

# Government Wharf Condition Assessment

Town of Kittery, ME

June 1, 2017



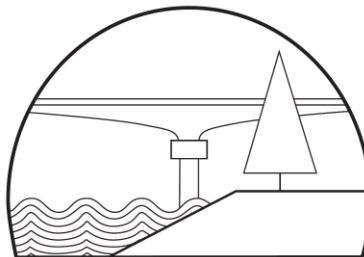
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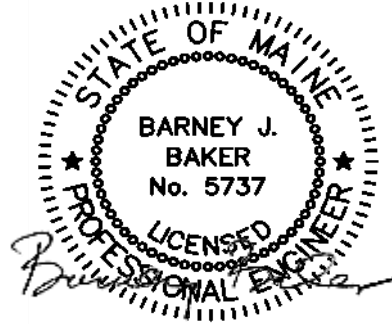
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**Table of Contents**

**Executive Summary ..... 1**

**1. Introduction/Overview.....2**

**2. Site Location and Exposure ..... 3**

**3. Pier Condition Review ..... 5**

**4. Condition Photographs ..... 9**

**5. Load Rating ..... 24**

**6. Conclusions & Recommendations.....26**

**7. Next Steps ..... 27**

**APPENDIX A- Drawings ..... 31**

**List of Tables**

Table 1 – Project Elevations by Datum ..... 3

Table 2 – Summary Condition Assessment of Government Wharf Pier ..... 5

Table 3 – Results of Load Rating Analysis ..... 25

Table 4 – Short-Term Repair Recommendation ..... 26

Table 5 – Preliminary Opinion of Cost for Budgeting..... 26

**List of Figures**

Figure 1 – View of Topside of Pier ..... 2

Figure 2 – View of East Side of Pier..... 2

Figure 3 – Section of Kittery Tax Map 4 (2016 Revision) ..... 4

Figure 4 – Pier Location (Section of NOAA Chart 13283-Portsmouth Harbor)..... 4

Figure 5 – 2017 FEMA FIRM Section ..... 4

Figure 6 – View of Pier from Town Landing Road ..... 9

Figure 7 – Overview of Pier Topside ..... 9

Figure 8 – East Side of Pier ..... 10

Figure 9 – West side of pier ..... 10

Figure 10 – View of bulkhead, pile supports, and bracing (Lines 4 & 5) ..... 11

Figure 11 – Stone faced bulkhead. Note: water seepage beneath bulkhead ..... 11

Figure 12 – Typical Condition of Decking ..... 12

Figure 13 – Decking in poor condition near pavement interface ..... 12

Figure 14 – Pier Stringers (Note: more algae growth and visible rot on older stringers) ..... 13

Figure 15 – Pier Stringers (Note: more algae growth and visible rot on older stringers) ..... 13

Figure 16 – Typical Condition of Stringers..... 14

Figure 17 – West end of bents 4 & 5. Note: significant deterioration of pile caps 4 & 5..... 14

Figure 18 – Significant deterioration of stringer near Line 5 ..... 15

Figure 19 – Failure of stringer at Line 5 ..... 15

Figure 20 – View of Bent 3 in very poor condition (believed to be abandoned) ..... 16

Figure 21 – West end of Bent 4. Note: Split in pile cap, striations in end pile ..... 16

Figure 22 – West end of Bent 5 Pile Cap. Note: Near complete failure of pile cap, significant rot in pile ..... 17

Figure 23 – Typical Pile and Bracing ..... 17

Figure 24 – End pile on Bent 4. Note: More severe deterioration..... 18

Figure 25 – End pile on Bent 4. Note: more severe deterioration ..... 18

Figure 26 – Bent 5 pile cap supported on rock bulkhead..... 19

Figure 27 – Typical Railing and Curb on East side of pier ..... 19

Figure 28 – Fender Pile at working face showing moderate rot ..... 20

Figure 29 – Fender Pile at working face showing severe rot and connection failure..... 20

Figure 30 – Fender Pile Deterioration, view from water side ..... 21

Figure 31 – View of Pier framing from water side, note: multiple generations of closely spaced stringers..... 21

Figure 32 – View of Pier framing on east edge. Note: outer stringer lifted due to hoist tension anchor..... 22

Figure 33 – Typical railing post connection with single timber bolt. .... 22

Figure 34 – Hoist located at southeast corner of pier ..... 23

Figure 35 – Underside of southeast corner of pier, note: hoist only fastened to decking..... 23

Figure 36 - AASHTO H-20 Truck..... 24

## Executive Summary

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In May 2017, Baker Design Consultants (BDC) was retained by the Town of Kittery to perform a condition assessment of Government Wharf on Town Landing Road in Kittery. The pier is used by commercial fisherman and was last inspected by Waterfront Engineers in 2007. At that time, the pier was estimated to have a remaining service life of 10 years. It has now been 10 years since the last inspection.

An inspection was performed by BDC to complete the following tasks.

- Document the current condition of the pier.
- Determine critical repair needs to keep the pier functioning.
- Provide an assessment of the remaining service life of the pier.
- Recommend a timeline for further inspection/repair or replacement of the structure.

Based on field observations and follow-up calculations to evaluate load capacity, there are several critical condition issues that make the pier unable to handle loading normally associated with commercial pier use. Until remedial action is taken to address these deficiencies, the pier must be 'posted' to reflect the reduced structural capacity of the structure.

**The pier should be posted immediately with signage limiting uniform live load to 100 psf and maximum vehicle size to 3.5 tons.** For reference, a 3.5-ton vehicle is roughly equivalent to a ½ ton pickup truck.

Critical deficiencies are noted below, described in more detail in the report and depicted in the appended plans.

1. Severe deterioration of pile caps in Lines 4 & 5
2. Missing shims between stringers/pile caps, and pile caps/piles in many locations that compromise member bearing conditions
3. (1) support pile in very poor condition
4. At least (6) fender piles in moderate to very poor condition
5. Poor anchorage for hoist to pier connection
6. Presence of "dead wood" beneath pier that will accelerate deterioration

In addition, several non-structural, code-compliance issues were observed that were not addressed after the 2007 inspection:

1. Existing ladder is not OSHA compliant and should be replaced.
2. Curbs on east and west sides are not OSHA compliant (7" curb height does not satisfy OSHA minimum height for vehicle curbs of 10")
3. Connection of railing posts to pier is questionable and may not satisfy OSHA loading requirements for handrails (50 plf uniform load or 200-lb point load)

Notwithstanding the critical issues and code noncompliance noted above, the pier structure condition is generally only in fair to serviceable condition due to the age of the structure. Even with the noted deficiencies corrected, the pier will only be serviceable for an estimated 5-10 years and will still need to be load rated.

Because of the short remaining service life of the pier, it is recommended that repairs also be short-term rather than long-term fixes. Notwithstanding this approach, it is likely that a repair program will cost in the range \$63,000 as noted in Table 5.

A replacement pier is estimated to cost in the range of \$300k to \$350k. Because of the timeframe needed for design, regulatory permitting, grant funding applications, and construction it is advised that this process begin as soon as possible.

## 1. Introduction/Overview

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In May 2017, Baker Design Consultants (BDC) was retained by the Town of Kittery to perform a condition assessment of Government Wharf, an existing municipal fishing pier located on Town Landing Road in Kittery. The pier was previously inspected by Duncan Mellor of Waterfront Engineers in 2007<sup>1</sup>. A list of recommended actions was provided in that report, and a remaining service life of 10 years was estimated. It has now been 10 years since the last inspection.

The inspection and analysis performed by BDC are intended to document the existing condition of the pier, determine any repair needs, assess the remaining service life, and establish a recommended timeline for further inspection/repair or replacement of the structure.

The existing pier is depicted in Figure 1 and Figure 2 below. The pier consists of a pile-supported timber structure approximately 32' wide x 36' long located directly seaward of a stone bulkhead abutment that makes up Town Landing Road. The timber pier is supported on a series of timber pile bents consisting of (6) or (7) piles and a timber pile cap. Four (4) pile bents currently exist, although one is an older bent that was abandoned in place. Piles are braced in both directions with timber diagonal bracing. Pier framing consists of 12x12 pile caps, 6x12 stringers, and 3x12 decking. Curbs and handrails are installed along the east and west faces of the pier. The working face of the pier (south) has a 12" vehicle curb, and no railings. There is a steel mast-and-spar style hoist mounted on the southeast corner of the pier which has a 1,000-lb capacity winch and a maximum reach of 17'.

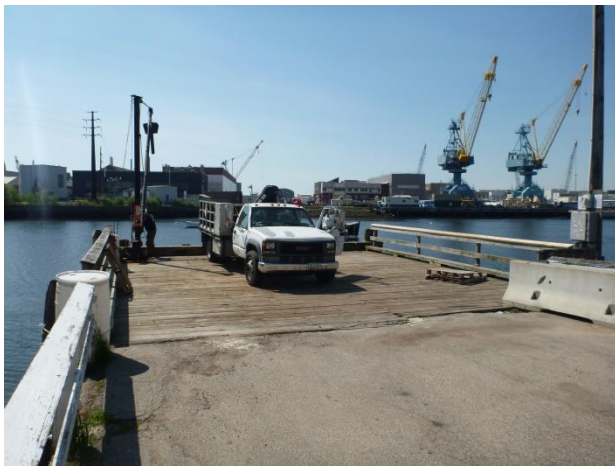


Figure 1 – View of Topside of Pier



Figure 2 – View of East Side of Pier

The following sections review site location and exposure conditions, observations from the field inspection, and results of a load rating analysis for the pier. Finally, critical repair issues are identified and recommended remedial actions are described.

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<sup>1</sup> Reference: "Inspections at Town Piers, Kittery & Kittery Point, Maine" by Waterfront Engineers, LLC, dated Jan. 21, 2008.

## 2. Site Location and Exposure

The existing pier is located at the end of Town Landing Road (presumably within the Town's Right-of-way), on the Kittery Shorefront. Refer to the section of Kittery Tax Map 4 provided as Figure 3, and the Nautical Chart section provided as Figure 4. The site is located across from Seavey Island and benefits from limited fetch and exposure due to its protected location. This is consistent with the FEMA mapping, base flood and zone designations for the site.

Site tidal elevations are listed in Table 1 below in Chart (MLLW = 0) and NAVD88 datum based on published data available from NOAA, Maine DEP, and FEMA. Based on the current (1986) FEMA map, the site is located in an A2 Zone with a 100-year flood elevation (BFE) = 9.8' (NAVD88). The 'preliminary' (2017) map which is pending approval, shows the site in an AE Zone with BFE = 10.0' (NAVD88). A section of the 2017 FEMA Map is provided in Figure 5.

The elevation of the existing pier has not been established by survey. Based on Maine GIS 2-ft contour data for Kittery, the pier deck elevation appears to be located at approximately 7' NAVD88, which is consistent with the location of high water staining on the support piles approximately 3' below the pier deck. This elevation is fairly low, and the pier can be expected to be overtopped during significant storm events, which is consistent with the limits of Special Flood Hazard Area identified by FEMA.

**Table 1 – Project Elevations by Datum**

ELEVATION		CHART	NAVD88	Notes
		(ft)	(ft)	
FEMA BFE		14.6	10.0	PRELIM (2017) ZONE AE (SITE IS ALSO MAPPED WITHIN REGULATORY FLOODWAY)
FEMA BFE		14.4	9.8	EFFECTIVE (1986) ZONE A2
Stillwater Elevations	0.2% Annual Chance	14.4	9.8	PRELIM (2017) FEMA FIS
	1% Annual Chance	13.8	9.2	
	2% Annual Chance	13.4	8.8	
	10% Annual Chance	12.8	8.2	
Highest Annual Tide		10.5	5.9	2016 MEDEP Predictions
MHHW		8.84	4.22	BASED ON TIDAL BM "SEAVEY ISLAND"
MHW		8.43	3.81	
NAVD88		4.62	0.00	
MLW		0.32	-4.30	
MLLW		0.00	-4.62	

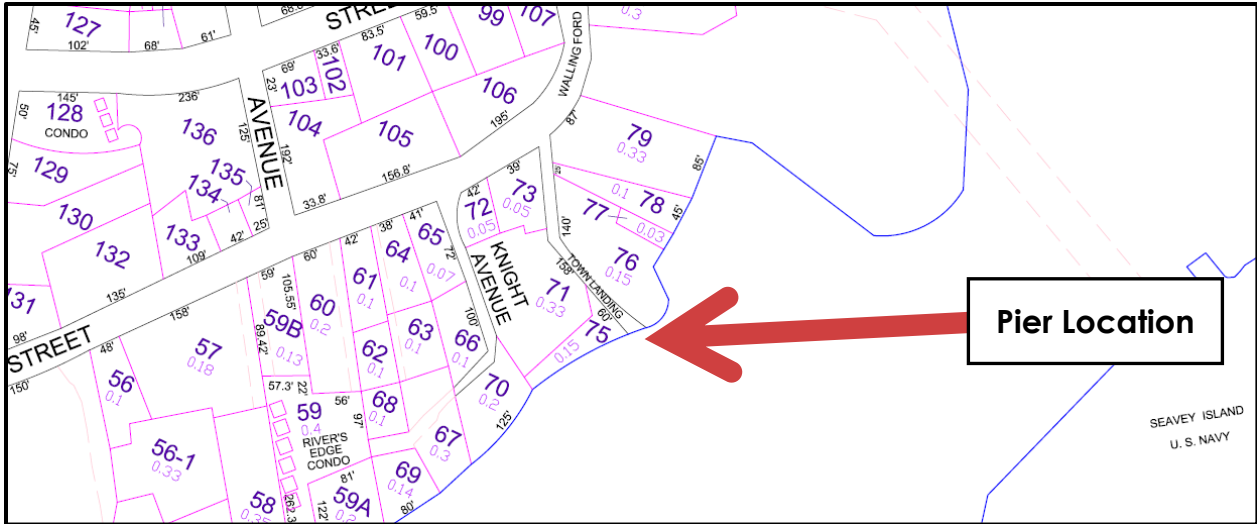


Figure 3 – Section of Kittery Tax Map 4 (2016 Revision)

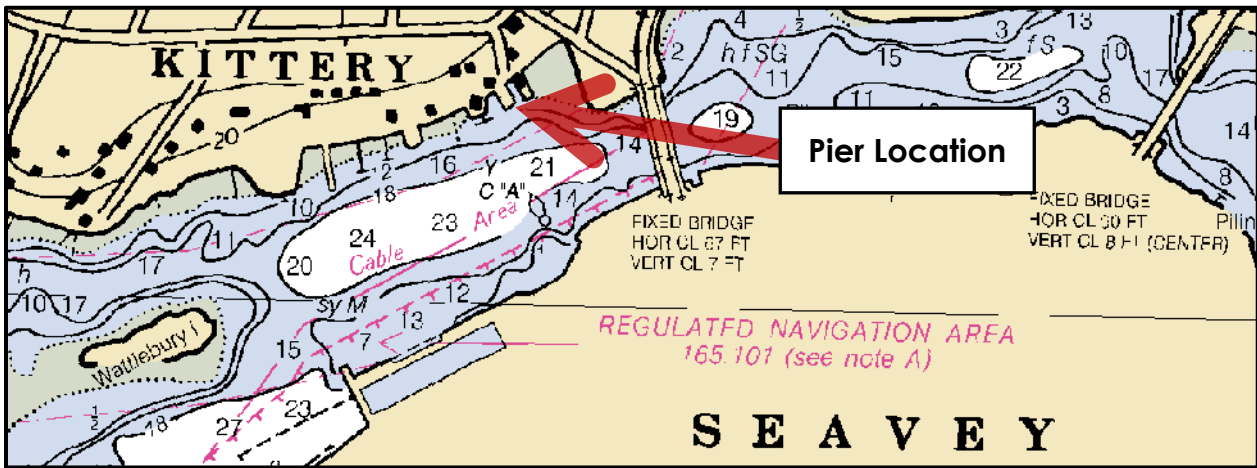


Figure 4 – Pier Location (Section of NOAA Chart 13283-Portsmouth Harbor)

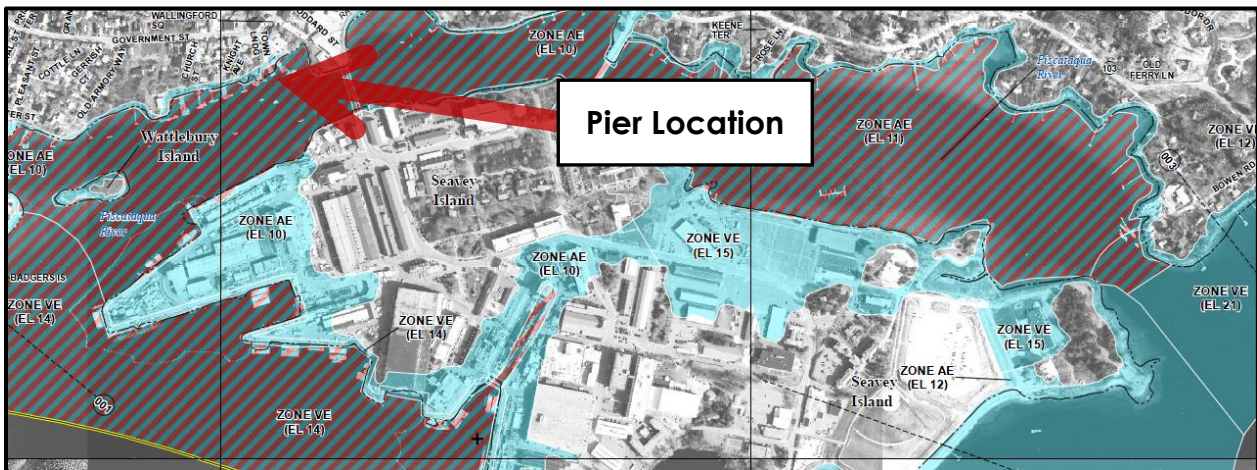


Figure 5 – 2017 FEMA FIRM Section



### 3. Pier Condition Review

An inspection of the pier was completed by Baker Design Consultants on May 18, 2017 from 0830 to 1230 at half- to low-tide (Low tide of +0.8 ft @ 1120). The inspection involved the following tasks:

- Visual inspection of the entire pier superstructure and substructure
- Measurement of pier dimensions, framing layout, pile locations, and section sizes for all primary structural members.
- Non-destructive physical evaluation of condition by probing/prodding of timber elements to assess location and depth of rot, and measurement to assess section loss in deteriorated areas
- The pier was thoroughly photographed to document overall condition configuration of all superstructure and substructure elements as well as any specific areas of concern.
- Underwater videos were taken around piles located beyond the low-water line to record the condition of the piles in the subtidal range.

The size, layout, and condition of the primary structural elements are described in Table 2 based on observations made during the May 2017 field inspection. Specific issues identified during the field survey are also identified in the table. Reference should also be made to Section 4 which provides photographs that demonstrate pier condition and configuration.

**Table 2 – Summary Condition Assessment of Government Wharf Pier**

Element	Size, Material, Orientation, Spacing	May 2017 Condition
DECKING	3 X 12 Incised lumber  Species, treatment level/ type and lumber grade unknown	<p><b>General Condition Summary:</b></p> <p>The existing decking consists of incised 3x12 lumber sections. The decking is generally in worn but serviceable condition. A review of record inspection information (2008 inspection report by Waterfront Engineers) suggests that the decking in place today was installed sometime after that inspection, and is therefore 10 years or less old. Signs of wear observed during the inspection include discoloration, splitting, checking, and occasional loose nailed connections. More heavily worn sections were observed near the transition from the paved upland approach to the timber pier. Accelerated deterioration of these sections is believed to be caused by surface water runoff from the adjacent roadway. In general, the decking condition is consistent with its age, and can be considered serviceable.</p> <p><b>Issues Noted:</b></p> <p>The hoist that is located at the southeast corner of the pier is fastened to the decking by (4) through bolts. This connection does not appear to be suitable and strengthening is recommended.</p>

STRINGERS	<p>6 X 12 FS</p> <p>Incised</p> <p>Species, treatment level/type and lumber grade unknown</p> <p>Spacing varies: 31.5"+/- typ.</p>	<p><b>General Condition Summary:</b></p> <p>Two generations of stringers are present under the pier in many locations.</p> <p>Older stringers are in very poor condition and in some cases have failed or are deteriorated to the point no longer providing any load capacity to the structure. At the 2007 inspection it was recommended that dead wood (including old, un-utilized timber) be removed from beneath the pier to minimize the potential for additional rot due to water accumulation. This does not appear to have been completed, and is still recommended.</p> <p>Newer stringers appear to be the same that were present at the 2007 inspection. The age of these members is not known. These stringers appear to be generally in fair condition. Most appear to be serviceable without the presence of significant rot or decay that would compromise their integrity. Probing of tops of strings with an awl revealed minimal depth of rot in most areas. Several localized issues were identified in that are described below.</p> <p><b>Issues Noted:</b></p> <p>Stringers extending over Bent 5 show advanced rot at the interface with the filled area behind the pier. This is caused by the presence of freshwater that sits on the stringers from rain and stormwater runoff from the adjacent road.</p> <p>In several areas, shims are missing beneath the stringers and poor bearing conditions exist. Stringers should be shimmed to provide full bearing.</p> <p>At the connection of the hoist tension ties, the stringer appears to be lifting off of the pile cap. This suggests that the stringer is not adequately anchored to resist the necessary uplift force. An improved anchor should be incorporated into the design.</p>
PILE CAPS	<p>12X12 FS</p> <p>Species, treatment level/type and lumber grade unknown</p>	<p><b>General Condition Summary:</b></p> <p>There are multiple generations of pile caps present beneath the pier. It appears that Bent 3 is a remnant from earlier construction that was abandoned in place. There is significant variation in the condition of the pile caps. Condition of each element is summarized below:</p> <ul style="list-style-type: none"> <li>• Line 1 (furthest seaward) – Fair to good condition, no structural concerns. Note that a pile that was identified as missing at the 2007 survey has since been replaced.</li> <li>• Line 2 – Fair to good condition. Gap between pile and pile cap at west end results in no bearing and potential overstressing of pile cap.</li> <li>• Line 3/3A – Very poor/failing condition. This bent is believed to have been abandoned in place and is not currently used. Removal is recommended.</li> <li>• Line 4 – Very poor condition. Pile cap is split vertically down the center starting at the west end and extending a portion of its length. Repair or replacement is necessary. Missing shims between piles and pile cap.</li> <li>• Line 5 (at bulkhead) – Very poor condition. Significant split is visible at west end extending through full depth of pile cap. Timber shows rot along its length at bulkhead connection. Potential for more deterioration in areas not able to be observed. Repair or replacement is necessary.</li> </ul> <p><b>Issues Noted:</b></p> <p>Line 4 and Line 5 pile caps are in a severe state of deterioration and should be repaired immediately to avoid potential failure.</p> <p>In several locations, shims are missing and pile caps do not bear on piles. Shims should be added where missing.</p>

<p style="text-align: center;">PIER SUPPORT PILES</p>	<p style="text-align: center;">12" NOMINAL</p> <p style="text-align: center;">Species and grade unknown, creosote treatment</p>	<p><b>General Condition Summary:</b></p> <p>Multiple generations of support piles exist beneath the pier. Quantities of piles in each bent line are listed below:</p> <ul style="list-style-type: none"> <li>• Line 1 – 7 piles</li> <li>• Line 2 – 7 piles</li> <li>• Line 3/3A – 6 piles (line 3), 2 piles (line 3A)</li> <li>• Line 4 – 6 piles</li> <li>• Line 5 – Bulkhead, 1 pile</li> </ul> <p>The oldest of the piles, which also represent those in the worst condition, are in Bent #3 and #3A. This bent is believed to have been abandoned in place and the piles are no longer used. It is recommended that any existing dead wood beneath the pier be removed.</p> <p>The remaining piles are generally in fair to good serviceable condition, with the exception of issues noted below. There were no noted instances of significant necking/section loss at the mudline. There were several instances of marine borer damage within the tidal range that represented up to ¾" of section loss. Remaining pile sections were generally solid and intact. Some amount of algae/marine growth is visible throughout all pile sections. No major settlement of substructure elements was observed that would be indicative of poor subsurface conditions or inadequate bearing capacity.</p> <p><b>Issues Noted:</b></p> <p>The westernmost pile in Bent 5 is in very poor condition, and has evidence of marine borer damage along its length. This pile also has notable rot at the top of the pile as it is exposed to freshwater from above. This pile should be replaced.</p> <p>In several locations, piles do not have complete bearing on pile caps due to missing shims. Shims should be replaced where missing.</p> <p>Pile capacity is not able to be evaluated due to lack of subsurface information.</p>
<p style="text-align: center;">PILE BRACING</p>	<p style="text-align: center;">3x8 and 3x12</p> <p style="text-align: center;">Species, treatment level/type and lumber grade unknown</p>	<p><b>General Condition Summary:</b></p> <p>Bracing is in fair to good condition. Marine borer damage is visible commonly, but is limited in extent and does not appear to compromise the integrity of the bracing. Connections are generally solid and functional.</p> <p><b>Issues Noted:</b></p> <p>None noted.</p>
<p style="text-align: center;">FENDER PILES</p>	<p style="text-align: center;">12" NOMINAL</p> <p style="text-align: center;">Species, treatment, type and grade unknown</p>	<p><b>General Condition Summary:</b></p> <p>Along the south (berthing) face of the pier, there are 10 fender piles installed. These piles generally appear to be of newer construction than support piles. Fender piles show some wear along their outer faces which can be expected with use. Tops of piles show significant rot and splitting from freshwater exposure.</p> <p><b>Issues Noted:</b></p> <p>6-7 piles show significant rot and splitting at the tops. In the worst cases, deterioration is advanced to the point of compromising the pile to curb connection</p>

<p style="text-align: center;">RAILINGS</p>	<p style="text-align: center;">4x4 posts 2x6 top rail 2x6 mid rail 42" high</p>	<p><b>General Condition Summary:</b></p> <p>Railings are 42" high and include a top rail, mid-height rail, and curb which appears to meet the general geometric criteria for OSHA compliance.</p> <p>Connection of the railing posts to the structure only use 1 bolt which may not adequately support the required 200 lb. top rail load per OSHA standards</p> <p><b>Issues Noted:</b></p> <p>Poor connections should be upgraded</p>
<p style="text-align: center;">CURBS</p>	<p style="text-align: center;">12x12 curb at working face  4x12 on 4x12 blocks on side faces (7" total height)</p>	<p><b>General Condition Summary:</b></p> <p>Curb materials are generally in good serviceable condition. It is believed that the curbs that exist today were installed sometime after the 2007 inspection was completed, and therefore are less than 10 years old. Condition is generally consistent with age with no major deterioration noted.</p> <p><b>Issues Noted:</b></p> <p>Based on OSHA requirements for marine facilities (Section 1917), vehicle curbs installed after October 3, 1983 are required to be at least 10" in height. (curbs installed prior to October 3, 1983 were only required to be 6"). It appears that the existing curbs were installed in the last 10 years, and as such should meet the 10" height requirement. Currently the south curb satisfies the OSHA height requirement, the east and west curbs do not.</p>
<p style="text-align: center;">STONE BULKHEAD</p>	<p style="text-align: center;">Stone varies in size and shape.  Wall has been pointed, unsure if original  Concrete cap</p>	<p><b>General Condition Summary:</b></p> <p>The existing wall construction is largely unknown. The size of stones varies greatly from some very large (~2'+ minimum dimension) to small (~6" minimum dimension). The wall cross section and bearing conditions are not known at this time and would be necessary in order to investigate the wall capacity. Sections of the bulkhead near the west corner are missing grout which suggests either this was never initially installed or has been lost at some point in the past. In general, the existing stone bulkhead appears to be relatively intact with no major signs of distress or failure observed that would indicate poor bearing conditions, instability, or overloading.</p> <p>The concrete cap at the top of the wall is in poor condition with significant cracking, damage, and section loss visible, particularly on the eastern side of the bulkhead</p> <p><b>Issues Noted:</b></p> <p>Water seepage was observed through wall at low tide, suggesting that water is being trapped behind the wall and an effective drainage medium likely does not exist.</p> <p>Concrete cap is failing and should be repaired.</p>

#### 4. Condition Photographs

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Figure 6 – View of Pier from Town Landing Road

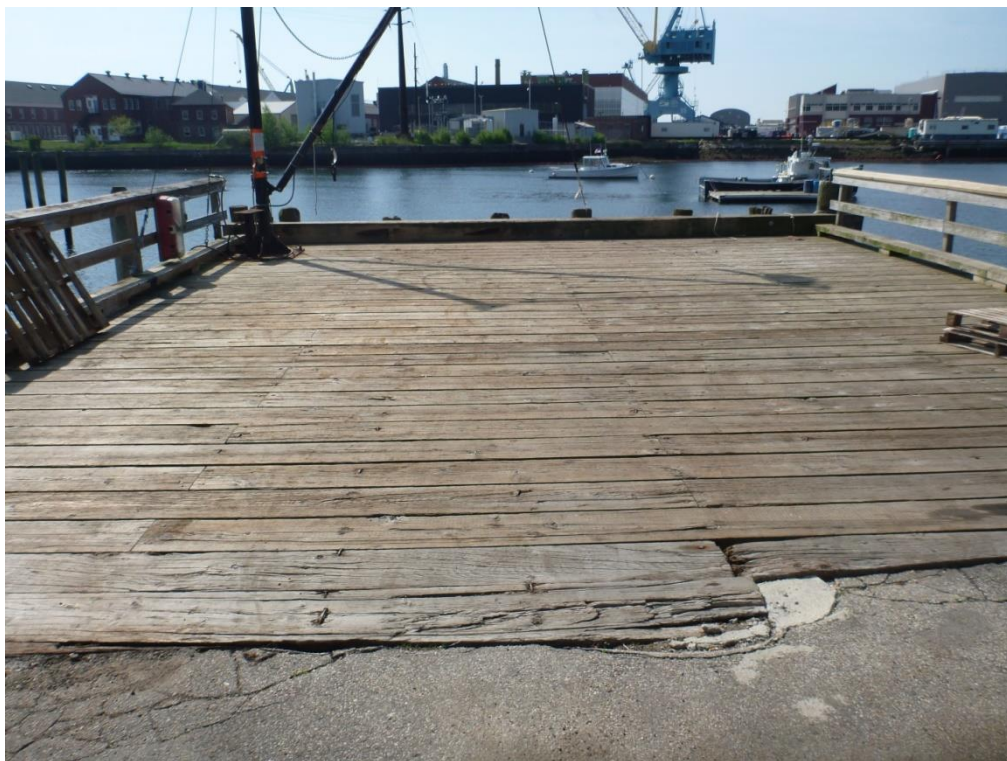


Figure 7 – Overview of Pier Topside



**Figure 8 – East Side of Pier**



**Figure 9 – West side of pier**



Figure 10 – View of bulkhead, pile supports, and bracing (Lines 4 & 5)



Figure 11 – Stone faced bulkhead. Note: water seepage beneath bulkhead



Figure 12 – Typical Condition of Decking

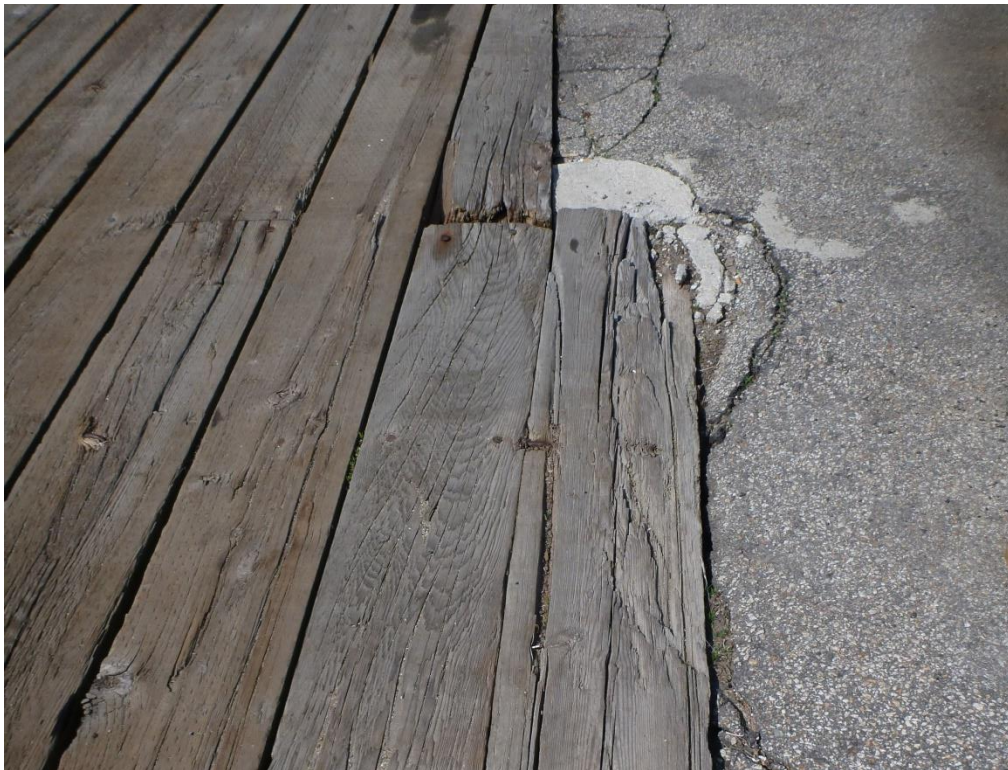


Figure 13 – Decking in poor condition near pavement interface





Figure 14 – Pier Stringers (Note: more algae growth and visible rot on older stringers)



Figure 15 – Pier Stringers (Note: more algae growth and visible rot on older stringers)



Figure 16 – Typical Condition of Stringers



Figure 17 – West end of bents 4 & 5. Note: significant deterioration of pile caps 4 & 5



Figure 18 – Significant deterioration of stringer near Line 5



Figure 19 – Failure of stringer at Line 5



Figure 20 – View of Bent 3 in very poor condition (believed to be abandoned)



Figure 21 – West end of Bent 4. Note: Split in pile cap, striations in end pile



Figure 22 – West end of Bent 5 Pile Cap. Note: Near complete failure of pile cap, significant rot in pile

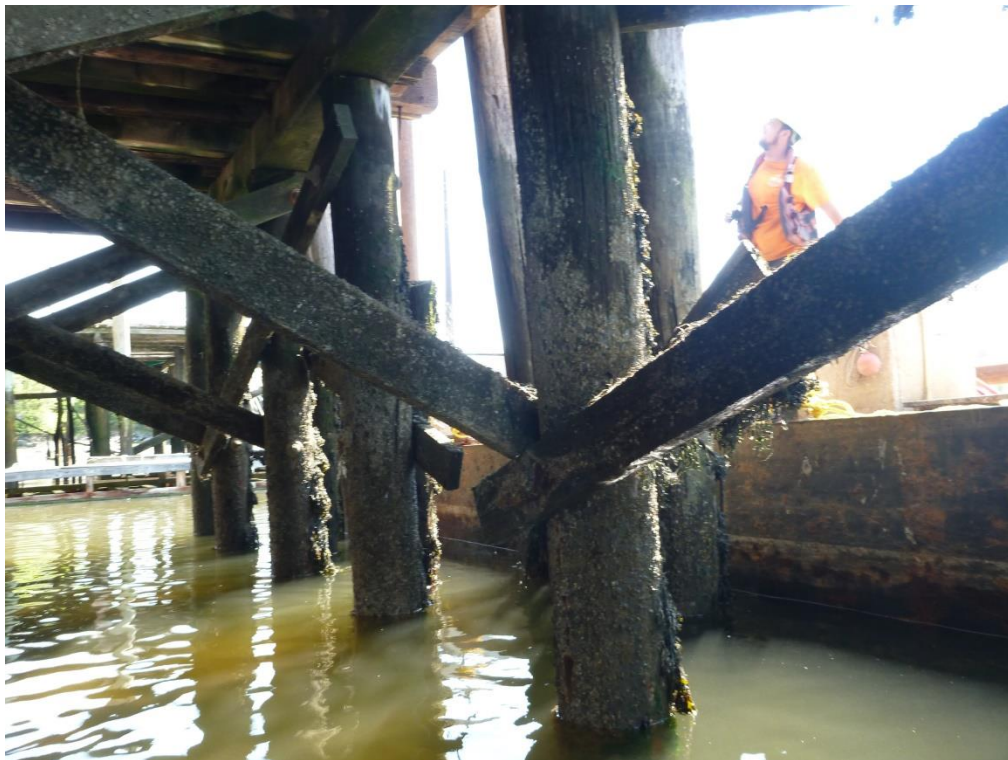


Figure 23 – Typical Pile and Bracing



Figure 24 – End pile on Bent 4. Note: More severe deterioration



Figure 25 – End pile on Bent 4. Note: more severe deterioration



Figure 26 – Bent 5 pile cap supported on rock bulkhead



Figure 27 – Typical Railing and Curb on East side of pier



Figure 28 – Fender Pile at working face showing moderate rot

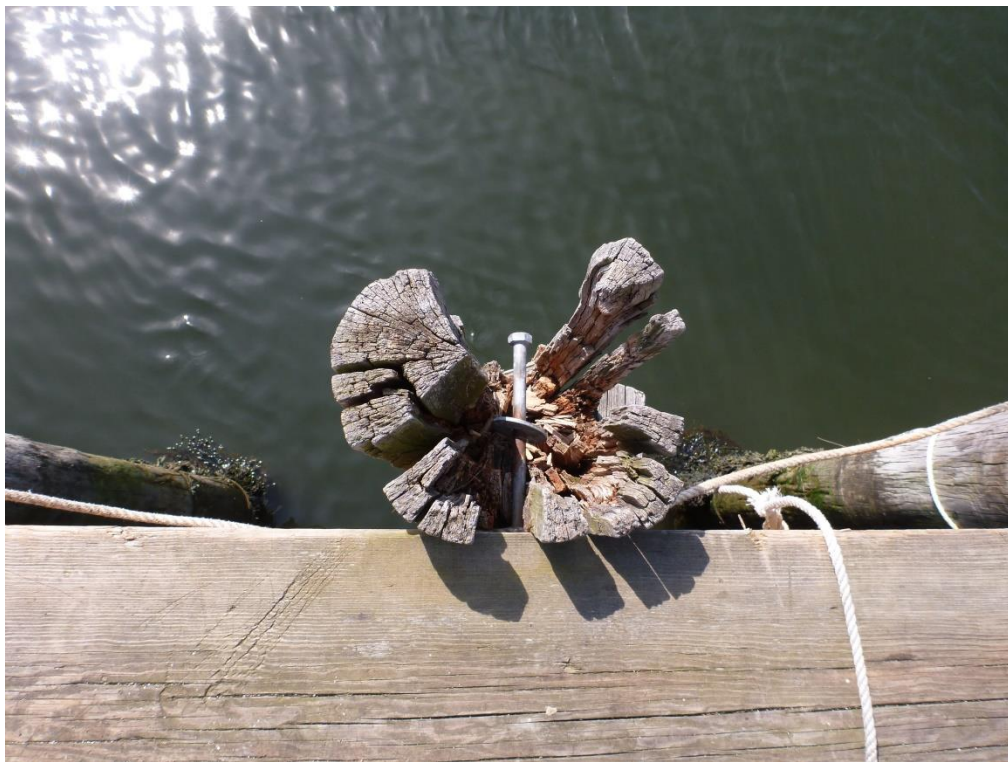


Figure 29 – Fender Pile at working face showing severe rot and connection failure





Figure 30 – Fender Pile Deterioration, view from water side



Figure 31 – View of Pier framing from water side, note: multiple generations of closely spaced stringers



Figure 32 – View of Pier framing on east edge. Note: outer stringer lifted due to hoist tension anchor.



Figure 33 – Typical railing post connection with single timber bolt.



Figure 34 – Hoist located at southeast corner of pier



Figure 35 – Underside of southeast corner of pier, note: hoist only fastened to decking

## 5. Load Rating

An analysis of the pier structure for vertical dead and live load was conducted using Woodworks software. For this analysis, the pier geometry, framing layout, and member sizes were as measured during the field inspection. The species of framing timber is unknown, but for the purpose of this analysis was assumed to be No. 2 Southern Pine. Reductions were made to member capacities to account for the observed level of deterioration as described in Table 3.

Live load cases considered on the pier included evaluation of effects of uniform load on the structure and the vehicle loading based on an AASHTO two axle truck. Three cases were considered for uniform loading

1. Uniform Live Load = 100 psf (pedestrian live loading for public spaces per IBC)
2. Uniform Live Load = 250 psf (uniform live load for areas subject to truck loading per IBC)
3. Maximum allowable live load based on element condition (if cases 1 and/or 2 not met)

Vehicle loading on the pier was considered based on a two-axle AASHTO truck based on an equivalent of the H-20 design vehicle. The AASHTO H-20 design truck (depicted in Figure 36) is a two-axle truck with a total weight of 20-tons (40 kip), with a 20/80 front to rear axle weight ratio. Individual wheel loads are applied over a rectangular area with dimensions 10"x20". If the pier is capable of safely carrying the H-20 vehicle, it can generally remain in service without a need for load posting. If the maximum safe vehicle load is less than an H-20, restrictions on truck loading are necessary to applied loading within safe operating conditions.

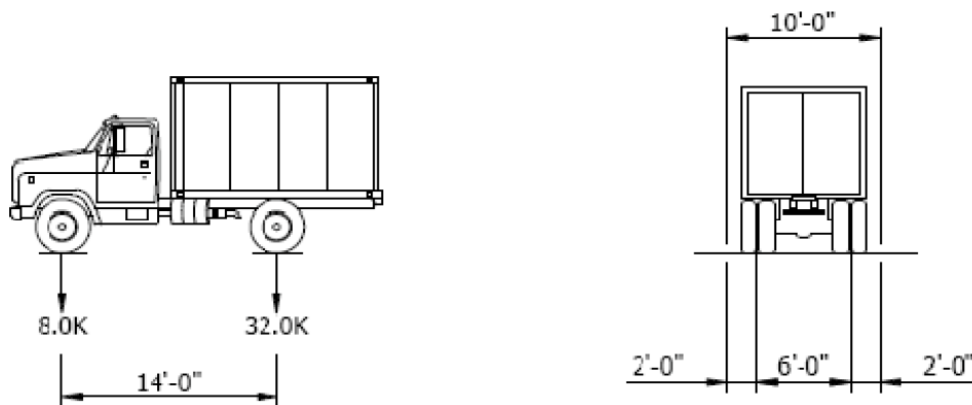


Figure 36 - AASHTO H-20 Truck

The results of the analysis for uniform and truck loading are presented in **Table 3**. In its current state, the pier capacity is considered to be very limited due to the severe condition of the pile caps in Bents 4 and 5. **Due to this, it is recommended that live loading and vehicle loading on the pier be restricted to a maximum uniform live load of 60-psf or a maximum vehicle load of H-3.5 (7,000-lb GVWR) until repairs can be completed. This loading is representative of a ½-ton pickup truck.**

If repairs are completed to the pile caps in Bents 4 and 5, the pier capacity will be controlled by the capacity of the stringers. In their current state of deterioration, the stringers can be considered to safely handle a maximum uniform live load of 125 psf, and a maximum vehicle weight of 14,000lb, or an H-7 vehicle. Because the live loading limits resulting from the analysis

are less than the values required by applicable codes, it is recommended that the pier be posted for limited safe loading, and use be monitored to minimize the possibility for excessive loading on the structure. With consideration for an additional factor of safety to account for the generally deteriorated and haphazard construction, **it is recommended that the pier load rating of maximum uniform live load of 100 psf, or a maximum vehicle load of H-5 (10,000-lb GVWR) be posted after repairs are complete. For reference, a 5-ton vehicle is approximately equivalent to a 1-ton pickup truck.**

If the recommended load limits are considered to be overly limiting to the use of the facility, selected upgrades could be designed to some or the entire pier to increase the safe live load capacity.

**Table 3 – Results of Load Rating Analysis**

Element	Notes/Assumptions	Uniform Load Cases			Vehicle Load Cases	
		Case 1 100 psf LL	Case 2 250 psf LL	Maximum Allowable	H-20 Truck	Maximum Allowable
Deck Boards 3 X 12	<ul style="list-style-type: none"> <li>Assumed No. 2 Southern Pine Lumber</li> <li>80% material capacity remaining</li> </ul>	OK	OK	---	OK	---
Stringers 6 X12 @ 31.5"	<ul style="list-style-type: none"> <li>Assumed No. 2 Southern Pine Lumber</li> <li>60% material capacity remaining</li> </ul>	OK	No Good	125 PSF	No Good	H-7
Pile Caps Lines 1 & 2	<ul style="list-style-type: none"> <li>Assumed No. 2 Southern Pine</li> <li>60% material capacity remaining</li> </ul>	OK	No Good	225 psf	OK	---
Pile Caps Lines 4 & 5	<ul style="list-style-type: none"> <li>Assumed No. 2 Southern Pine</li> <li>30% material capacity remaining</li> </ul>	No Good	No Good	60 psf	No Good	H-3.5
Piles	<ul style="list-style-type: none"> <li>Assumed 75 % material capacity remaining</li> </ul>	OK*	OK*	---	OK*	---

\*Piles were evaluated based on structural capacity only. Geotechnical capacity is unable to be evaluated at this time due to lack of subsurface information.

## 6. Conclusions & Recommendations

This report details the results of a field inspection and load rating analysis of the Government Wharf located on Town Landing Road in the Town of Kittery. Through this work, many issues have been identified that require short-term remediation in order for the pier to keep operating safely. These repair needs are listed in Table 4.

**Table 4 – Short-Term Repair Recommendation**

Category	Recommendations
Structural	<ol style="list-style-type: none"> <li>1. Install signage to post weight limits on pier of 100 psf uniform load or 5 ton truck load</li> <li>2. Install shims in locations where missing beneath stringers and pile caps</li> <li>3. Repair pile caps in lines 4 &amp; 5</li> <li>4. Replace westernmost pile in Bent 5</li> <li>5. Replace deteriorated fender piles at pier face</li> <li>6. Remove dead wood (Grid Line 3 piles, caps, and stringers) beneath pier</li> <li>7. Strengthen hoist connection to decking</li> <li>8. Improve anchorage of hold downs for hoist tension ties</li> </ol>
Code Compliance	<ol style="list-style-type: none"> <li>9. Replace ladder with OSHA Compliant version</li> <li>10. Upgrade curbs on east and west sides to be OSHA Compliant</li> <li>11. Upgrade connection of railing posts to pier and add new railing posts to ensure railings satisfy OSHA loading requirements</li> </ol>

A preliminary opinion of cost for the short-term repair program is provided in Table 5 to support the Town's budgeting for the work. The estimated budget of \$63,000 includes a 25% contingency to account for the preliminary nature of the estimate. This budget can be further refined once the final scope of work for the repair program is determined.

**Table 5 – Preliminary Opinion of Cost for Budgeting**

ITEM NO.	ITEM	No.	Length	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	MOBILIZATION			1	LS	\$ 10,000	\$ 10,000
2	INSTALL MISSING SHIMS			1	LS	\$ 500	\$ 500
3	BENTS #4 & 5 PILE CAP REPAIR	No.	Length				
	NEW TIMBER CAPS	2	40.0	80	LF	\$ 25	\$ 2,000.0
	BRACKETS AND HARDWARE			1	LS	\$ 1,000	\$ 1,000.0
	INSTALLATION			4	DAY	\$ 2,000	\$ 8,000.0
4	BENT #5 SUPPORT PILE REPLACEMENT			1	EA	\$ 3,500	\$ 3,500
5	FENDER PILE REPLACEMENT			7	EA	\$ 2,500	\$ 17,500
6	REMOVE DEAD WOOD BENEATH PIER			2	DAY	\$ 2,000	\$ 4,000
7/8	UPGRADE HOIST CONNECTIONS			1	LS	\$ 2,000	\$ 2,000.0
9	REPLACE TIMBER LADDER			1	LS	\$ 500	\$ 500.0
10/11	HANDRAIL AND CURB UPGRADES	No.	Length				
	ADD HANDRAIL POSTS	6	4.5	27	LF	\$ 2.50	\$ 67.5
	UPGRADE HARDWARE			14	EA	\$ 50	\$ 700.0
	UPGRADE CURBS (ADD 4X12)	2	36.0	72	LF	\$ 7.00	\$ 504.0
	INSTALLATION			1	LS	\$ 500	\$ 500.0
<b>TOTAL CONSTRUCTION COST</b>						<b>Subtotal</b>	<b>\$ 50,772</b>
<b>CONTINGENCY</b>						25%	<b>\$ 12,693</b>
<b>PRELIMINARY OPINION OF COST FOR BUDGETING</b>						<b>TOTAL</b>	<b>\$ 63,000</b>

## 7. Next Steps

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It is recommended that the Town move ahead with the repairs described in Section 6 as soon as possible to allow the pier to remain in service and operate safely. BDC can assist in design and bid solicitation for the repair program by request.

While it is critical that the recommended repairs be completed, given the significant structural and regulatory compliance issues observed, any repairs or maintenance to the structure should be considered short term. The report outlines a series of repairs and upgrades that is intended to keep the pier operational for another 5-10 years. In the meantime it is recommended that the Town begin to plan and budget for replacing the pier within a 5-10 year timeframe.

It is recommended that the Town move toward a full replacement of the pier. A new pier design would consider structural loading requirements, resistance to wind and wave action, code compliance, and functional efficiency. Because the existing subsurface conditions at the pier are unknown, it is recommended that a geotechnical program be completed as part of this work to investigate subsurface conditions both within the existing filled bulkhead and within the area of the pile supported pier. A rough budgetary estimate for the cost of a total pier replacement is \$300,000-\$350,000 depending on the extent of repairs required to the stone bulkhead. An additional budget of approximately \$25,000 is recommended to cover fees for design and permitting of the replacement facility.

This work could be eligible for cost sharing under a State grant program such as the Maine DOT Small Harbor Improvement Program (SHIP), which will provide up to 50% state funding toward the design and construction of the facility. State funding is also available through the Maine Coastal Program Shore and Harbor Management Grant Program, which will provide up to 75% state funding toward planning and design activities related to harbor improvement projects such as the proposed pier replacement. BDC can assist the Town with grant funding applications, design, permitting, and bid solicitation for a replacement pier by request.

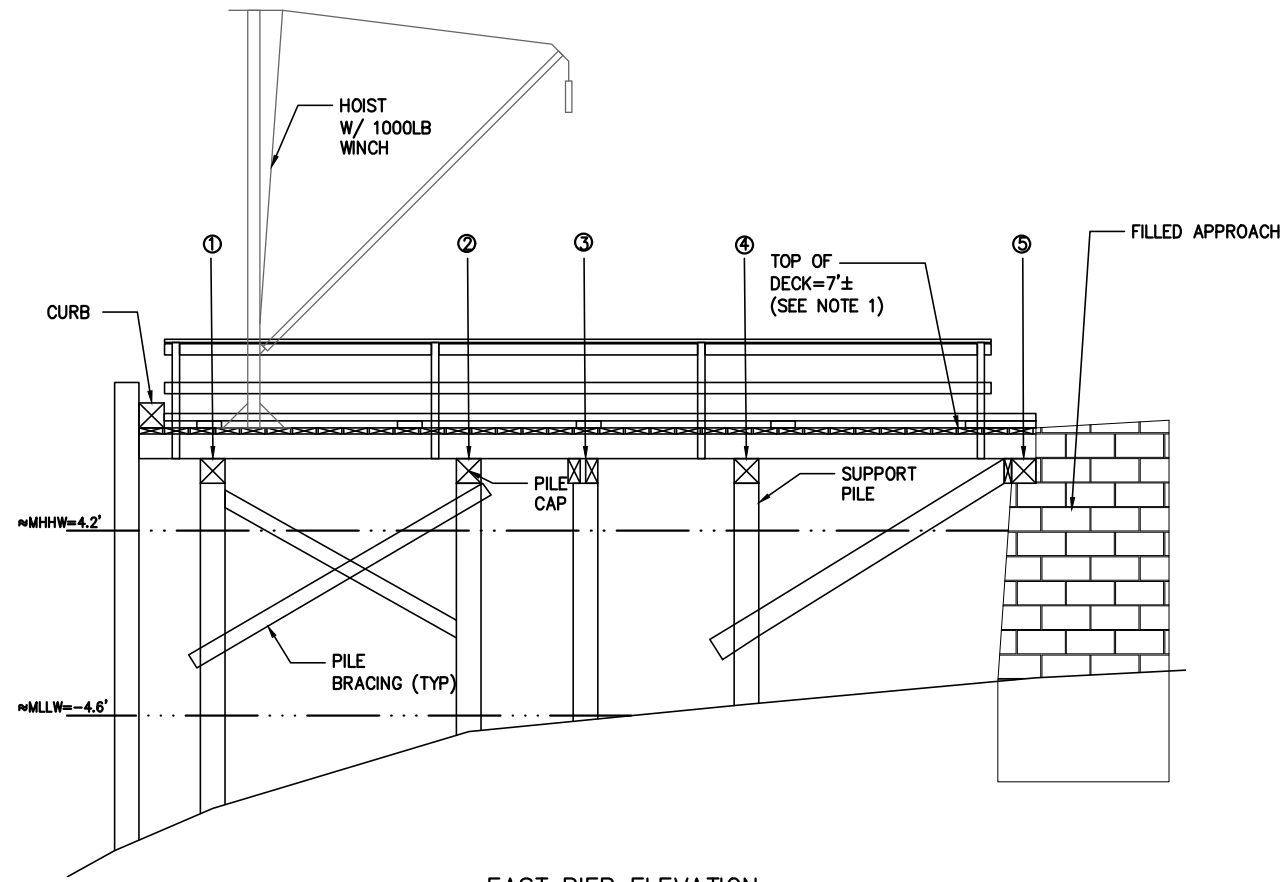
## *APPENDIX A- Drawings*

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- SK-1 General Plan
- SK-2 Pile and Framing Layout
- SK-3 Pier Condition Notes and Recommended Action



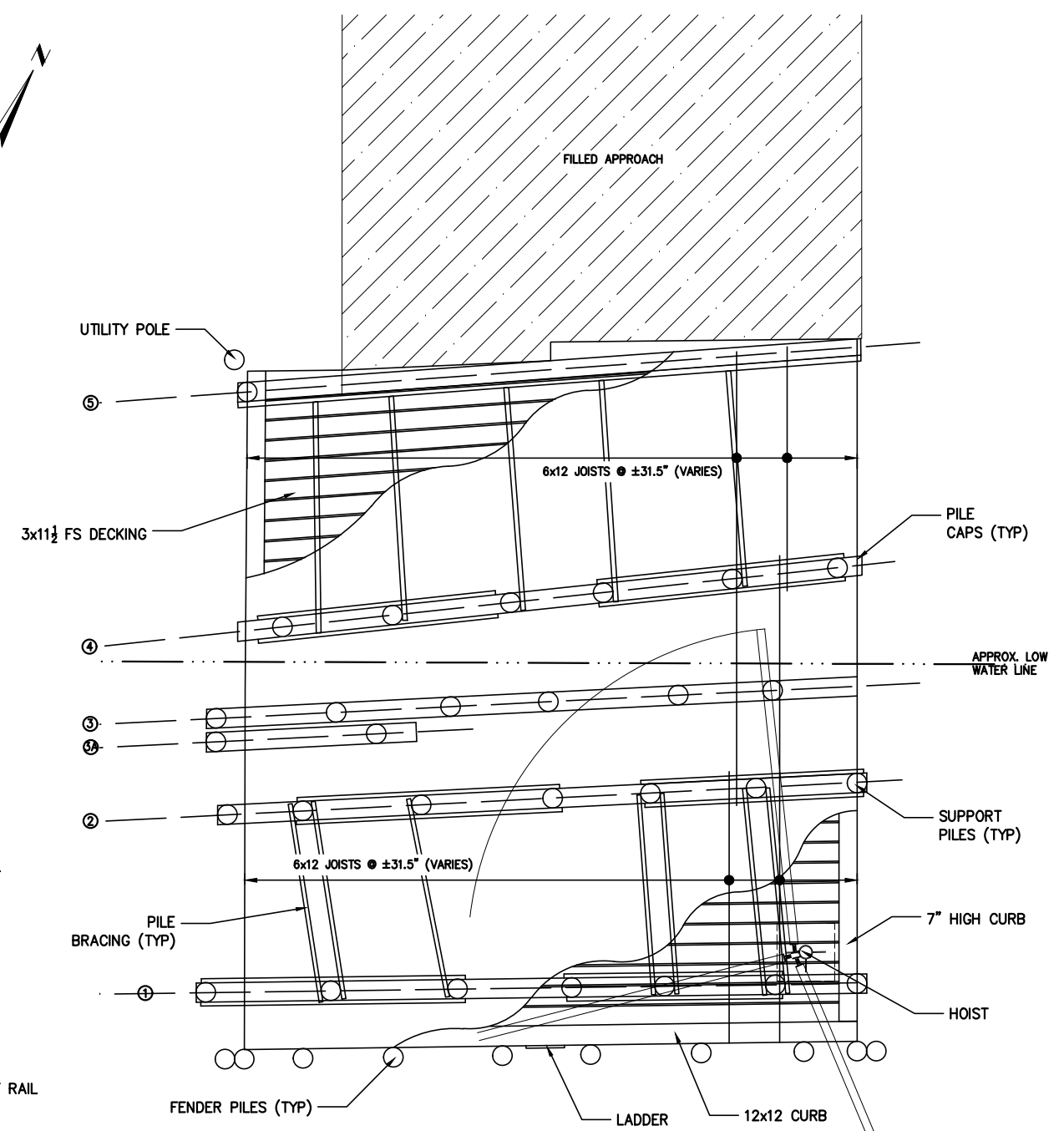
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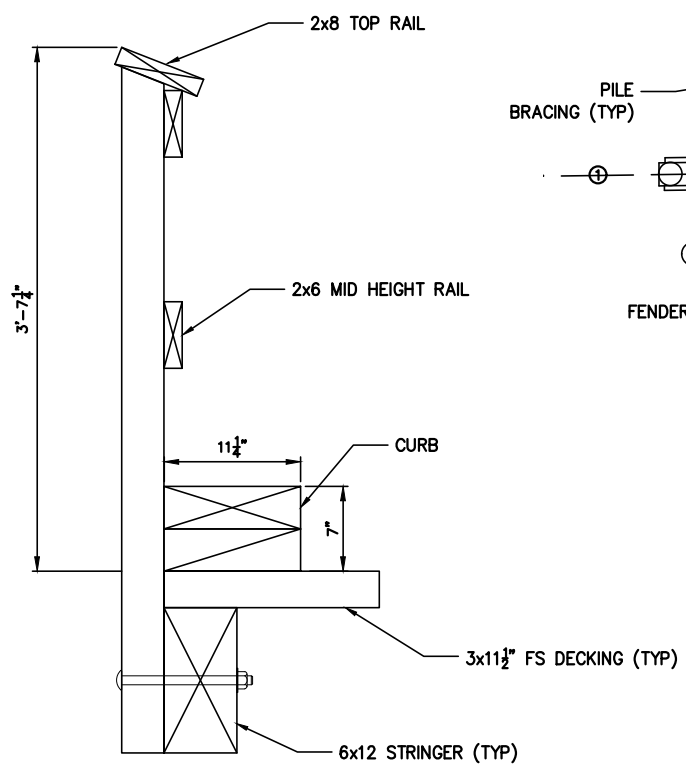
**EAST PIER ELEVATION**  
DRAWING NOT TO SCALE

PROJECT ELEVATIONS (BY DATUM)			
ELEVATION	CHART (ft)	NAVD88 (ft)	NOTES
Base Flood Elevation (Proposed)	14.6	10.0	FEMA 2017 FIRM, ZONE AE
Base Flood Elevation (Existing)	14.4	9.8	FEMA 1986 FIRM, ZONE A2
500-Year Stillwater	14.4	9.8	FEMA 2017 Flood Insurance Study
100-Year Stillwater	13.8	9.2	
50-Year Stillwater	13.4	8.8	
10-Year Stillwater	12.8	8.2	
Highest Annual Tide	10.5	5.9	2016 MEDEP Predictions
MHHW	8.8	4.22	BASED ON NOAA TIDAL BM "SEAVEY ISLAND"
MHW	8.43	3.81	
NAVD88	4.62	0.00	
MLW	0.32	-4.30	
MLLW	0.00	-4.62	

1. BASE FLOOD INFORMATION TAKEN FROM FEMA FLOOD INSURANCE RATE MAP
2. HIGHEST ANNUAL TIDE TAKEN FROM MAINE DEP PUBLISHED PREDICTIONS
3. TIDAL INFORMATION TAKEN FROM NOAA PUBLISHED DATA



**EXISTING PIER PLAN**  
DRAWING NOT TO SCALE



**EXISTING RAILING SECTION**  
DRAWING NOT TO SCALE

**NOTES**

1. TOP OF DECK ELEVATION IS APPROXIMATE BASED ON FIELD OBSERVATIONS, AND HAS NOT BEEN ESTABLISHED BY SURVEY
2. ALL ELEVATIONS ARE TO NAVD88 DATUM UNLESS NOTED OTHERWISE

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Civil, Marine, and Structural Engineering  
7 Spruce Road • Freeport • Maine • 04032 • 207-866-9724 • info@bakerdcs.com

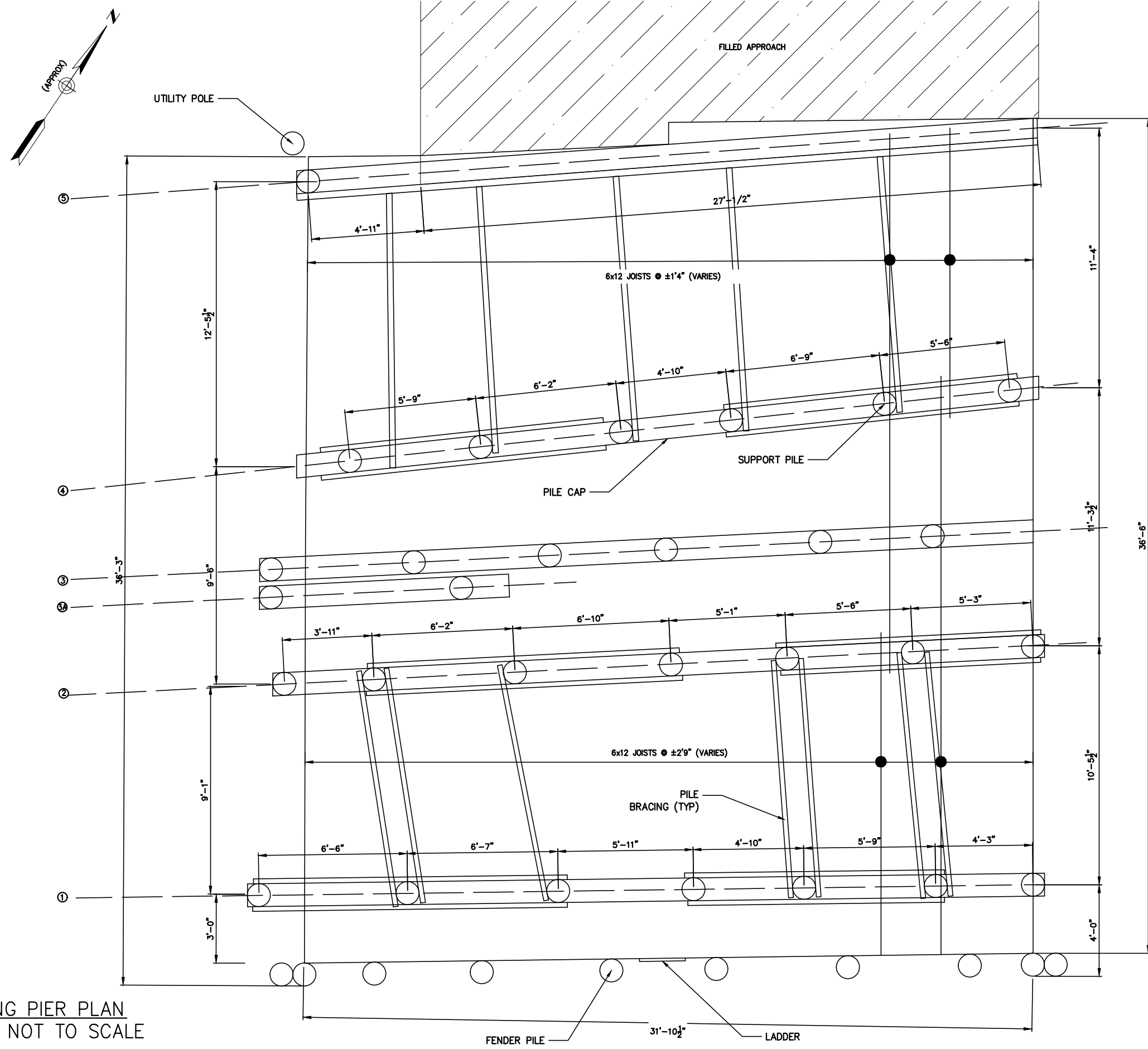
DESIGNED BY:	DJB	GTC	INSPECTION REPORT NO.:	05.31.17	DJB
DRAWN BY:			SUBMISSION DATE:		
CHECKED BY:	DJB & BUB				
SCALE:	AS SHOWN				

SHEET TITLE:  
**GENERAL PLAN**

PROJECT:  
Kittery Port Authority  
**GOVERNMENT WHARF INSPECTION**  
Kittery, Maine

DATE:	MAY 2017
CONTRACT NO.:	17-08
SHEET NO.:	SK-1
REV.:	A

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EXISTING PIER PLAN  
DRAWING NOT TO SCALE

NOTES

1. JOIST SPACING BASED ON AVERAGE MEASUREMENT SPACING OF INTACT, FUNCTIONAL JOISTS AND DOES NOT CONSIDER THE PRESENCE OF OLDER, SISTERED JOISTS, OR OBSOLETE "DEADWOOD". ACTUAL SPACING VARIES

**BAKER DESIGN CONSULTANTS**  
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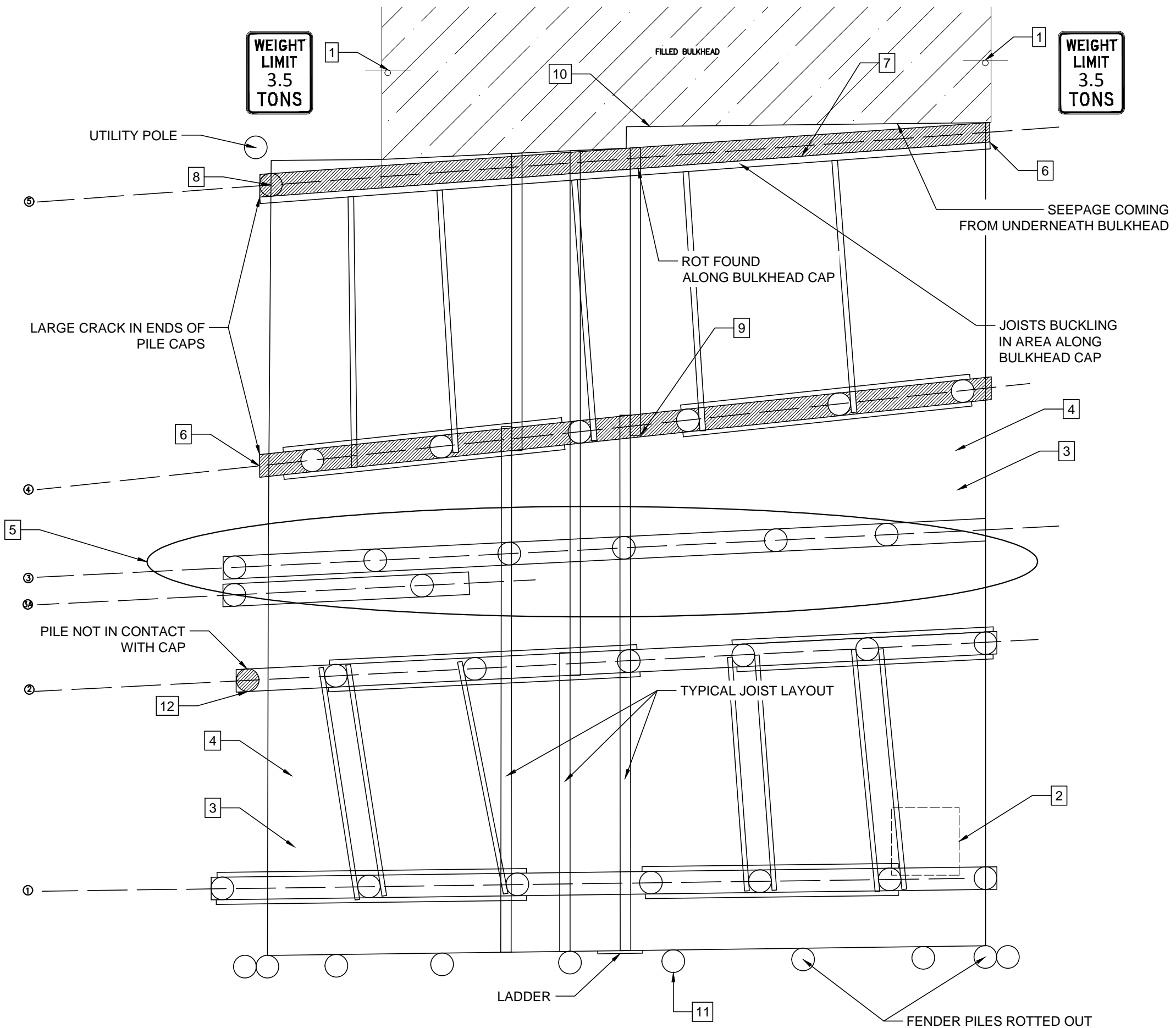
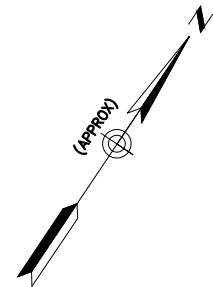
STATE OF MAINE  
BARNEY J. BAKER  
No. 5737  
LICENSED PROFESSIONAL ENGINEER

DESIGNED BY:	DJB
DRAWN BY:	GTC
CHECKED BY:	DJB & BJB
SCALE:	AS SHOWN

SHEET TITLE: **PILE AND FRAMING LAYOUT**  
PROJECT: **GOVERNMENT WHARF INSPECTION**  
Kittery, Maine

DATE:	MAY 2017
CONTRACT NO.:	17-08
SHEET NO.:	SK-2
REV.:	A

NO.	DATE	DESCRIPTION
A	05.31.17	INSPECTION REPORT SUBMISSION
DJB		INT.



**REQUIRED ACTION**

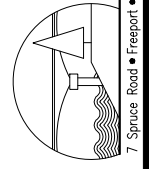
1. INSTALL LOAD RATING SIGNAGE FOR 3.5 TONS
2. STRENGTHEN HOIST BASE CONNECTION AND CABLE ATTACHMENTS
3. UPGRADE RAILING
4. PROVIDE COMPLIANT CURBS TO EAST AND WEST EDGES OF DECK
5. REMOVE GRID LINE 3 AND 3A PILES AND CAPS AND DISPOSE OF OFFSITE
6. REPLACE OR SISTER CAPS ON LINE 4 AND 5
7. CHECK JOIST SUPPORT AT CAP AND SISTER AS REQUIRED
8. REPLACE DETERIORATED PILE AT END OF LINE 5
9. CHECK TOP FACE OF JOISTS AND REPLACE AS NEEDED
10. MONITOR STONE ABUTMENT FOR CRACKS AND FOR SETTLEMENT
11. REPLACE OAK FENDER PILES
12. SHIM ALL PILES WHERE SEPARATION WITH CAP OCCURS

**NOTES**

CONDITION NOTES ARE PER FIELD SURVEY COMPLETED MAY 18, 2017 BY BAKER DESIGN CONSULTANTS

EXISTING PIER PLAN  
NOT DRAWN TO SCALE

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NO.	DATE	DUB	INT.
A	05.31.17		
INSPECTION REPORT SUBMISSION			

DESIGNED BY:	DUB	GTC
DRAWN BY:	DUB & BUB	
CHECKED BY:	DUB & BUB	
SCALE:	AS SHOWN	

SHEET TITLE: <b>PIER CONDITION NOTES AND RECOMMENDED ACTION</b>	
PROJECT: <b>GOVERNMENT WHARF INSPECTION</b>	
Kittery Port Authority Kittery, Maine	
DATE:	MAY 2017
CONTRACT NO.:	17-08
SHEET NO.:	SK-3
REV.:	A