

# TECHNICAL MEMORANDUM

---

TO: Andrea Sweigart  
**EDAW/AECOM**

FROM: Peter Elkan, PE  
**Moffatt & Nichol**

DATE: December 4, 2009

RE: **SITE RECONNAISSANCE AND INVENTORY**

---

This memorandum documents the site reconnaissance and existing conditions assessment in support of the City of Alexandria waterfront planning efforts. The purpose of this investigation was to obtain an initial understanding of the material type, extent and condition of the shoreline treatment (e.g. steel and timber bulkheads, rip-rap, pavement, “natural” vegetation, etc.) and structures (e.g. piers, wharfs, etc.) along the waterfront. The preliminary observations of existing conditions were based on review of existing data and site investigations performed during the week of May 17 – 23, 2009. This reconnaissance-based rating should not be construed as a structural condition assessment, but rather as a preliminary evaluation.

## 1.0 Methods

Representatives from Moffatt & Nichol (M&N) conducted field investigations during the week of May 2009; the City of Alexandria shoreline treatment and structures sited along the waterfront were inventoried and photo documented from land and water. The approximate extent and material composition of shoreline treatment was documented. The treatment was categorized based on the material composition and the type of structure (e.g. steel sheet pile bulkhead, concrete rip-rap, improvised revetment, natural beach). For each structure, the approximate length, free height and water at the edge of the structure were recorded; for rip-rap slopes, the approximate median diameter of armor stone was noted.

A cursory inspection of each accessible structure was made in order to qualitatively assess the overall global structural integrity from above water only. Global deficiencies are documented but individual defects were not identified. A qualitative rating (Table 1) was assigned to each structure during the site visit (i.e. critical, poor, fair, satisfactory, good).

Along reaches where there is existing rip-rap, cross-shore limits of existing revetments were identified; evidence of stone displacement and undermining was also noted and a general characterization assigned (Table 2). Those segments categorized as “natural” or unprotected were rated based on the evidence of scour and stability (Table 3).

**Table 1. Structural Condition Assessment Ratings ( Bulkheads and Piers)**

Rating	Description
Good	No visible damage or only minor damage is noted. Structural elements may show very minor deterioration, but no overstressing is observed. No repairs are required.
Satisfactory	Limited minor to moderate defects or deterioration are observed, but no overstressing is observed. No repairs are required.
Fair	All primary structural elements are sound, but minor to moderate defects or deterioration is observed. Localized areas of moderate to advanced deterioration may be present but do not significantly reduce the load-bearing capacity of the structure. Repairs are recommended, but the priority of the recommended repairs is low.
Poor	Advanced deterioration or overstressing is observed on widespread portions of the structure but does not significantly reduce the load-bearing capacity of the structure. Repairs may need to be carried out with moderate urgency.
Serious	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of primary structural components. Local failures are possible and loading restrictions may be necessary. Repairs may need to be carried out on a high-priority basis with urgency.
Critical	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high priority basis with strong urgency.

**Table 2. Rip-Rap General Characterization**

Rating	Description
Good	No visible damage or only minor damage of armor stone is noted. Displacement of stone limited. No evidence of undermining and soil loss.
Satisfactory	Limited minor to moderate defects or deterioration of the revetment are observed. Some evidence of undermining, settlement or displacement.
Fair	Minor to moderate defects or deterioration are observed consistently. Evidence of undermining, settlement or displacement.
Poor	Advanced deterioration, displacement, undermining, settlement or displacement widespread along the revetment.

**Table 3. Natural Shoreline Bank Stability Characterization**

Rating	Description
Good	No visual evidence of bank instability.
Satisfactory	Limited minor to moderate erosion or undercutting or scour of the soil profile.
Fair	Locations of bank erosion or scour exhibited. No evidence of imminent bank failure.

## 2.0 Shoreline Treatment

Based on the field investigations, greater than 50% of the shoreline fronting the City of Alexandria is protected with riprap (Table 4). Roughly one third of the approximate 6 miles of shoreline is armored in place with a bulkhead or hardened structure. Roughly 7% of the shoreline is characterized as “natural beach” or unprotected; the majority of the natural shoreline is located along Jones Point Park. Figure 1 illustrates examples of the various shoreline types identified within the project area.

**Table 4. Summary of Generalized Shoreline Treatment Classification**

General Description Summary	Length (ft)	Portion of Total
Rip Rap	16952	54%
Bulkhead/Hardened Shore	10592	34%
Natural Beach	2181	7%
Other (e.g. Gabion, Tire Revetment, Unknown)	1793	6%
Total	31518	100%

A detailed summary of structure type and material composition is provided in Table 5. The location of shoreline treatment is delineated and illustrated in Appendix A.

There is significant variation in the type of stabilization structures which have been employed along the City of Alexandria shoreline. Selection and design of stabilization measures is dependent on a number of factors including, but not limited to: shoreline use, economics, site characteristics, availability of space, construction feasibility, environmental considerations, availability of materials and maintenance requirements.

Bulkheads are typically employed where there is an interest to maximize the upland property area, creating a vertical drop at the shoreline. Rip-rap revetments are commonly employed where the cost of materials is low and materials are easily transported to the site; revetments are “self adjusting” to small amounts of substrate movement. Gabions (baskets of wire mesh filled with stones) and other alternative revetment types may be employed to achieve a steeper slope (than could be achieved with rip-rap); however an important consideration in the use of alternative materials is the durability. As identified above over 50% of the shoreline is treated with rip-rap. For this study, shoreline with rip-rap is generally categorized as either “uniform” or “improvised”. “Uniform” is used to characterize stone revetment which maintains a uniform crest, slope and composition; it was likely designed for specific storm surge and wave height design criteria. An “improvised” revetment does not maintain a uniform crest elevation or slope comprised of an assortment of stone, concrete slabs and construction debris that have historically been placed in an effort to stabilize the shoreline. The majority of the revetment shoreline (13,621 ft) is characterized as “improvised”. Approximately 3300 ft of shoreline was designated as “uniform” revetment; the majority of this extends from the Oronoco Bay to the north end of Tide Gate Park.

A summary of the existing condition assessment of the shoreline is compiled in **Table 6** and illustrated in **Figure 2**. Approximately 75% of the shoreline stabilization is characterized as fair or better and appears to be meeting its intended use without any repairs needed.



**Figure 1. Examples of Shoreline Treatment**

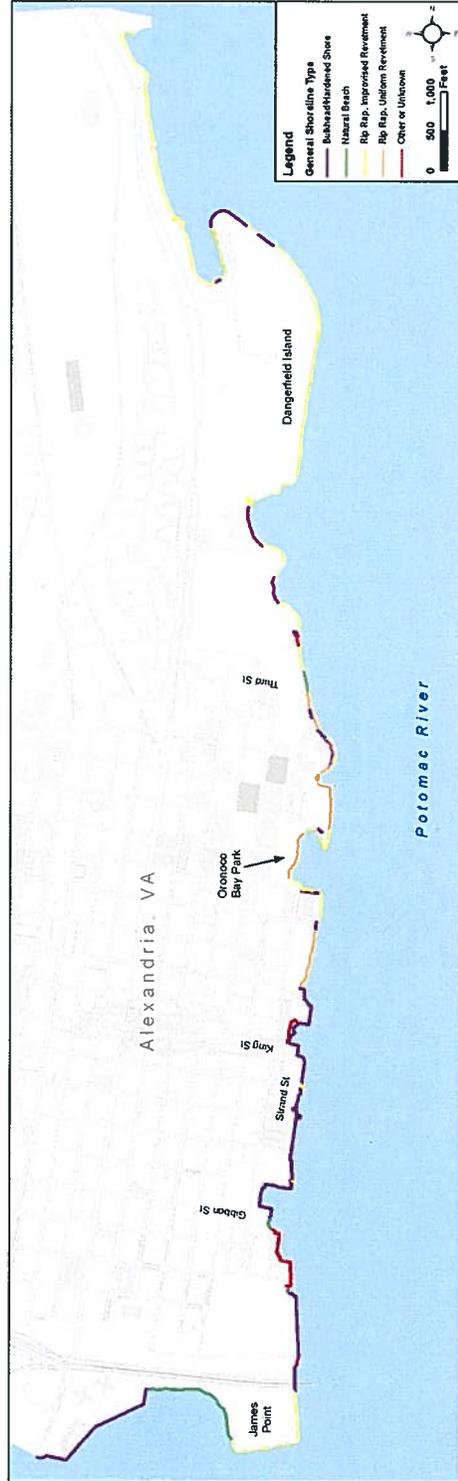
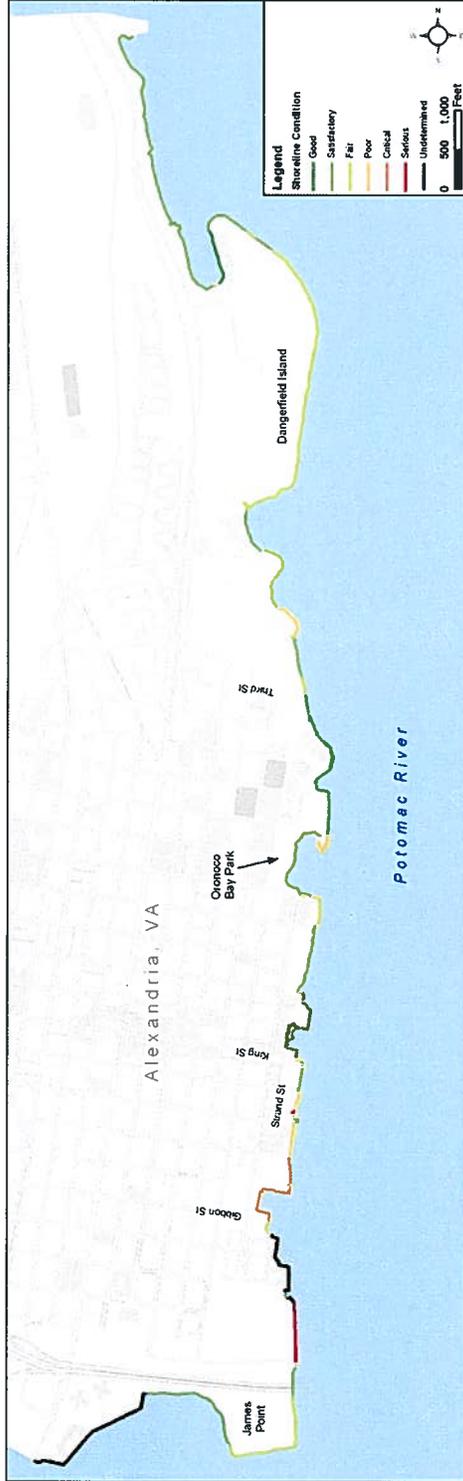


Figure 2. General Shoreline Treatment and Preliminary Condition



**Table 5. Summary Detailed Type of Shoreline Treatment Classification**

<b>Detailed Description Summary</b>	<b>Length (ft)</b>	<b>Portion of Total</b>
Riprap Revetment - Uniform	3331	11%
Riprap Revetment - Improvised	13621	43%
Concrete Boat Ramp	181	1%
Concrete Bulkhead	1797	6%
Steel Sheet Pile Bulkhead	2425	8%
Timber Sheet Bulkhead	3570	11%
Vinyl Sheet Pile Bulkhead	236	1%
Concrete Bulkhead w/ Timber Sheet Piles	1024	3%
Concrete Revetment	786	2%
Concrete Wall	574	2%
Natural Beach	2181	7%
Recycled Tire Revetment	71	0%
Gabion Revetment	310	1%
Unknown	1412	4%
<b>Total</b>	<b>31518</b>	<b>100%</b>

**Table 6. Summary Shoreline Condition Assessment**

<b>Condition</b>	<b>Length (ft)</b>	<b>Portion of Total</b>
Good	2664	8%
Satisfactory	13189	42%
Fair	8019	25%
Poor	2265	7%
Serious	996	3%
Critical	1024	3%
Not Classified	3361	11%
<b>Total</b>	<b>31518</b>	<b>100%</b>

Less than 15% of the shoreline was identified to be in poor to critical condition. There were four shoreline reaches (250 feet or less) categorized as being in poor condition that are distributed along the City shoreline from south of Mirant energy to south of “the Strand” (Figure 2). Figure 3 illustrates one of the reaches with poor conditions; a concrete paved revetment fronting the parking area adjacent to Nina’s Dandy has been undermined.



**Figure 3 View of the concrete revetment shoreline in front of the parking lot at the Strand.**

The shoreline which is considered to be in either serious or critical condition includes the bulkhead at Windmill Hill Park (approximately 956 linear feet) and the reach of concrete bulkhead north of the Woodrow Wilson Bridge (approximately 1,000 linear feet). Figure 4 and Figure 5 illustrate existing conditions of the shoreline at Windmill Hill Park and north of the Woodrow Wilson Bridge.

Annotated maps illustrating the detailed spatial distribution and site photos documenting the shoreline inventory are included in Appendices A and B respectively. The general extent and nature of structural deterioration was noted; locations illustrating existing conditions and evidence of deterioration or damage were photo documented (e.g. spalling, cracking). Table 7 provides a detailed breakdown of the conditions assessment by reach; reach identification numbers correspond to labeled segments illustrated in Appendix A.



**Figure 4. View looking north of the concrete bulkhead north of the Woodrow Wilson Bridge**



**Figure 5. View looking at the north shoreline of Windmill Hill Park**

**Table 7. Shoreline Treatment Inventory**

Reach Reference Number	Detail	Approx Length (ft)	Approx Max Stone Size	Approx. Freeboard Height	Approx Depth of Water	Preliminary Condition Evaluation
CB1	Concrete Bulkhead	86		5'-0"	2'-0"	Poor
CB2	Concrete Bulkhead	679		6'-0"	2'-0"	Satisfactory
CB3	Concrete Bulkhead	37		8'-0"	4'-0"	Satisfactory
CB4	Concrete Bulkhead	66		5'-0"	2'-0"	Critical
CB5	Concrete Bulkhead	958		7'-6"	2'-6"	Critical
CB6	Concrete Bulkhead	24		4'-0"	1'	Fair
CB7	Concrete Bulkhead	809		16'-6"	11'-6"	Serious
CBR1	Concrete Boat Ramp	46				Satisfactory
CBR2	Concrete Boat Ramp	31				Satisfactory
CBR3	Concrete Boat Ramp	69				Serious
CBR4	Concrete Boat Ramp	143				Poor
CBR5	Concrete Boat Ramp	54				Poor
CR1	Concrete Revetment	463		8'-0"	0'	Satisfactory
CR2	Concrete Revetment	93	4'-0"	4'-0"	1'-0"	Poor
CR3	Concrete Revetment	60	4'-0"	3'-0"	0'	Poor
CR4	Concrete Revetment	171		3'-0"	0'	Poor
CW1	Concrete Wall	152		20'-0"	2'-0"	Satisfactory
CW2	Concrete Wall	81		4'-0"	1'-0"	Satisfactory
CW3	Concrete Wall	93		3'-0"	0'	Satisfactory
CW4	Concrete Wall	117		8'-0"	2'-0"	Undetermined
CW5	Concrete Wall	57		6'-0"	3'-0"	Fair
CW6	Concrete Wall	74		3'-0"	0'	Fair
GR1	Gabion Revetment	114	8"	5'-0"	0'	Satisfactory
GR2	Gabion Revetment	68	8"	5'-0"	0'	Satisfactory
GR3	Gabion Revetment	128	8"	7'-0"	0'	Satisfactory
N2	Natural Beach	251				Fair
N3	Natural Beach	191				Satisfactory
N4	Natural Beach	1498				Satisfactory
N5	Natural Beach	241				Fair
RR1	Rip Rap	4037	4'-0"			Satisfactory
RR2	Rip Rap	724	2'-0"			Good
RR3	Rip Rap	158	4'-0"			Fair
RR4	Rip Rap	4124	4'-0"			Fair
RR5	Rip Rap	598	2'-0"			Fair
RR6	Rip Rap	506	4'-0"			Poor
RR7	Rip Rap	355	4'-0"			Satisfactory
RR8	Rip Rap	480	2'-0"			Good
RR9	Rip Rap	629	2'-0"			Good

**Table 7. Shoreline Treatment Inventory (continued)**

Reach Reference Number	Detail	Approx Length (ft)	Approx Max Stone Size	Approx. Freeboard Height	Approx Depth of Water	Preliminary Condition Evaluation
RR10	Rip Rap	766	2'-0"			Good
RR11	Rip Rap	432	4'-0"			Poor
RR12	Rip Rap	853	4'-0"			Satisfactory
RR13	Rip Rap	360	2'-0"			Satisfactory
RR14	Rip Rap	382	2'-0"			Fair
RR15	Rip Rap	788	4'-0"			Satisfactory
RR16	Rip Rap	65	2'-0"			Good
RR17	Rip Rap	32	1'-0"			Poor
RR18	Rip Rap	1663	4'-0"			Fair
SSP1	Steel Sheet Pile	81		20'-0"	2'-0"	Satisfactory
SSP10	Steel Sheet Pile	108		6'-0"	3'-0"	Poor
SSP11	Steel Sheet Pile	130		8'-0"	5'-0"	Satisfactory
SSP12	Steel Sheet Pile	490		12'-0"	5'-0"	Poor
SSP13	Steel Sheet Pile	372		17'-0"	13'-0"	Satisfactory
SSP2	Steel Sheet Pile	89		20'-0"	2'-0"	Satisfactory
SSP3	Steel Sheet Pile	168		20'-0"	3'-0"	Fair
SSP4	Steel Sheet Pile	252		10'-0"	2'-0"	Poor
SSP5	Steel Sheet Pile	78		6'-0"	5'-0"	Satisfactory
SSP6	Steel Sheet Pile	312		16'-0"	10'-0"	Satisfactory
SSP7	Steel Sheet Pile	40		6'-0"	3'-0"	Unknown
SSP8	Steel Sheet Pile	47		6'-0"	3'-0"	Fair
SSP9	Steel Sheet Pile	259		7'-0"	4'-0"	Satisfactory
TB1	Timber Sheet Bulkhead	179		8'-0"	4'-0"	Satisfactory
TB10	Timber Sheet Bulkhead	1836		4'-0"	1'-0"	Ruins
TB2	Timber Sheet Bulkhead	124		5'-0"	1'-0"	Satisfactory
TB3	Timber Sheet Bulkhead	136		5'-0"	0'	Satisfactory
TB4	Timber Sheet Bulkhead	409		9"	0'	Satisfactory
TB5	Timber Sheet Bulkhead	109		8'-0"	5'-0"	Satisfactory
TB6	Timber Sheet Bulkhead	322		15'-0"	8'-6"	Satisfactory
TB7	Timber Sheet Bulkhead	96		8'-0"	3'-6"	Satisfactory
TB8	Timber Sheet Bulkhead	284		12'-0"	7'-6"	Satisfactory
TB9	Timber Sheet Bulkhead	74		5'-0"	4'-0"	Ruins
TR1	Recycled Tire	71		7'-0"	1'-0"	Fair
U1	Unknown	409		15'-0"	8'-6"	Unknown
U2	Unknown	1002		14'-0"	10'-0"	Unknown
VSP1	Vinyl Sheet Pile	236		7'-0"	6'-0"	Satisfactory

### 3.0 Structural Inventory

In addition to the shoreline stabilization measures, M&N inventoried land based structures. All piers and wharfs that may be publicly accessed were included in the assessment. Select privately owned piers/wharfs, that were deemed relevant to the City overall waterfront planning, were also included in the assessment.

A total of 21 structures were identified in the preliminary conditions assessment. The inventoried structures include 12 timber pile supported piers and docks, 4 wharfs (the two Robinson terminals and two located at City Marina), 2 floating structures (located at Waterfront Park and Shipyard Park) and 3 other structures (pile supported boardwalk and walkways for greenway and concrete fishing pier). The structure locations are illustrated in **Figure 6** and identified on the aerial photographs in Appendix A. Examples of the various structures are illustrated in **Figures 7, 8, 9 and 10**. Photos documenting details of the structures are also included in Appendix B.

As identified above, the characterization of existing conditions is based on a cursory inspection of each accessible structure and is based on the current use. This reconnaissance-based rating should not be construed as a structural condition assessment, but rather as a preliminary evaluation. A summary of the preliminary conditions assessment is provided in Table 8. Three of the timber pile supported structures (2, 16 and 18) were characterized as being in fair condition exhibiting moderate to significant deterioration of piles, bents, stringers or decking (**Table 9**). Structures 8 (wharf at City Marina) and 13 (pedestrian overlook sited at the north end of Founders Park) were not readily accessible and therefore not reviewed. A portion of Robinson Terminal North was designated as being in poor condition; further discussion of Robinson terminals is provided below. Based on the cursory field investigation and information available, the remaining structures are characterized as satisfactory, meeting current use.

The City park staff, based on their site specific knowledge and experience, has identified the location of structural deterioration of waterfront infrastructure as well as marina operational issues. City staff provided documentation of their independent review and assessment of infrastructure in a memorandum dated June 12, 2009 with specific areas of concern further described in a memo dated December 1, 2009 documenting and site visit by EDAW/AECOM and city staff. A schematic diagram from the December 1, 2009 memo noted the locations of areas of concern (e.g. decking, bulkhead, debris collection) is included in Appendix C of this report. Although outside of the scope of this analysis, it is recommended that an engineering assessment of marina infrastructure be performed to address the areas of concern.

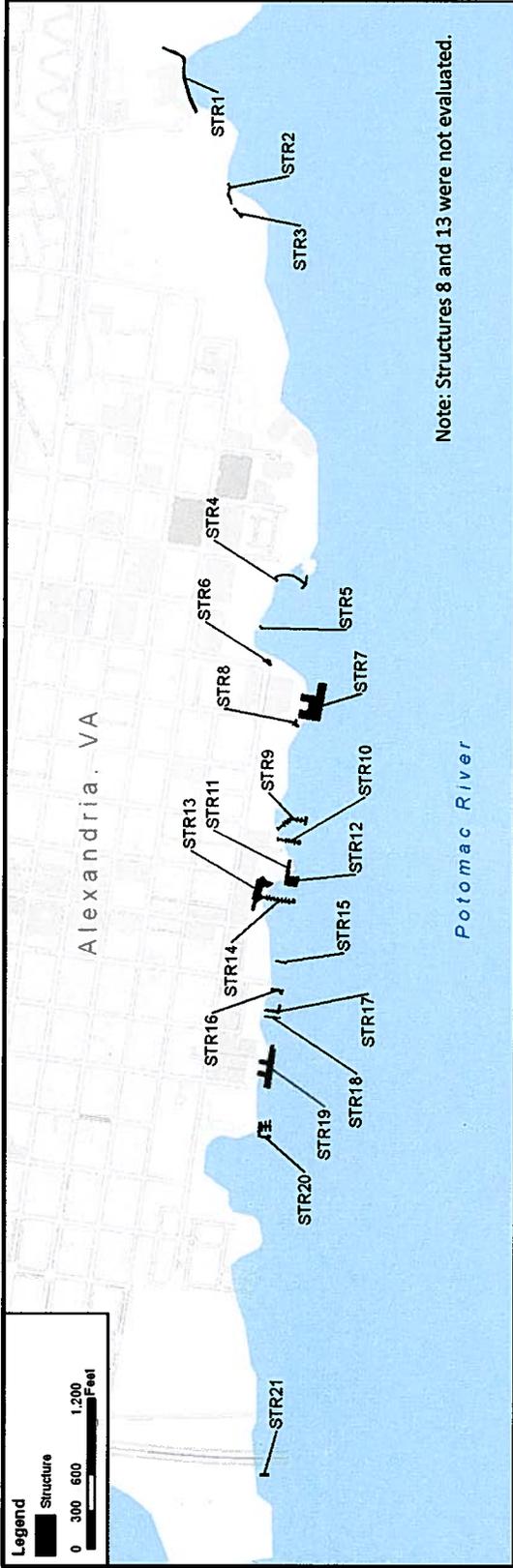
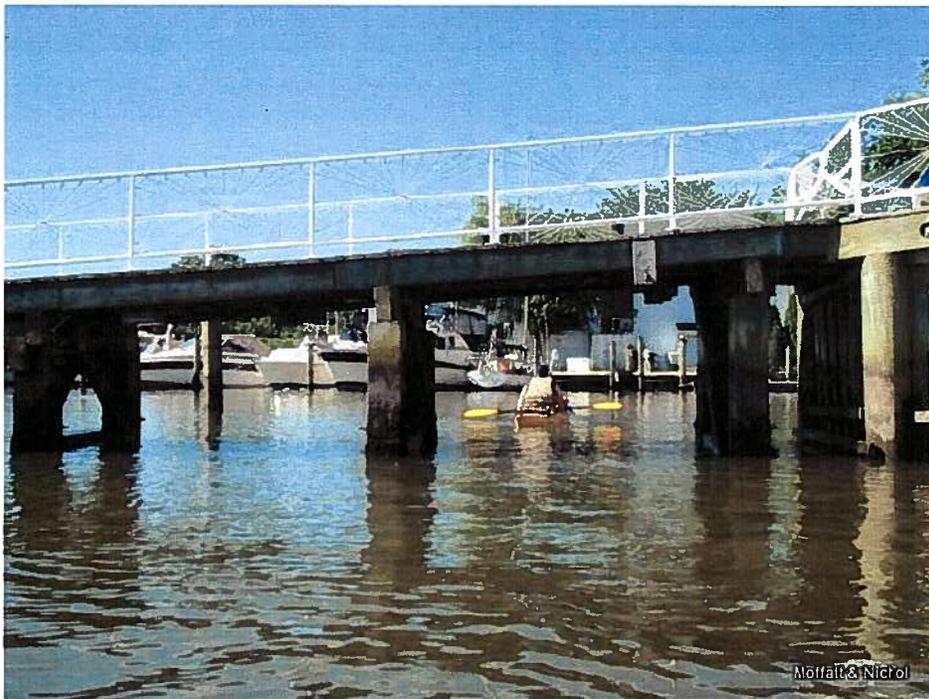


Figure 6. Structure Location Map



**Figure 7. Timber and steel pile supported pier at Robinson Terminal North**



**Figure 8. Timber pile supported pier connecting to the wharf at City Marina**



**Figure 9. Steel pontoon supported floating pier with timber guide piles at Waterfront Park**



**Figure 10. Floating fishing pier with steel guide piles at south end of Shipyard Park**

**Table 8. Summary of Structural Site Inventory**

Structure Identification	Material & Type	Approx. Pile/Individual Foundation Count	Approx Free Height	Approx Depth of Water	Preliminary Condition Evaluation
STR1	Timber Pile Supported Timber Boardwalk		4'-0"	0'	Satisfactory
STR2	Steel Knee Brace (Compression Strut) Supported Walkway	13 Knee Braces	15'-0"	above water	Fair
STR3	Timber Pile Supported Timber Boardwalk		15'-0"	0'	Satisfactory
STR4	Timber Pile Supported Timber Boardwalk	80 piles, 2 piles/bent	4'-0"	2'-0"	Satisfactory
STR5	Octagonal Timber Pile Supported platform	8 Piles	4'-0"	2'-0"	Satisfactory
STR6	Timber Pile Supported Timber Platform	20 Piles	5'-0"	0'	Satisfactory
STR7	Robinson Terminal North	Area A-156 timber piles, Area B-45 timber piles, Area C-195 tapered steel tube piles	10'-0" depth of water	16'	Area A&B: Poor Area C: Satisfactory
STR8	Timber Pile and Concrete Wall (CW4)	3 timber piles	12'-0"	2'-0"	Unknown
STR9	Timber Pile Supported pier	90 timber piles	22'-0"	18'-0"	Satisfactory
STR10	Timber Pile Supported pier	42 timber Piles	16'-0"	12'-0"	Satisfactory
STR11	Timber Pile Supported pier	40 timber piles	18'-0"	14'-0"	Satisfactory
STR12	Timber Pile Supported pier	Unknown, Timber piles were obscured	25'-0"	18'-0"	Satisfactory
STR13	Wharf at City Marina - composite lumber boardwalk	Unknown, inaccessible	16'-0"	8'-6"	Unknown
STR14	Timber Pile Supported pier	80 timber piles	13'-0"	9'-0"	Satisfactory
STR15	Steel pontoon supported floating pier w/ timber guide piles	Two, 3 pile timber guide pile clusters. 6 total piles.	8'-0"	4'-0"	Satisfactory
STR16	Timber Pile Supported pier	22 timber piles	20'-0"	17'-0"	Fair
STR17	Timber Pile Supported pier	34 timber Piles	16'-0"	11'-0"	Satisfactory
STR 18	Timber Pile Supported pier	22 timber piles	16'-0"	12'-0"	Fair
STR 19	Robinson Terminal South	104 tapered tube steel piles	30'-0"	20'-0"	Satisfactory
STR 20	Floating piers w/ steel pipe guide piles	15 steel pipe guide piles, 8 timber piles	17'-0"	16'-0"	Satisfactory
STR 21	Concrete pier w/ timber decking and timber handrail	Unknown	19'-0"	13'-0"	Satisfactory

## Robinson Terminal North

For purpose of discussion, Robinson Terminal North is divided into three sections: A, B and C (Figure 11). Sections A and B are supported by Timber piles; Section C is supported by tapered steel tube piles.

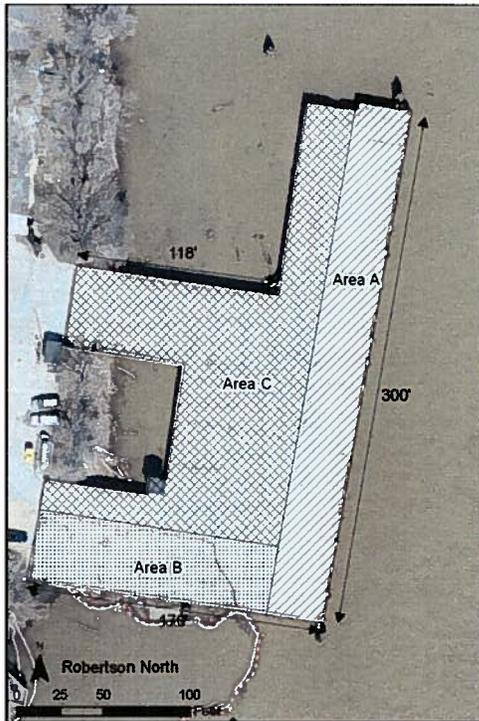


Figure 11. Plan view of Robinson Terminal North

### Area A

The timber piles in Area A are in satisfactory condition overall, but are split in some instances at the tops of the piles where they are connected to the timber bent caps (Photo 4-2-203 of Appendix B). This may indicate lateral load overstress at some time during the structure's operation. Minor to moderate corrosion exists on the steel angle cross braces and hardware. The timber bent caps are rotten (Photo 4-2-223 of Appendix B) in many instances and may be susceptible to bearing overstress. Minor corrosion exists on the steel W-Shape stringers and associated bracing and hardware. Some instances of concrete spalling on the underside of the precast concrete panels were noted. The condition of the concrete topping slab was not determined due to limited site access. Overall, the global condition assessment for Area A is considered Poor.

The fenders on the East (front) face of the structure are composed of a single timber pile bolted to two tapered tube steel pipe backing piles making up a three pile cluster. The fender pile clusters are spaced at approximately 14' on center.

## Area B

The timber piles in Area B are in satisfactory condition overall. The timber bent caps are rotten in many instances and may be susceptible to bearing overstress. Bearing overstress has already occurred in one location on the South Face of the structure. The concrete deck sags significantly in this location (**Figure 12**). The timber stringers show little visual indication of rot, but it is very possible that rotten stringers are present based on the observed condition of other timber members. Moderate corrosion is evident on the central steel stringer. Some instances of rot were noted on the timber decking under the concrete deck.



**Figure 12. View of approach looking north at Robinson Terminal North**

In a few locations the timber decking has collapsed exposing the underside of the concrete topping slab. The timber decking is likely susceptible to bearing overstress where they are supported by the timber stringers and central steel stringer. Based on the large section size of the timber decking it is possible that the designer may have accounted for composite action between the concrete deck and the timber decking or at least additional capacity provided by the timber decking. It is also possible that the timber decking was intended to be stay in place formwork. A more detailed inspection would be required to determine the intended purpose of the timber decking, but in either case settlement of the concrete topping slab due to rotten timber decking is possible overtime. The condition of the concrete topping slab was not determined due to limited site access. Overall, based on this preliminary assessment, Area B is classified as Poor.

## Area C

The tapered tube steel piles are satisfactory overall, but one instance was noted where a steel pile is split (Photo 4-2-193 of Appendix B). Minor corrosion is evident throughout with a few instances of moderate corrosion. The condition of the concrete topping slab was not able to be determined due to limited site access. Area C is satisfactory.

## Robinson Terminal South

Robinson Terminal South (Figure 13) is a tapered tube steel pile supported structure with a concrete deck. The deck of the structure is composed of precast panels w/ a cast in place concrete topping slab on the South end of the pier. The concrete deck on the North end of the pier was cast on stay in place galvanized steel forms. The precast panels and corrugated galvanized steel forms span from East to West and are supported by 6 steel W-Shape stringers that in turn span from North to South (Photo 5-4-342 of Appendix B). The Stringers span over a variety of steel bent types with the first being that of steel W-Shapes supported by 4 single tapered tube steel piles of varied spacing. The remaining bents are supported by steel H-Shapes in turn supported by 2 pile tapered tube steel pile clusters. The two access trestles are of similar construction, but the bents span North to South and the stringers span east to West.



**Figure 13. Robinson Terminal South plan view**

A boat lift with a corrugated galvanized steel roof and steel superstructure framing is located on the North end of the pier. Four tapered tube steel piles support the boat lift.

Similar to the North Terminal, the fenders on the East (front) face of the structure are composed of a single timber pile bolted to two tapered tube steel pipe backing piles making up a three pile cluster. The fender pile clusters are spaced at approximately 14' on center.

The exact nature and condition of the topside of the deck was not determined due to limited access to the site. The tapered tube steel piles are satisfactory overall. Minor corrosion is evident throughout with a few instances of moderate corrosion.

## Outfalls

While conducting the field assessment of shoreline treatment and structures, M&N staff noted the approximate location, size and material of outfalls sited along the City shoreline (Table 9). The approximate location of the outfalls is identified on aerial photographs located in Appendix A. The accuracy of this information is reconnaissance level and will need to be field verified with detailed survey measurements.

**Table 9. Outfalls located along the City of Alexandria shoreline**

<b>Outfall Identification</b>	<b>Approximate Diameter</b>	<b>Material and Description</b>
OF1	12"	Concrete Pipe penetrating Gabion Revetment 1
OF2	24"	Concrete Pipe penetrating Gabion Revetment 1
OF3	Unknown, Tidal gates approximately 6' x 4'	Combined Sewer Overflow (CSO) at Pendleton Street
OF4	12"	Corrugated Galvanized Steel Pipe penetrating bank North of SSP1
OF5	Unknown	Unknown Material, penetrates river bank behind south end of SSP2
OF6	24"	Unknown Material, Daylights far from bank and has a gravel lined swale that leads to river.
OF7	48"	Concrete Pipe penetrating concrete Wall.
OF8	48"	Concrete Pipe penetrating concrete Wall at SSP3
OF9	24"	Concrete Pipe penetrating TB2
OF10	48"	Concrete Pipe penetrating CW4.
OF11	12"	Concrete Pipe penetrating SSP12 at low waterline
OF12	36"	Concrete Pipe Penetrating CTB2
OF13	Unknown	Unknown source of water runoff through CTB2
OF14	Unknown	Rip Rap Swale

## 4.0 Summary and Recommendations

The preliminary observations of existing conditions identified above were based on review of existing data and site investigations performed during May 2009. This reconnaissance-based rating should not be construed as a structural condition assessment, but rather as a preliminary evaluation.

For those structures which the City may modify the intended use, as part of the waterfront planning process, a detailed engineering conditions assessment is recommended. The detailed engineering inspection and assessment should be performed both above and below water as necessary to:

- Quantify the extent of observed deterioration or damage, and assess and rate the overall condition of the structure.
- Quantitatively evaluate the localized loss of capacity on a typical and worst case section (e.g. due to steel section loss, timber deteriorations, concrete deterioration, and/or observed concrete cracking).
- Perform an analysis of the structure to determine the capacity relative to the anticipated service application and loads, taking into account any loss of capacity due to deterioration or damage. Proposed change in the use of structures will be identified and evaluated as part of the conceptual design process (e.g. Robinson Terminal North).
- Determine the significance of the deterioration of the structure connecting components and its impact on future durability and service life.
- Assess the need for structural rehabilitation and/or protection measures.

As identified above, the majority of the existing shoreline treatment and structures were classified based on the preliminary observations as meeting intended structural use. Specific reaches of the public shoreline (e.g. parking area fronting the Strand, bulkhead at Windmill Hill Park) categorized as being in poor or critical condition as well as those areas of concern identified by the city staff (December 1, EDAW/AECOM), should be prioritized for further evaluation and improvement.

In support of the overarching goals of the waterfront plan, there are opportunities to improve the core project area by shoreline enhancement and modification to existing structures. The structural integrity of the existing shoreline treatment could be improved while allowing for increased waterfront access, providing ecological benefits and enhanced aesthetics.

## 5.0 References

RPCA Park Planning, June 12 2009. *Memorandum regarding Waterfront Planning & Operations Criteria and Potential Improvements.*

EDAW/AECOM, December 1 2009. *Memorandum regarding Shoreline Walk.*