fill remains within the ruptured cell and varies in size from large to small rocks. Other debris is found around the cell including pieces and slabs of concrete, metal beams and pipes, and timbers. The substrate surrounding the North Dolphin is similar to that surrounding the Breasting Platform and appears to support a similar community. As around the Breasting Platform, the substrate softens along the eastern and southern sides of the cell and this softer sediment supports a dense population of burrowing cerianthid anemones, *B. stella* and *C. borealis*, in some cases resembling a meadow. The remaining, essentially intact vertical surfaces of the sheet pile are covered by a dense community of sessile organisms similar to those found on the Breasting Platform. Certain sections of the sheet pile where buckling appears to have occurred during the failure of the western face are bare as a result of large sheets of the community having become detached; patches of the dense community, consisting primarily of tunicates, are occasionally seen resting on the bottom.

Photo 3. School of Atlantic pollock adjacent to pilings and pier wall

(Source: Stephen Karpiak)

Photo 4. Debris adjacent to wall providing complex, hard habitat



(Source: Stephen Karpiak)

The South Dolphin remains standing although a considerable amount of debris surrounds the cell. Similar to the Breasting Platform, this debris consists of concrete and steel bars, steel beams, pipes and wooden timbers and pilings. The seabed substrate and benthic community surrounding the area adjacent to the cell is similar to that surrounding the Breasting Platform and North Dolphin. The sessile community on the vertical surface of the sheet pile is the same as that found on the vertical surface of the Breasting Platform and North Dolphin, that is, one dominated by tunicates over most of the subtidal area with sea stars, sea urchins and spider crabs found in the lower subtidal levels close to the bottom.

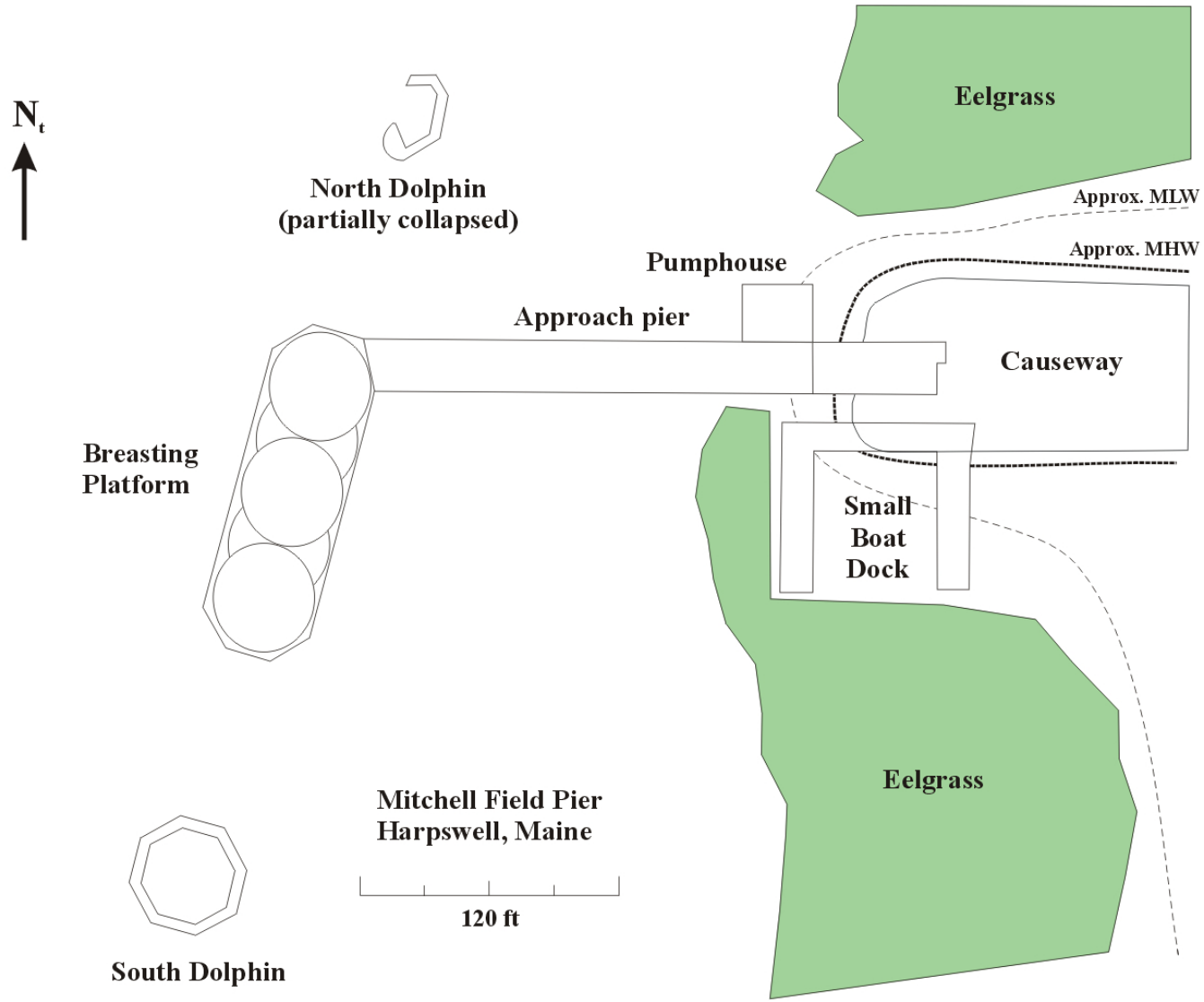
Although not part of the current project, a survey and delineation of the eelgrass, *Zostera marina*, meadows that exist on either side of the causeway leading to the Approach Pier was performed on July 27, 2011 as part of the habitat assessment conducted for the proposed boat launch facility at Mitchell Field (see Figure 2). South of the causeway the eelgrass meadow forms a band between 140 feet to 165 feet wide, narrowing to approximately 28 feet adjacent to the western wall of the boat slip. North of the causeway the meadow is approximately 190 to 210 feet wide. The seabed in this area is coarser and the meadow is interrupted by areas of exposed bedrock (ledge); an interruption of the meadow also occurs in the vicinity of the Approach Pier resulting from shading by the pier.

Pier structures options

Several options are available to the Town ranging from rehabilitation of certain pier structures to demolition of all structures. Rehabilitation of all or portions of the pier structures would initially result in the temporary loss of the existing communities associated with the removed or covered structures; however, depending on the amount of rehabilitation undertaken and assuming replacement with similar materials, partial to complete recovery of the communities would be expected over time. Complete removal of all structures down to the existing seabed with off-site disposal of all materials within the cells would result in the permanent loss of the entire vertical intertidal and subtidal habitat currently provided by the structures. Furthermore, to avoid entanglement of fishing gear, all existing steel and concrete debris will likely be removed. Removal of this debris will result in some temporary elevation of turbidity within the general area and disturbance to the substrate and benthic community within the immediate area of the removal. Following removal of the vertical structures and all debris, the seabed would be expected to eventually return to a condition similar to that existing prior to construction, likely a fine to coarse sand and silt substrate.

Another option would involve the removal of the vertical cell structures down to a safe navigational depth of 20 feet at mean low water (MLW). This option would also result in the loss of the existing intertidal and subtidal habitat currently provided by those portions of the structure above -20 feet MLW. Disposal options for the fill material contained within the removed portion of the structure include: 1) off-site disposal; 2) upland disposal; 3) reuse in the construction of the proposed boat launching facility north of the causeway; and 4) creation of an artificial reef at the site. The latter disposal option was developed based on the fact that the area adjacent to the pier is heavily fished for lobsters and the documentation of a large number of lobsters around the pier as seen on the video recordings made in June 2011. This option would seek to preserve the shelter function for lobsters currently provided by the debris along the bottom.

Figure 2. Pier structures and eelgrass, *Zostera marina*, delineation



During construction of the Mitchell Field pier an area approximately 455 feet by 100 feet was dredged down to bedrock. Reuse of fill material for the construction of the boat launching facility would dispose of approximately 33% of the material estimated to be contained in the structures to be removed. The remaining 66% of the fill material would be placed adjacent to the remaining portions of the structures. Assuming a 3:1 slope, a stone artificial reef would be created extending approximately 455 feet long by 105 feet wide with a height equivalent to the height of the remaining structure above the seabed. The footprint of the artificial reef would be very similar in area to that of the area dredged during construction of the pier facility in the 1950's. If none of the fill material were used in the construction of the boat launching facility and all of the fill material were to be placed adjacent to the remaining structures at a 3:1 slope, the resulting artificial reef would cover an area approximately 455 feet in length by 160 feet wide; height of the artificial reef would again be that of the remaining structure above the seabed; the resulting footprint would be greater than that of the original dredge disturbance.

In either case, the existing vertical surface habitat would be lost, but would likely be largely compensated for, perhaps even exceeded, by the hard surface habitat area provided by the created artificial reef. Creation of the artificial reef would constitute a substitution of hard, complex, 3-dimensional habitat affording a large amount of interstitial spaces of varying sizes for a softer substrate with less complexity, similar to the softer substrates currently existing around the structures.

Regardless of the option selected by the Town for the complete or partial rehabilitation or disposal of the Mitchell Field pier, some additional work may be required. If the option to create an artificial reef is selected, additional work will likely be required to: 1) further characterize the existing habitat values and functions that would be lost as a result of placement of fill materials over the existing substrate; and 2) to project the values and functions that would be provided by the newly created habitat. This additional work would involve video recording of transects set perpendicular to the existing pier structures and extending at least several feet beyond the anticipated footprint of any disturbance to or coverage of the substrate. Sampling of the substrate may be required for analysis of the biological community within the substrate. An Essential Fish Habitat (EFH) analysis will also be required.

Furthermore, regardless of the disposition of fill material, partial or complete removal of the structures will result in the loss of the wave attenuation function presently provided by the pier structures thereby exposing the area to greater wave action. Complete or partial removal of the pier structures, as well as the creation of an artificial reef, will also undoubtedly result in changes in hydrodynamics within the area that will likely cause changes to the existing intertidal and subtidal habitats.

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APPENDIX B- Regulatory Agency Contacts