



**City of Kingston  
Report to Council  
Report Number 17-282**

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**To:** Mayor and Members of Council  
**From:** Lanie Hurdle, Commissioner, Community Services  
**Resource Staff:** Julie Salter-Keane, Community Projects Manager  
**Date of Meeting:** November 7, 2017  
**Subject:** Deep Water Dock & Cruise Ships Options

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**Executive Summary:**

As part of its 2015-2018 Strategic Plan developed in 2015, Council identified the feasibility of a deep-water dock facility for cruise-type ships as one of its priorities during its term. Kingston has many embarkation locations on the waterfront; most catering to smaller personal motorized and non-motorized watercrafts.

The city's ability to provide a deep water dock to accommodate cruise ships would significantly contribute to tourism and economic development activities. Staff also believe that a deep water dock location downtown would be ideal to support a pedestrian friendly environment and experience.

In the past few months, city staff have worked with the Great Lakes Cruising Coalition, the Great Lakes Cruise Company, the Canadian Marine Pilots Association (Richard Winnel, Seaway Pilot), Ontario Waterway Cruises Inc., and St. Lawrence Cruise Lines to get a better understanding of the ships that are travelling through the St. Lawrence and Great Lakes as well as their process to select ports on their cruise itineraries. Currently, the city-owned Crawford Wharf accommodates two cruise ships, one with the Ontario Waterway Cruises Inc. (The Kawartha Voyageur) and the other with the St. Lawrence Cruise Lines (The Canadian Empress) on a regular basis. These two (2) cruise ships are smaller in size and can accommodate up to 66 passengers. The Conti Group operates the MS Hamburg, a 420 passenger luxury cruise ship, that sometimes port in Kingston but cannot dock anywhere and therefore has to transport passengers to shore. This is not an ideal experience for visitors and the Conti Group.

Based on information collected by staff from the Great Lakes Cruising Coalition and the Seaway Pilot, water depth and length of docks are the most critical elements to be able to accommodate larger cruise ships. Staff have recently retained the services of Riggs Engineering (Riggs) to

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review water depth at current dock/wharf facilities within the city. Riggs specifically looked at 1 Queen Street Wharf, Crawford Wharf, 55 Ontario Street (Former Marine Museum Wharf) and the Coal Dock. Crawford Wharf is the only dock owned by the city. Other locations are either in private ownership or institutional ownership. Staff have not requested an investigation of water depth at the Portsmouth Olympic Harbour site as the area is already heavily utilized by recreational vessels.

The review completed by Riggs was based on the following tasks and analyses:

- bathymetric survey of the sites;
- review of historic water levels at Kingston for cruise ship season;
- review of vessel characteristics and minimum draft requirements;
- assessment of percentage of time that mooring depth requirements can be met without dredging; and
- review of site characteristics and opportunities to improve mooring potential.

A memorandum with technical analysis completed by Riggs is included as Exhibit A to Report Number 17-282.

Based on the information collected and reviewed by Riggs and the Canadian Marine Pilots Association, Crawford Wharf can only accommodate smaller types of cruise ships, two of which are already docking at the Wharf. The Grand Caribe and Grand Mariner cruise ships can be accommodated at the Crawford Wharf, but do not currently stop in Kingston. In order to be able to accommodate the larger cruise ships operated by the Great Lakes Cruise Company and the Conti Group, significant dredging and expansion would be required at the Crawford Wharf. It is anticipated that such an endeavor would be complex, expensive and potentially include risks related to the structural stability of the Wharf depending on the amount of dredging required. It is important to note that this Wharf is also leased to and utilized by Kingston 1000 Islands Cruises which would be impacted by such significant structural changes.

Based on Riggs' technical analysis, 1 Queen Street Wharf, with moderate dredging, is the best location to accommodate cruise ships. The Coal Dock and 55 Ontario Street all have sufficient water depth to accommodate the larger cruise ships; however, they both have limitations to mooring due to the condition of the infrastructure. Each dock and water level history has been plotted and attached as Exhibit A to Report Number 17-282. Therefore, there is potential for a deep-water dock in Kingston but this would require the city to partner with a private or institutional owner. It should be noted that it is possible that the largest cruise ship (Hamburg) may not be able to moor even with some improvements.

Staff have reviewed all information provided by the Great Lakes Cruising Coalition, the cruise lines, the coastal engineer and the seaway pilot regarding Crawford Wharf's expansion, and believe that the city's best option is to try to establish a partnership with the owner of 1 Queen Street Wharf property for the potential development of a deep-water dock. There are multiple reasons for this recommendation:

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- Location – Other than Crawford Wharf, 1 Queen Street Wharf is the most central to downtown and would provide a positive and pedestrian friendly experience to visitors. Other docks would require visitors to either walk longer distances to the downtown core and/or be bused to the downtown core;
- Capacity for vessel mooring - Based on data provided by Riggs, the Queen Street Wharf would appear to be the most suitable location for a potential Cruise Ship mooring site for all vessels considered except the Hamburg. While some moderate dredging is expected to be required, the visible portions of the structure appear to be in relatively good condition, the geometry of the wharf is expected to be adequate and there is presently no intensive marine function at this location. There is the potential to reduce dredging requirements through the provision of mooring dolphins (or other means to extend the mooring area to the east) that could be considered at this site. Crawford Wharf does not meet water depth and the structural length requirements for the larger cruise ships. Work required on the Crawford Wharf would include extensive dredging, which could impact the stability of the Wharf, and an extension of the Wharf which could all be very expensive and have an impact on the current lease holder which is an important tourism asset. The proximity of the site to Confederation basin could result in some conflict with recreational vessels as well. Other docks have the appropriate water depth about 95% of the time to accommodate larger cruise ships; however, both would require investment to rehabilitate the shoreline infrastructure to provide a competent mooring structure and safe passenger handling;
- Other development synergies – The Ministry of Transportation is completing its Environmental Assessment for the expansion of its Wolf Islander Ferry dock located next to 1 Queen Street. The owners of the property have also indicated that they are contemplating potential improvements and development on the property which possibly accommodate an expansion; and
- Partnership opportunities - In order to assure sustainability as a cruise ship port of call, private sector organizations could be approached to partner with the city in coordinating appropriate welcoming festivities as well with Tourism Kingston and the Downtown Business Improvement Area. Other organizations including, but not limited to, the Kingston Accommodation Partners could also be approached.

**Recommendation:**

**That** Council direct staff to work on short term cruise ship options with Tourism Kingston to market Crawford Wharf in Kingston as a port for the Grand Caribe and Grand Mariner operated by the Great Lakes Cruise Company; and

**That** Council direct staff to initiate discussions with the owner of 1 Queen Street for a potential future partnership to develop short term and long term options for a deep water dock; and

**That** Council direct staff to discuss this potential deep water dock location with the Ministry of Transportation to identify any development synergies and opportunities through the future expansion of the Wolf Islander Ferry Terminal; and

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**That** Council approve up to \$80,000 funded from the Working Fund Reserve for staff to continue detailed work related to an assessment of structure, navigation lines, review of hydrodynamics and consultation with sea pilots for the potential of a future deep water dock at 1 Queen Street; and

**That** Council direct staff to report back with additional technical information as well as the outcome of discussions for the potential development of a deep water dock at 1 Queen Street.

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**Authorizing Signatures:**

ORIGINAL SIGNED BY COMMISSIONER

**Lanie Hurdle, Commissioner, Community Services**

ORIGINAL SIGNED BY CHIEF ADMINISTRATIVE OFFICER

**Gerard Hunt, Chief Administrative Officer**

**Consultation with the following Members of the Corporate Management Team:**

Desirée Kennedy, Chief Financial Officer & City Treasurer	Not required
Denis Leger, Commissioner, Corporate & Emergency Services	Not required
Mark Van Buren, Acting Commissioner, Transportation & Infrastructure Services	Not required

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**Options/Discussion:****Cruise Lines/Cruise Ships**

Staff have collected information on cruise lines and cruise ships that sail through the Kingston region. Some of these cruise ships, although limited, currently moor in Kingston. Information on each cruise ship capacity is also included in the section below.

## 1. Ontario Waterway Cruises Inc.

- a. Kawartha Voyageur – accommodates about 45 passengers and is approximately 36.6 metres in length with a draft of approximately 1.8 metres. Overnight ports for the Kawartha Voyageur include: Kingston, Jones Falls, Poonamalie, Merrickville, Long Island Flight Locks, Hartwells Locks, Peterborough, Healey Falls, Frankford, Picton and Gananoque.

This cruise ship has been accommodated in Kingston in the past and moors at Crawford Wharf. In 2018, the Kawartha Voyageur is scheduled to moor in Kingston on the following dates: May 19<sup>th</sup>, May 31<sup>st</sup>, June 10<sup>th</sup>, June 20<sup>th</sup>, July 30<sup>th</sup>, August 9<sup>th</sup>, September 8<sup>th</sup>, September 18<sup>th</sup> and September 28<sup>th</sup>.

## 2. St. Lawrence Cruise Lines

- a. Canadian Empress – accommodates about 66 passengers and is approximately 33 metres in length with a draft of approximately 1.8 metres. Overnight ports vary depending on cruises but include: Kingston, 1000 Islands Anchorage, Brockville, Ivy Lea, Upper Canada Village, Morrisburg, Coteau Landing, Lachine, Montreal, Cornwall, Ottawa and Carillon.

This cruise ship has been accommodated in Kingston in the past and moors at Crawford Wharf. In 2018, the Canadian Empress is scheduled to moor in Kingston on the following dates: May 6<sup>th</sup>, May 13<sup>th</sup>, May 25<sup>th</sup>, May 29<sup>th</sup>, June 10<sup>th</sup>, June 20<sup>th</sup>, June 24<sup>th</sup>, July 6<sup>th</sup>, July 10<sup>th</sup>, July 19<sup>th</sup>, July 29<sup>th</sup>, August 2<sup>nd</sup>, August 14<sup>th</sup>, August 18<sup>th</sup>, August 20<sup>th</sup>, September 9<sup>th</sup>, September 13<sup>th</sup>, September 25<sup>th</sup>, September 29<sup>th</sup>, October 11<sup>th</sup>, October 15<sup>th</sup>, October 22<sup>nd</sup> and October 26<sup>th</sup>.

## 3. Great Lakes Cruise Company

- a. Grand Caribe – accommodates about 88 passengers and is approximately 54 metres in length with a draft of approximately 2.10 metres. This cruise ship operates in the Great Lakes between June and October and currently does not moor in Kingston. During 2018, the Grand Caribe will pass by the City of Kingston six times on various itineraries.
- b. Grand Marnier – accommodates about 88 passengers and is approximately 56 metres in length with a draft of approximately 2.0 metres. This cruise ship operates in the Great Lakes between June and October and currently does not moor in Kingston.

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During 2018, this ship will pass by the City of Kingston twice during the cruise season.

- c. M/V Victory 1 – accommodates 202 passengers and is approximately 91.44 metres in length with a draft of approximately 4.12 metres. M/V Victory II is the identical sister ship to the Victory I. The Victory II's inaugural voyage will be on May 20, 2018. Both cruise ships will operate between May and October but do not moor in Kingston. In 2018, Victory 1 will pass by the City of Kingston eight times during the cruise season.
  - d. Pearl Mist – accommodates 210 passengers and is approximately 99 metres in length with a draft of approximately 3.5 metres. This cruise line operates two (2) cruises that pass by the City of Kingston between May and September and does not moor in Kingston.
4. Conti Group – operated by Plantours Kreuzfahrten
- a. MS Hamburg – accommodates 420 passengers and is approximately 145 metres in length with a draft of approximately 5.75 metres. This cruise ship operates from June until October and does have two stops scheduled in Kingston in 2018 but cannot moor at any wharf facility. Passengers have to be transported from the ship to Crawford Wharf with smaller boats.

Based on staff review of cruise ships sailing through the Kingston region, only cruise ships with small passenger capacity can currently be accommodated at Crawford Wharf. The Great Lakes Cruise Company and the MS Hamburg are the largest cruise line/ships and none of these cruise ships can currently moor at the Crawford Wharf or in Kingston.

#### **Technical Review of Dock/Wharf Facilities in Kingston**

Staff have retained the services of Riggs Engineering (Riggs) to complete a review of existing city-owned and private dock/wharf facilities in Kingston to assess their mooring capacity for cruise ships. Since Kingston can currently accommodate St. Lawrence Cruise Lines and Ontario Waterway Cruises, the focus of the assessment was completed based on the capacity to moor cruise ships operated by the Great Lakes Cruise Company and the MS Hamburg. Riggs assessed 1 Queen Street Wharf, Crawford Wharf, 55 Ontario Street (former Marine Museum site) and the Coal Dock based on the following criteria:

- bathymetric survey of the sites;
- review of historic water levels at Kingston for cruise ship season;
- review of vessel characteristics and minimum draft requirements;
- assessment of percentage of time that mooring depth requirements can be met without dredging; and
- review of site characteristics and opportunities to improve mooring potential.

The following section provides more details on each wharf/dock facility. Exhibit A of this report includes Riggs' Engineering detailed report.

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## 1. Queen Street Wharf

The Queen Street Wharf is situated immediately south of the present Wolf Islander Ferry dock. The pier is not utilized and a parking lot is situated at the in shore end of the pier. While there are no obvious signs of significant deterioration of the steel sheet pile, the condition of the structure has not been investigated in detail. Local depths generally vary between approximately 3.0 metres and 4.5 metres below datum. The suitability of the south face of the Queen Street Wharf for each of the vessels considered is summarized below:

- The M/V Victory I typically would not have sufficient draft clearance throughout the majority of the berthing area and therefore, some dredging would be required if this location is considered further for this vessel. The wharf does appear to provide sufficient length for mooring with minimal vessel overhang.
- The Pearl Mist would have nominal draft + 0.5 metres clearance more than 95% of the time during the sailing season over much of the mooring area. It is expected that some localized dredging would be required along the wharf wall and potentially near the inshore (west) end of the mooring area. The wharf provides sufficient length for mooring with minimal vessel overhang.
- The practicality of mooring the Hamburg at the Queen Street Wharf is limited. There would not be sufficient draft clearance in this location without considerable dredging efforts in the mooring area and the approach. Furthermore, the current wharf structure does not provide sufficient length for this vessel and it is expected that supplementary structural considerations such as dolphins would be required to provide mooring support beyond the east of the end of the wharf.
- The Grand Caribe and Grand Mariner would have nominal draft + 0.5 metres clearance more than 95% of the time during the sailing season based on the historic water level record. The wharf provides sufficient length for mooring without overhang.

Dredging costs at the Queen Street Wharf will depend on the sediment characteristics and quality. Dredge design would need to consider the structural characteristics of the wharf wall and would be constrained by the natural shoreline near the southwest limits of the mooring area.

It is not possible to estimate the dredging requirements necessary to accommodate the Hamburg at this location based on the information available due to uncertainty in approach conditions. It is anticipated that costs for dredging and structural modifications, as well as permitting implications, could make this site an impractical location for the Hamburg.

Dredging requirements to accommodate the M/V Victory 1 along the south wall of the Queen Street Wharf are roughly estimated at 1,500 metres<sup>3</sup>; assuming an allowance of \$50/metres<sup>3</sup> for dredging and \$50/metres<sup>3</sup> for disposal, the approximate cost of dredging would be expected to be on the order of \$150,000. It is possible that dredging costs could be offset to some extent



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if the vessel mooring location is shifted to the east; this would require additional structural measures such as mooring dolphin(s) constructed off the east end of the pier. Additional costs for structural review, dredge design and any structural modifications which may be necessary to accommodate mooring of the cruise ships considered herein have not been estimated at this time.

It is important to note that the Ministry of Transportation is currently completing its Environmental Assessment (EA) to proceed with the expansion of its Wolfe Islander Ferry dock. It is anticipated that the Ferry dock will be under construction over the next year. Staff have also been advised by the property owner of potential interest in improving and developing the property located at 1 Queen Street.

## 2. Crawford Wharf

The Crawford Wharf is presently the loading/unloading dock for a number of small local cruise boats. While the capability of the site for smaller vessel mooring is generally accepted and approach routes are understood, the site is more challenging for larger vessels with increased draft and dock length requirements. The local depths are somewhat variable with depths of 4 metres +/- below datum along approximately half of the length of the north face, but with diminishing depths moving west along the wharf wall. There is also a marginal reduction in depth immediately east of the end of the wharf which may pose some restrictions on vessel approach. The suitability of the Crawford Wharf for each of the vessels considered is summarized below:

- The M/V Victory I typically would not have sufficient draft clearance throughout the majority of the berthing area and therefore, dredging would be required if this location is considered further for this vessel. The north face of the wharf would require a dredging to be focused at the western end of the berth with some dredging along the wharf wall. The south face would require dredging throughout, with most efforts to be focused along the south edge of the mooring area and in the approach channel. It is expected that the vessel overhang at this location would be unacceptable for the M/V Victory 1 on the north side of the wharf due to space constraints (local shoreline structure) for the vessel bow. Mooring on the south side of the wharf with this size of vessel may result in conflicts with recreational vessels using the northern entrance to Confederation Basin. Mooring dolphins would be required to make this a viable location.
- The Pearl Mist would have nominal draft + 0.5 metres clearance more than 95% of the time over much of the required mooring length on the south wall but some dredging would be required at the west end of the berth and in isolated areas along the berth length. Similar concerns expressed for the M/V Victory 1 would apply to the Pearl Mist, including proximity of structures near the bow on the north side of the wharf and potential conflicts with local recreational boating activity on the south side of the wharf. Therefore, it is expected that mooring dolphin(s) would be required to make this a viable location. As with the Queen Street Wharf, reduced dredging requirements could be achieved through shifting the mooring location to the east through the use of dolphins.

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- The Hamburg is considered to be too large a vessel for practical mooring at the Crawford Wharf.
- The Grand Caribe and Grand Mariner would have nominal draft + 0.5 metres clearance more than 95% of the time during the sailing season based on the historic water level record. The wharf provides sufficient length for mooring without overhang.

Dredge design would need to consider the structural characteristics of the wharf wall and local adjacent structures.

It is not possible to estimate the dredging requirements necessary to accommodate the Hamburg at this location based on the information available due to uncertainty in approach conditions. It is anticipated that costs for dredging and structural modifications as well as permitting implications could make this site an impractical location for the Hamburg.

Dredging requirements to accommodate the M/V Victory 1 along the north wall of the Crawford Wharf are roughly estimated at 2,000 metres<sup>3</sup>; assuming an allowance of \$50/metres<sup>3</sup> for dredging and \$50/metres<sup>3</sup> for disposal, the approximate cost of dredging would be expected to be in the order of \$200,000. Dredging to accommodate the M/V Victory 1 would accommodate the Pearl Mist as well.

Additional costs for structural review, dredge design and any structural modifications which may be necessary to accommodate mooring of the cruise ships considered herein have not been estimated at this time.

### 3. 55 Ontario Street Wharf

The wharf at 55 Ontario Street is presently not used for any intensive marine function. The condition of the structure is uncertain. However, Riggs Engineering has advised that the concrete parapet structures that historically formed the surface perimeter of the wharf are in a state of considerable disrepair and it is expected that relatively significant structural works would be necessary at this site to provide a suitable mooring space. The property owner also has an active development application for this site which does not contemplate a deep water dock. The local depths are somewhat variable in the area with depths of 6 metres +/- to 7 metres +/- below datum along the east end of the wharf, decreasing to 5 metres +/- below datum and less along the north and south sides of the wharf. The suitability of the wharf for mooring each of the vessels considered is summarized below:

- The M/V Victory I would have nominal draft + 0.5 metres clearance more than 95% of the time during the sailing season based on the historic water level record. This depth would be available along the east end of the wharf, but it is expected that mooring would require consideration of supplementary structures such as dolphins to ensure a suitable berth space as well as infrastructure improvements to provide for safe passenger loading and unloading. Suitable depths are also available along the south face of the 55 Ontario Street Wharf wall but the wharf wall and upland area is also in a state of considerable disrepair.

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- The Pearl Mist would have nominal draft + 0.5 metres clearance more than 95% of the time during the sailing season based on the historic water level record. This depth would be available along the east end of the 55 Ontario Street Wharf, but it is expected that mooring would require consideration of supplementary structures such as dolphins to ensure a suitable berth space. Suitable depths are also available along the south face of the 55 Ontario Street Wharf wall but as previously noted, the wharf wall and upland area is in a state of considerable disrepair.
- While the Hamburg would have nominal draft + 0.57 metres clearance more than 95% of the time during the sailing season over most of the potential mooring space along the east end of the 55 Ontario Street Wharf, the geometry of this vessel is somewhat challenging due to the proximity of the pier at the end of Gore Street. Supplementary mooring structures and reconstruction of the wharf walls would be required to ensure a suitable berth space as well as improvements to provide for safe passenger loading and unloading. The vessel is expected to be too long to practically moor along the south side of the 55 Ontario Street Wharf.
- The Grand Caribe and Grand Mariner would have nominal draft + 0.5 metres clearance more than 95% of the time during the sailing season based on the historic water level record. It is anticipated that supplementary mooring structures or wharf reconstruction would be required to permit mooring on the east end or south side of the 55 Ontario Street Wharf. Additional infrastructure improvements would be required to permit safe passenger loading and unloading.

The costs of structural measures to accommodate mooring at this site have not been estimated at this time and would require site specific investigations to provide conceptual designs for budgetary considerations. Of the sites considered, it is expected that this site would require the most intensive shoreline improvements to provide for a suitable mooring location. A small lake bed area just off the northeast corner of the wharf requires further investigation to define the nature of a local high point in the bed and potential local dredge requirement.

#### 4. Coal Dock

The Coal Dock at the former Psychiatric Hospital is presently not used for any intensive marine function. The structure is subject to some deterioration and is presently fenced off to the public. The local depths are generally uniform in the area and in the order of 6 metres +/- below datum near the wharf wall, increasing offshore. The suitability of the Coal Dock for mooring each of the vessels considered is summarized below:

- The M/V Victory I would have nominal draft + 0.5 metres clearance more than 95% of the time during the sailing season based on the historic water level record. The wharf provides sufficient length for mooring without any significant overhang but it is anticipated that structural improvements would be required to provide a competent mooring structure at this location.

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- The Pearl Mist would have nominal draft + 0.5 metres clearance more than 95% of the time during the sailing season based on the historic water level record. There would be approximately 20 metres of vessel overhang at this location for the Pearl Mist and it is anticipated that structural improvements would be required to provide a competent mooring structure.
- The Hamburg would have nominal draft + 0.57 metres clearance over much of the wharf length more than 95% of the time during the sailing season based on the historic water level record. There are, however, areas along the edge of the wharf where depths are limiting and may require dredging if this site was to be considered. The Hamburg would overhang the end of the wharf by about 30 metres +/- at both ends and therefore, it is expected that additional structural measures would be required to accommodate the vessel length and it is anticipated that structural improvements would be required to the existing dock wall to provide a competent mooring face.
- The Grand Caribe and Grand Mariner would have nominal draft + 0.5 metres clearance more than 95% of the time during the sailing season based on the historic water level record. The wharf provides sufficient length for mooring without overhang but it is anticipated that structural improvements would be required to provide a competent mooring structure.

**Existing Policy/By-Law:**

Not applicable

**Notice Provisions:**

Not applicable

**Accessibility Considerations:**

Not applicable

**Financial Considerations:**

It is recommended that up to \$80,000 be approved from the Working Fund Reserve to complete work related to an assessment of structure, navigation lines, review of hydrodynamics and consultation with sea pilots for the potential of a future deep water dock at 1 Queen Street.

**Contacts:**

Lanie Hurdle, Commissioner, Community Services 613-546-4291 extension 1231

Julie Salter-Keane, Community Projects Manager 613-546-4291 extension 1163

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**Other City of Kingston Staff Consulted:**

Kathy Gray, Property Specialist

Luke Follwell, Director, Recreation & Leisure Services

**Exhibits Attached:**

Exhibit A Riggs Engineering Memorandum



To: Ms. Julie Salter-Keane  
City of Kingston.

## MEMORANDUM

From: Stu Seabrook, P.Eng.

Date: 2017-10-27 (Revision 2)

**Re: City of Kingston - Cruise Ship Mooring Potential**

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This memorandum provides a review of 4 locations along the Kingston waterfront with regard to potential for mooring of various cruise ships which sail through the Kingston region. The review is based on the following tasks and analyses:

- bathymetric survey of the sites by Riggs Engineering
- review of historic water levels at Kingston for cruise ship season
- review of vessel characteristics and minimum draft requirements
- assessment of percentage of time that mooring depth requirements can be met without dredging
- review of site characteristics and opportunities to improve mooring potential

### **Bathymetric Survey**

Bathymetry of 4 potential mooring sites was surveyed by Riggs Engineering on September 5, 2017. The sites surveyed were:

- a) Queen Street Wharf
- b) Crawford Wharf
- c) 55 Ontario Street Wharf
- d) Coal Dock

Surveyed depths were reduced to Chart Datum (IGLD 1985) for Lake Ontario and are presented in Appendix A to this memorandum. As these depths represent the depth below a constant still water level of 74.2 m IGLD 1985 they do not adequately represent the expected available depth at the docks under typical summer water levels during the cruise sailing season. The south side of the Queen Street Wharf was surveyed subsequent to the majority of the sites using different equipment and involved fewer soundings and is therefore expected to produce slightly more variability in results; the difference is not expected to impact the findings presented herein.

In order to better represent the available depths for cruise ship mooring under variable water level conditions, an analysis of historic water levels was completed as discussed in the following section.

### **Review of Historic Water Levels**

Water levels at Kingston are variable from season to season and from day to day. The seasonal and long term variations are due to the hydrologic inputs to the lake from the broader Great Lakes system and the regional contributing catchments. Water levels in Lake Ontario are controlled at the hydro dam near Cornwall, Ontario. Shorter term water

level variations are due to oscillations within Lake Ontario and more locally, within the regional Kingston basin. These oscillations are largely due to wind effects which can vary considerably on a short-term basis.

As a result of this water level variability, the available depth (vessel draft) at any given location is constantly changing, and a site may be viable some of the time, but not others. Long-term Lake Ontario Water Levels are presented in Appendix B to this memorandum. The first figure in Appendix B shows long-term historic trends in average Lake Ontario levels. As mentioned however, there are regional and short-term variations which are not reflected in these average trends.

The Canadian Hydrographic Service of the Department of Fisheries and Oceans measures water levels at Kingston on an ongoing basis. Water levels from recent years are available at 6 minute intervals; older local historic water level information is generally available on an hourly basis. Hourly water level data between 1962 and 2017 have been collected and assessed for the windowed periods of interest (cruise ship sailing season).

City of Kingston staff have advised that the sailing season is typically June 1 to September 20 for most vessels of interest. One vessel (Hamburg) sails only between August 1 and September 20. Therefore, historic water level data for these periods have been assessed to determine the percentage of time within the record, the water level has been above (or below) any given value.

Plots representing this assessment are presented in Appendix B to this memorandum. The viability of mooring at any given site depends on the depth (dictated by the water level and local bed elevations discussed in the previous two sections) and the depth requirements of the vessel. These depth requirements are discussed in the following section.

### **Review of Vessel Characteristics**

A total of 5 vessels have been considered for potential mooring at Kingston. A summary of the vessel characteristics is presented in the table below.

<b>Cruise Ships Considered : Vessel Characteristics</b>			
<b>Vessel Name</b>	<b>Length (m)</b>	<b>Breadth (m)</b>	<b>Draft (m) (nominal)<sup>1</sup></b>
<b>M/V Victory 1</b>	91.44	15.24	4.12
<b>Pearl Mist</b>	99.05	16.8	3.5
<b>Hamburg</b>	145.00	21.5	5.75
<b>Grand Caribe</b>	54.10	11.91	2.10
<b>Grand Mariner</b>	56.64	11.91	2.00

1. Vessel draft is reported here as the actual depth to keel as per information provided. Additional clearance requirements not included here.

The draft of a vessel is a variable that is affected by the nature of the vessel loading, the vessel ballast and dynamics when under power. Vessel draft relevant to the mooring requirements for the vessels discussed herein were reviewed with Richard Winnel of the Canadian Marine Pilots Association. Mr. Winnel confirmed the nominal draft

requirements for the vessels and advised that insurance requirements generally include a 10% allowance above the nominal draft for under-keel clearance.

For the purpose of this investigation, a minimum under-keel allowance of 0.5 m or 10% of the nominal draft (whichever is larger) has been assumed. For example, adequate draft for mooring of the MV Victory 1 would be 4.52 m (0.5 m clearance above nominal draft), while adequate draft for mooring the Hamburg would be 6.32 m (0.57 m clearance above nominal draft).

The vessel length and beam are also relevant considerations with regard to space constraints at the wharf. For the purpose of this analysis, it is assumed that no more than 10% of the vessel length may overhang at either end of a mooring wall without consideration of additional mooring structures (such as dolphins). This assumption would be subject to vessel specific considerations but is consistent with comments from Mr. Winnel and considered appropriate for this level of review.

The assumed vessel alignment while moored is presented in the Figures in Appendix C to this memorandum. Where physical dock wall length is insufficient to limit overhang to 10% of the vessel length, the vessel is placed as far forward along the wharf wall as considered practical. In some cases, the limiting of overhang length would require dredging of the mooring area. Such considerations are discussed in the following sections.

### **Review of Mooring Potential**

The potential for mooring each of the vessels noted above at each of the 4 sites surveyed has been considered on the basis of the percentage of time during the sailing season that the water depth is sufficient to provide the nominal draft + specified allowance. The results are presented graphically in Appendix C to this memorandum, and are discussed briefly below.

#### **a) Queen Street Wharf:**

The Queen Street Wharf is situated immediately south of the present Wolf Islander Ferry dock. The pier is not utilized and is overgrown; a parking lot is situated at the inshore end of the pier. While there are no obvious signs of significant deterioration of the steel sheet pile, the condition of the structure has not been investigated in detail. Local depths generally vary between approximately 3.0 m and 4.5 m below datum. The suitability of the south face of the Queen Street Wharf for each of the vessels considered is summarised below:

- The M/V Victory I typically would not have sufficient draft clearance throughout the majority of the berthing area and therefore, dredging would be required if this location is considered further for this vessel. The wharf does appear to provide sufficient length for mooring with minimal vessel overhang.
- The Pearl Mist would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season over much of the mooring area but it is still expected that some localized dredging would be required along the wharf wall and potentially near the inshore (west)end of the mooring area. The wharf does appear to provide sufficient length for mooring with minimal vessel overhang.



- The practicality of mooring the Hamburg at the Queen Street Wharf is limited. There would not be sufficient draft clearance in this location without considerable dredging efforts in the mooring area and the approach. Furthermore, the wharf does not provide sufficient length for this vessel and it is expected that supplementary structural considerations such as dolphins would be required to provide mooring support beyond the east of the end of the wharf.
- The Grand Caribe and Grand Mariner would have nominal draft + 0.5 m clearance more than 95% of the time within the mooring area during the sailing season based on the historic water level record. The wharf provides sufficient length for mooring without overhang.

Dredging costs will depend on the sediment characteristics and quality. Dredge design would need to consider the structural characteristics of the wharf wall and would be constrained by the natural shoreline near the southwest limits of the mooring area.

It is not possible to estimate the dredging requirements necessary to accommodate the Hamburg at this location based on the information available and due to uncertainty in approach conditions. It is anticipated that costs for dredging and structural modifications as well as permitting implications could make this site an impractical location for the Hamburg.

Dredging requirements to accommodate the M/V Victory 1 along the south wall of the Queen Street Wharf are roughly estimated at 1500 m<sup>3</sup>; assuming an allowance of \$50/m<sup>3</sup> for dredging and \$50/m<sup>3</sup> for disposal, the approximate cost of dredging would be expected to be on the order of \$150,000. It is possible that dredging costs could be offset to some extent if the vessel mooring location is shifted to the east; this would require additional structural measures such as mooring dolphin(s) constructed off the east end of the pier. Dredging to accommodate the M/V Victory 1 would accommodate the Pearl Mist as well.

Additional costs for structural review, dredge design and any structural modifications which may be necessary to accommodate mooring of the cruise ships considered herein have not been estimated at this time. Navigation charts indicate depth limitations over a portion of the approach to this location for the M/V Victory 1 and the Pearl Mist which would also require dredging. The costs of such efforts have not been addressed at this time and require detailed survey of this region of the approach route.

#### b) Crawford Wharf

The Crawford Wharf is presently the loading/unloading dock for a number of small local cruise boats. While the capability of the site for smaller vessel mooring is generally accepted and approach routes are understood, the site is more challenging for larger vessels with increased draft requirements. The local depths are somewhat variable with depths of 4 m +/- below datum along approximately half of the length of the north face, but with diminishing depths moving west along the wharf wall. There is also a marginal reduction in depth immediately east of the end of the wharf which may be a pose some restrictions on vessel approach. The suitability of the Crawford Wharf for each of the vessels considered is summarised below:

- The M/V Victory I typically would not have sufficient draft clearance throughout the majority of the berthing area and therefore, dredging would be required if this

location is considered further for this vessel. The north face of the wharf would require a dredging to be focused at the western end of the berth with some dredging along the wharf wall. The south face would require dredging throughout, with most efforts to be focused along the south edge of the mooring area and in the approach channel. It is expected that the vessel overhang at this location would be unacceptable for the M/V Victory 1 on the north side of the wharf due to space constraints (local shoreline structure) for the vessel bow. Mooring on the south side of the wharf with this size of vessel may result in conflicts with recreational vessels using the northern entrance to Confederation Basin. Therefore, it is expected that mooring dolphin(s) would be required to make this a viable location.

- The Pearl Mist would have nominal draft + 0.5 m clearance more than 95% of the time over much of the required mooring length along the south wall but some dredging would be required at the west end of the berth and in isolated areas along the berth length. Similar concerns expressed for the M/V Victory 1 would apply to the Pearl Mist, including proximity of structures near the bow on the north side of the wharf and potential conflicts with local recreational boating activity on the south side of the wharf. Therefore, it is expected that mooring dolphin(s) would be required to make this a viable location. As with the Queen Street wharf, reduced dredging requirements could be achieved through shifting the mooring location to the east through the use of dolphins.
- The practicality of mooring the Hamburg at the Crawford wharf is limited. Extensive dredging would be required throughout the mooring area and in the approach in order to provide draft clearance. Furthermore, supplementary structures (e.g. dolphins) would be necessary to provide suitable berth length.
- The Grand Caribe and Grand Mariner would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season based on the historic water level record. The wharf provides sufficient length for mooring without overhang.

Dredging costs will depend on the sediment characteristics and quality. Dredge design would need to consider the structural characteristics of the wharf wall and local adjacent structures.

It is not possible to estimate the dredging requirements necessary to accommodate the Hamburg at this location based on the information available and due to uncertainty in approach conditions. It is anticipated that costs for dredging and structural modifications as well as permitting implications could make this site an impractical location for the Hamburg.

Dredging requirements to accommodate the M/V Victory 1 along the north wall of the Crawford Wharf are roughly estimated at 2000 m<sup>3</sup>; assuming an allowance of \$50/m<sup>3</sup> for dredging and \$50/m<sup>3</sup> for disposal, the approximate cost of dredging would be expected to be on the order of \$200,000. Dredging to accommodate the M/V Victory 1 would accommodate the Pearl Mist as well.

Additional costs for structural review, dredge design and any structural modifications which may be necessary to accommodate mooring of the cruise ships considered herein have not been estimated at this time. Navigation charts indicate depth limitations over a portion of the approach to this location for the M/V Victory 1 and the Pearl Mist which

would also require dredging. The costs of such efforts have not been addressed at this time and require detailed survey of this region of the approach route.

c) 55 Ontario Street Wharf:

The Wharf at 55 Ontario Street is presently not used for any intensive marine function. The condition of the underwater portions of the structure in general is uncertain, but casual observation does indicate that the concrete parapet structures that historically formed the surface perimeter of the wharf are in a state of considerable disrepair and it is expected that relatively significant structural works would be necessary at this site to provide a suitable mooring space. The local depths are somewhat variable in the area with depths of 6 m +/- to 7 m +/- below datum along the east end of the wharf, decreasing to 5 m +/- below datum and less along the north and south sides of the wharf. The suitability of the Wharf at 55 Ontario Street for mooring each of the vessels considered is summarised below:

- The M/V Victory I would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season based on the historic water level record. This depth would be available along the east end of the Wharf, but it is expected that mooring would require consideration of supplementary structures such as dolphins or reconstruction of the wharf walls to ensure a suitable berth space as well as infrastructure improvements to provide for safe passenger loading and unloading. Suitable depths are also available along the south face of the 55 Ontario Street Wharf wall but this wharf wall and upland area is also in a state of considerable disrepair.
- The Pearl Mist would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season based on the historic water level record. This depth would be available along the east end of the 55 Ontario Street location, but it is expected that mooring would require consideration of supplementary structures such as dolphins or reconstruction of the wharf walls to ensure a suitable berth space as well as infrastructure improvements to provide for safe passenger loading and unloading.. Suitable depths are also available along the south face of the 55 Ontario Street Wharf wall but as previously noted, the wharf wall upland area is in a state of considerable disrepair.
- While the Hamburg would have nominal draft + 0.57 m clearance more than 95% of the time during the sailing season over most of the potential mooring space along the east end of the 55 Ontario Street Wharf, the geometry of this vessel is somewhat challenging due to the proximity of the pier at the end of Gore Street. It is expected that supplementary mooring structures and reconstruction of the wharf walls would be required to ensure a suitable berth space as well as infrastructure improvements to provide for safe passenger loading and unloading.. The vessel is expected to be too long to practically moor along the south side of the 55 Ontario Street Wharf.
- The Grand Caribe and Grand Mariner would have nominal draft + 0.5 m clearance more r than 95% of the time during the sailing season based on the historic water level record. It is anticipated that supplementary mooring structures or wharf wall reconstruction would be required to permit mooring on the east end or south side of the 55 Ontario Street Wharf. Additional infrastructure improvements would be required to permit safe passenger loading and unloading.

The cost of structural measures to accommodate mooring at this site have not been estimated at this time and would require site specific investigations to provide conceptual designs for budgetary considerations. Of the sites considered, it is expected that this site would require the most intensive shoreline improvements to provide for a suitable mooring location. A small lake bed area just off the northeast corner of the wharf requires further investigation to define the nature of a local high point in the bed and potential local dredge requirement.

d) Coal Dock:

The Coal Dock at the former Psychiatric Hospital is presently not used for any intensive marine function. The structure is subject to some deterioration and is presently fenced off to the public. The local depths are generally uniform in the area and on the order of 6 m +/- below datum near the wharf wall, increasing offshore. The suitability of the Coal Dock for mooring each of the vessels considered is summarised below:

- The M/V Victory I would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season based on the historic water level record. It is expected that there would be minimal vessel overhang at this location, but it is anticipated that some structural improvements would be required to provide a competent mooring structure.
- The Pearl Mist would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season based on the historic water level record. There would be approximately 20 m of vessel overhang at this location for the Pearl Mist and it is anticipated that some structural improvements would be required to provide a competent mooring structure..
- The Hamburg would have nominal draft + 0.57 m clearance over much of the wharf length more than 95% of the time during the sailing season based on the historic water level record. There are, however some depth limiting areas along the edge of the wharf where dredging is expected to be necessary if this site was to be considered. The Hamburg would overhang the end of the wharf by about 30 m +/- at both ends and therefore, it is expected that additional structural measures would be required to accommodate the vessel length and it is anticipated that some structural improvements would be required to the existing dock wall to provide a competent mooring face.
- The Grand Caribe and Grand Mariner would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season based on the historic water level record. The wharf provides sufficient length for mooring without overhang but it is anticipated that some structural improvements would be required to provide a competent mooring structure..

The cost of structural measures to accommodate mooring at this site have not been estimated at this time and would require site specific investigations to provide conceptual designs for budgetary considerations. The nature of bed materials along the dock wall requires further investigation to assess dredging requirements or potential to address the through structural modifications.

### **Closing Comments**

Based on the level of review completed in support of this memorandum, the Queen Street Wharf would appear to be the most suitable location for a potential Cruise Ship mooring site for all vessels considered except the Hamburg. While some moderate dredging is expected to be required, the visible portions of the structure appear to be in relatively good condition, the geometry of the wharf is expected to be adequate and there is presently no intensive marine function at this location. A structural review of the wharf is recommended to identify any potential deficiencies and to provide guidance with regard to dredging constraints. Potential to reduce dredging requirements through provision of mooring dolphins (or other means to extend the mooring area to the east) could be considered at this site. Based on the information presented herein, it is expected that this site is not a practical option for mooring the Hamburg due to geometric and depth considerations. Navigation charts indicate depth limitations in the approach to this location for the M/V Victory 1 and the Pearl Mist which would also require dredging; quantification of these dredging needs requires detailed local investigations of the approach.

The Crawford Wharf presently serves as mooring facility for smaller cruise boats and as such has some level of proven capacity. However, there are depth limitations along the western end of the wharf on the north side and some additional depth constraints along the south side of the wharf which constrain the berth width and approach. With a combination of dredging and structural works to extend the mooring area to the east, it is anticipated that the Crawford Wharf could be a viable mooring location for all vessels considered with the exception of the Hamburg. The proximity of the site to Confederation basin could result in some conflict with recreational vessels. Based on the information presented herein, it is expected that this site is not a practical option for mooring the Hamburg due to geometric and depth considerations. Navigation charts indicate depth limitations in the approach to this location for the M/V Victory 1 and the Pearl Mist which would also require dredging; quantification of these dredging needs requires detailed local investigations of the approach.

The Wharf at 55 Ontario Street has limited accessible contiguous wharf wall length and therefore, it is anticipated that supplementary mooring structures would be required to accommodate a berth in this location. Furthermore, much of the wharf wall in this location is in a state of considerable disrepair and would require structural rehabilitation of the wall and the upland area to provide a competent mooring area and safe passenger handling. As the local depths appear to be suitable for all vessels considered (with minor accommodations required for the Hamburg) this location could be a viable site for all vessels with investment to rehabilitate the shoreline infrastructure. This site is more exposed than the Queen Street and Crawford Wharf locations which could present more challenging docking conditions.

The Coal Dock provides sufficient depths for all vessels considered with the exception of the Hamburg for which some localized dredging would be required. There is some deterioration of the existing dock wall which would require investigation and rehabilitation as may be required to provide a competent mooring structure and safe passenger handling. This site is more exposed than the Queen Street and Crawford Wharf locations which could present more challenging docking conditions.

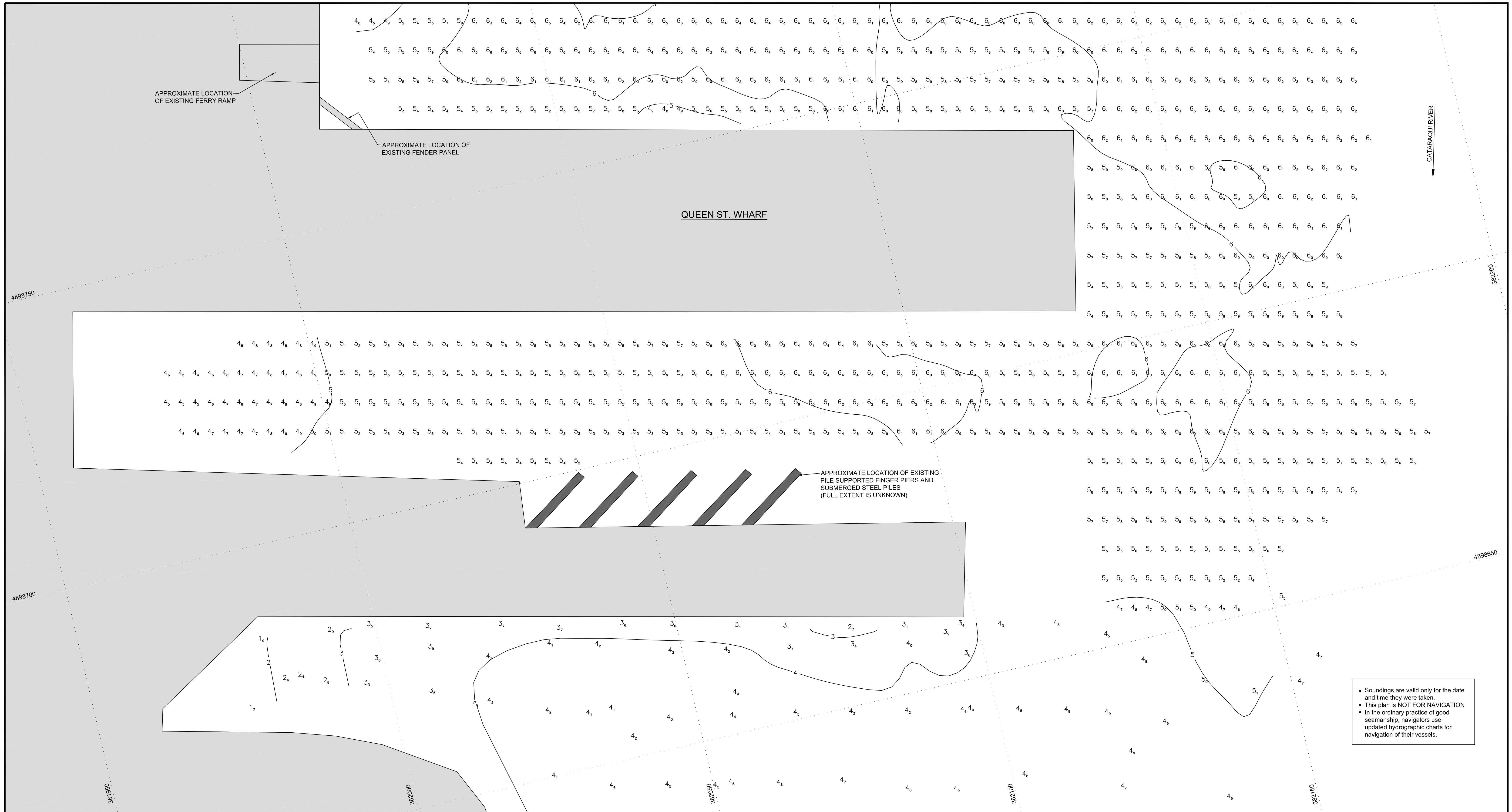
The review provided herein is preliminary in nature. It does not include consideration of the following:

- Structural integrity of the various wharf and dock walls - an assessment of structures would be required to determine what works may be required to adequately accommodate mooring of the vessels considered herein.
- Navigation approach lines - Approaches to each of these sites have not been investigated in detail at this time. It will be important to delineate safe approach lines to any viable mooring site and identify dredging requirements and any other navigation issues to be addressed in this regard.
- Detailed review of hydrodynamics - a detailed review of hydrodynamic conditions affecting vessel motion and associated depth and dredge requirements is recommended to finalize site design parameters. It is noted that the Queen Street and Crawford Dock sites do provide more sheltered locations for mooring.
- Sea Pilot Consultation - It is also recommended that further consultation with the Canadian Marine Pilots Association and their U.S. counterparts is undertaken during any detailed review of a particular site to ensure that all relevant operational issues are resolved..

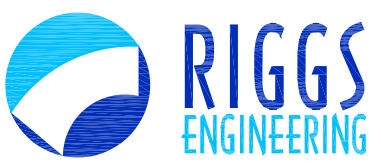
Per: Stu Seabrook, P.Eng.

A handwritten signature in black ink, appearing to read 'S. Seabrook', is positioned to the right of the typed name.

APPENDIX A  
BATHYMETRIC SURVEYS

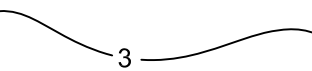


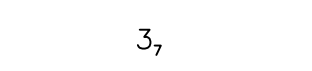
• Soundings are valid only for the date and time they were taken.  
 • This plan is NOT FOR NAVIGATION  
 • In the ordinary practice of good seamanship, navigators use updated hydrographic charts for navigation of their vessels.

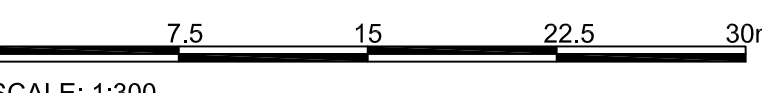
**Firm:**  
  
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No.	Revision	Date
1	REVISED SURVEY LIMITS	OCT/24/2017

**LEGEND:**

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 SOUNDING DEPTH 3.7 METERS BELOW CHART DATUM

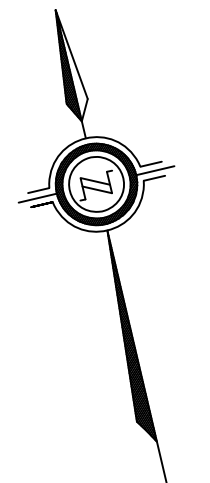
  
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**NOTES:**

- SOUNDINGS WERE TAKEN ON SEPTEMBER 5, 2017 AND OCTOBER 16, 2017.
- SOUNDINGS ARE SHOWN IN METERS BELOW CHART DATUM.
- CHART DATUM FOR LAKE ONTARIO IS 74.2 METERS ABOVE SEA LEVEL (I.G.L.D. 1985).
- WATER LEVEL AT THE TIME OF THE SURVEY ON SEPTEMBER 5 WAS 0.97 METERS ABOVE CHART DATUM, AND THE WATER LEVEL AT THE TIME OF SURVEY ON OCTOBER 16 WAS 0.64 METERS ABOVE CHART DATUM.
- VERTICAL CONTROL ESTABLISHED FROM CHS GAUGE KINGSTON.
- COORDINATE GRID REFERS TO UTM NAD83 ZONE 18.
- POSITIONING SYSTEM - HEMISPHERE R320
- SOUNDER - RESON NAVISOUND 110

\* THE SOUNDING INFORMATION REPRESENTS RESULTS OF THE SURVEY MADE ON THE DATES SPECIFIED AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THAT TIME.

**Stamp:**



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**Client:**  
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 216 ONTARIO ST.  
 KINGSTON, Ontario  
 K7L 2Z3

**Project Name:**  
 2017 SOUNDINGS FOR  
 CRUISE SHIP BERTHING

**Drawing Title:**  
 QUEEN ST. WHARF  
 SOUNDING SURVEY  
 2017

Date:	SEPT. 7, 2017	Drawn by:	AM	Checked by:	BR
Scale:	AS NOTED:	Project No.	17-1326		
		Drawing No.	<b>MA-01</b>		



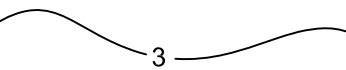


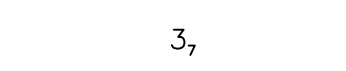
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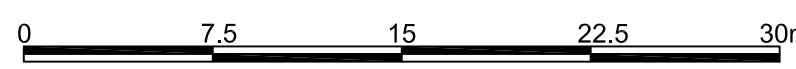
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No.	Revision	Date

**LEGEND:**

 3  
 MAJOR SUBMERGED DEPTH CONTOUR BELOW CHART DATUM

 3,  
 SOUNDING DEPTH 3.7 METERS BELOW CHART DATUM

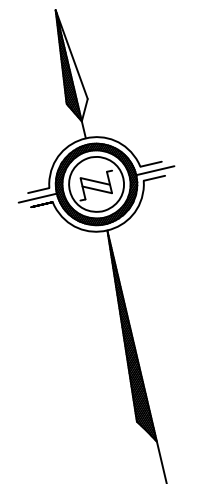
  
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**NOTES:**

- SOUNDINGS WERE TAKEN ON SEPTEMBER 5, 2017.
- SOUNDINGS ARE SHOWN IN METERS BELOW CHART DATUM.
- CHART DATUM FOR LAKE ONTARIO IS 74.2 METERS ABOVE SEA LEVEL (I.G.L.D. 1985).
- WATER LEVEL AT THE TIME OF THE SURVEY WAS 0.96 METERS ABOVE CHART DATUM.
- VERTICAL CONTROL ESTABLISHED FROM CHS GAUGE KINGSTON.
- COORDINATE GRID REFERS TO UTM NAD83 ZONE 18.
- POSITIONING SYSTEM - HEMISPHERE R320
- SOUNDER - RESON NAVISOUND 110

\* THE SOUNDING INFORMATION REPRESENTS RESULTS OF THE SURVEY MADE ON THE DATES SPECIFIED AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THAT TIME.

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 KINGSTON, Ontario  
 K7L 2Z3

**Project Name:**  
 2017 SOUNDINGS FOR  
 CRUISE SHIP BERTHING

**Drawing Title:**  
 CRAWFORD WHARF  
 SOUNDING SURVEY  
 2017

**Date:** SEPT. 7, 2017

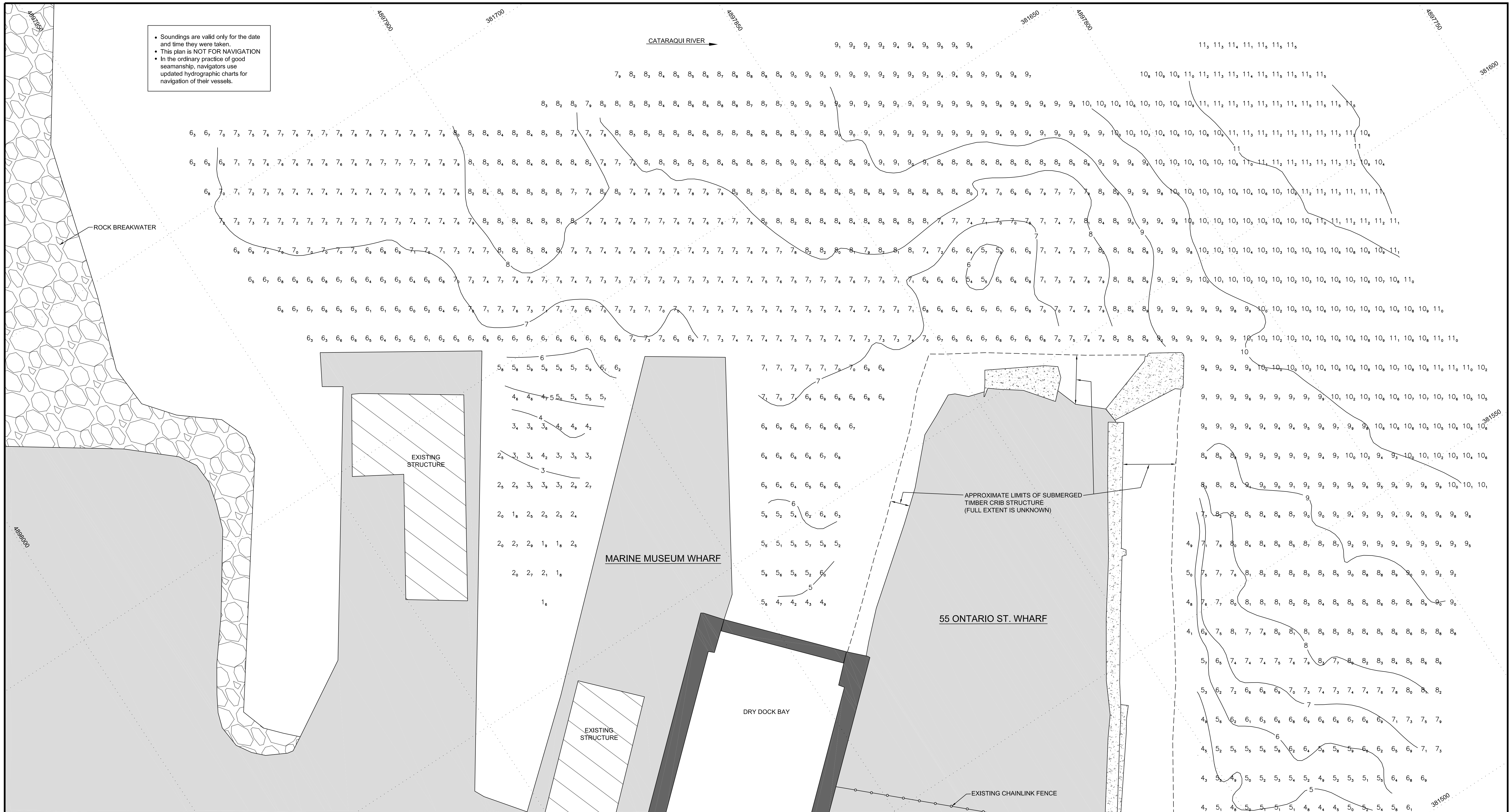
**Drawn by:** AM

**Checked by:** BR

**Scale:** AS NOTED

**Project No.:** 17-1326

**Drawing No.:** MA-02



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SCALE: 1:300

**NOTES:**

- SOUNDINGS WERE TAKEN ON SEPTEMBER 5, 2017.
- SOUNDINGS ARE SHOWN IN METERS BELOW CHART DATUM.
- CHART DATUM FOR LAKE ONTARIO IS 74.2 METERS ABOVE SEA LEVEL (I.G.L.D. 1985).
- WATER LEVEL AT THE TIME OF THE SURVEY WAS 0.95 METERS ABOVE CHART DATUM.
- VERTICAL CONTROL ESTABLISHED FROM CHS GAUGE KINGSTON.
- COORDINATE GRID REFERS TO UTM NAD83 ZONE 18.
- POSITIONING SYSTEM - HEMISPHERE R320
- SOUNDER - RESON NAVISOUND 110

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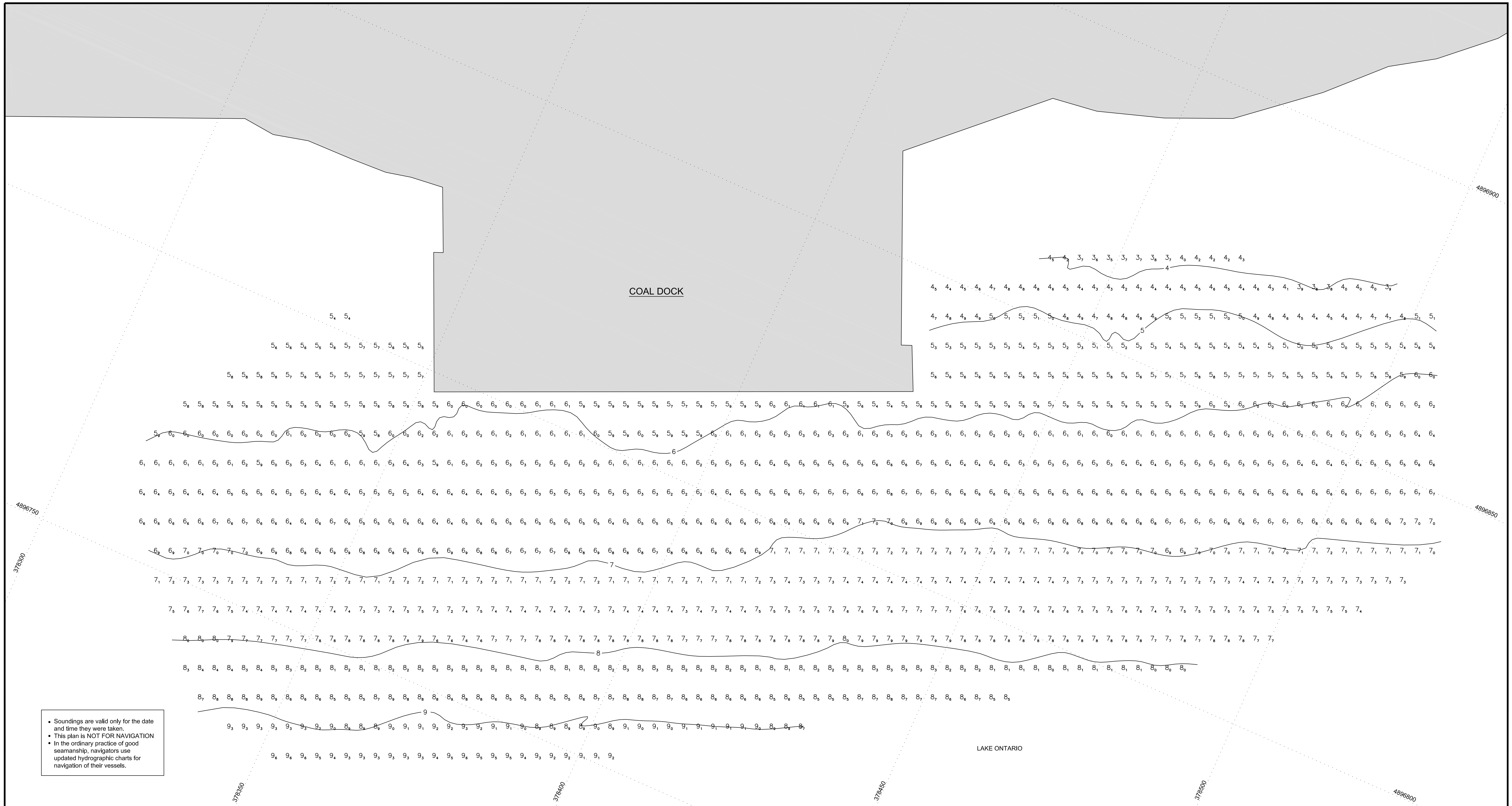
Client: **CITY OF KINGSTON**  
 216 ONTARIO ST.  
 KINGSTON, Ontario  
 K7L 2Z3

Project Name: **2017 SOUNDINGS FOR CRUISE SHIP BERTHING**

Drawing Title: **MUSEUM DOCK SOUNDING SURVEY 2017**

Date: SEPT. 7, 2017  
 Drawn by: AM  
 Checked by: BR

Scale: AS NOTED  
 Project No. 17-1326  
 Drawing No. **MA-03**



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No.	Revision	Date

**LEGEND:**

MAJOR SUBMERGED DEPTH CONTOUR BELOW CHART DATUM

SOUNDING DEPTH 3.7 METERS BELOW CHART DATUM

0 7.5 15 22.5 30m  
 SCALE: 1:300

**NOTES:**  
 1. SOUNDINGS WERE TAKEN ON SEPTEMBER 5, 2017.  
 2. SOUNDINGS ARE SHOWN IN METERS BELOW CHART DATUM.  
 3. CHART DATUM FOR LAKE ONTARIO IS 74.2 METERS ABOVE SEA LEVEL (I.G.L.D. 1985).  
 4. WATER LEVEL AT THE TIME OF THE SURVEY WAS 0.96 METERS ABOVE CHART DATUM.  
 5. VERTICAL CONTROL ESTABLISHED FROM CHS GAUGE KINGSTON.  
 6. COORDINATE GRID REFERS TO UTM NAD83 ZONE 18.  
 7. POSITIONING SYSTEM - HEMISPHERE R320  
 8. SOUNDER - RESON NAVISOUND 110  
 \* THE SOUNDING INFORMATION REPRESENTS RESULTS OF THE SURVEY MADE ON THE DATES SPECIFIED AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THAT TIME.

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Client:  
**CITY OF KINGSTON**  
 216 ONTARIO ST.  
 KINGSTON, Ontario  
 K7L 2Z3

Project Name:  
**2017 SOUNDINGS FOR  
 CRUISE SHIP BERTHING**

Drawing Title:  
**COAL DOCK  
 SOUNDING SURVEY  
 2017**

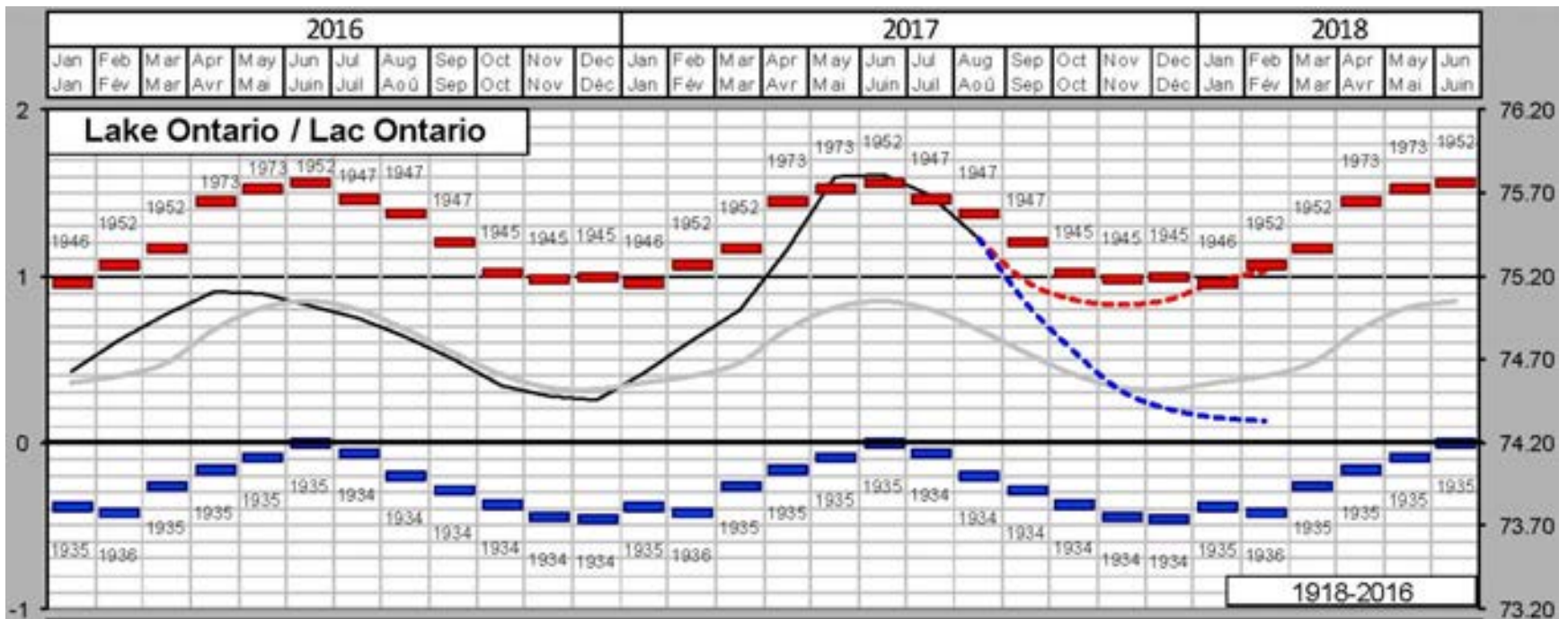
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 Checked by: BR

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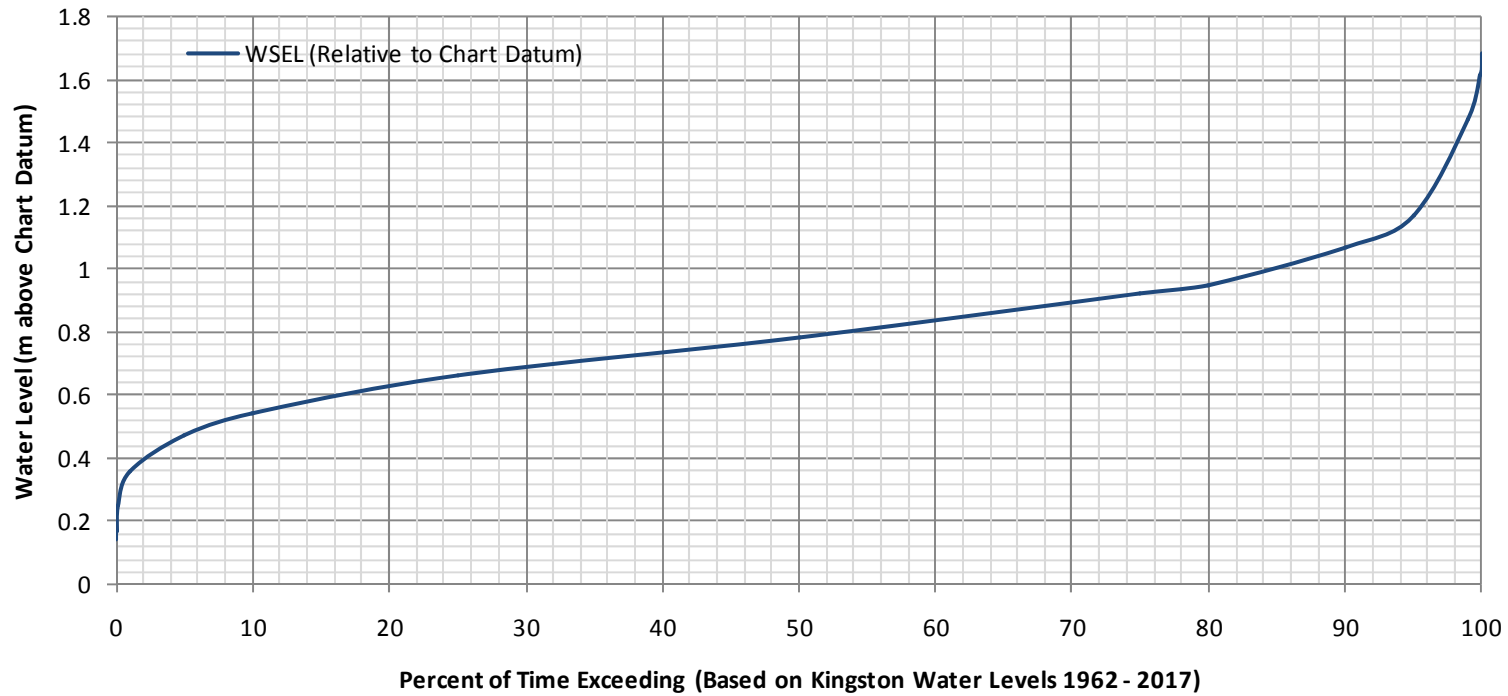
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APPENDIX B  
WATER LEVEL INFORMATION

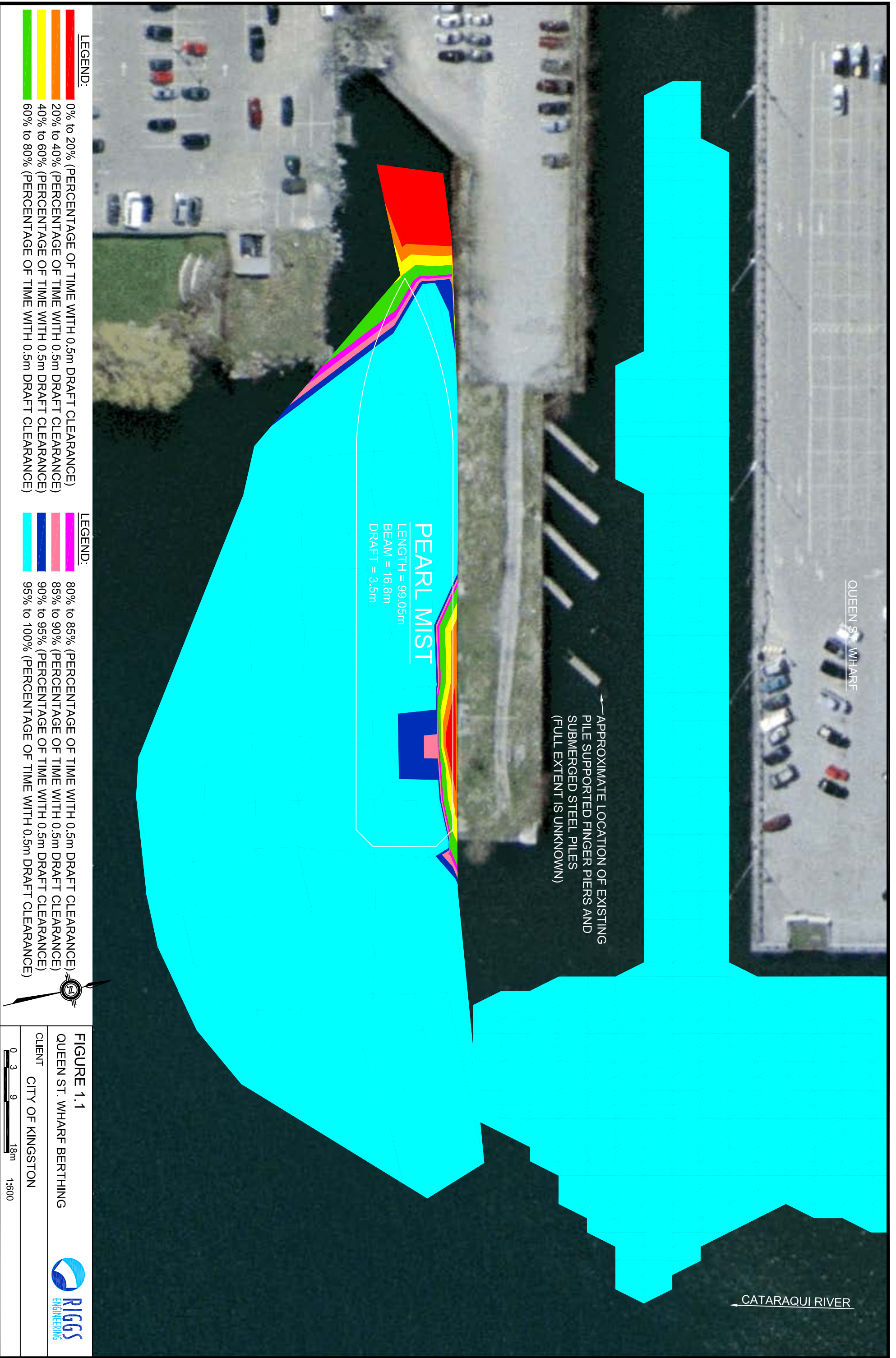
Lake Ontario - Long Term Water Level Trends  
Average Lake Levels



### Boating Season (June 1 to September 20) Water Level (Above Chart Datum)- Percent Exceeding



APPENDIX C  
MOORING POTENTIAL FIGURES





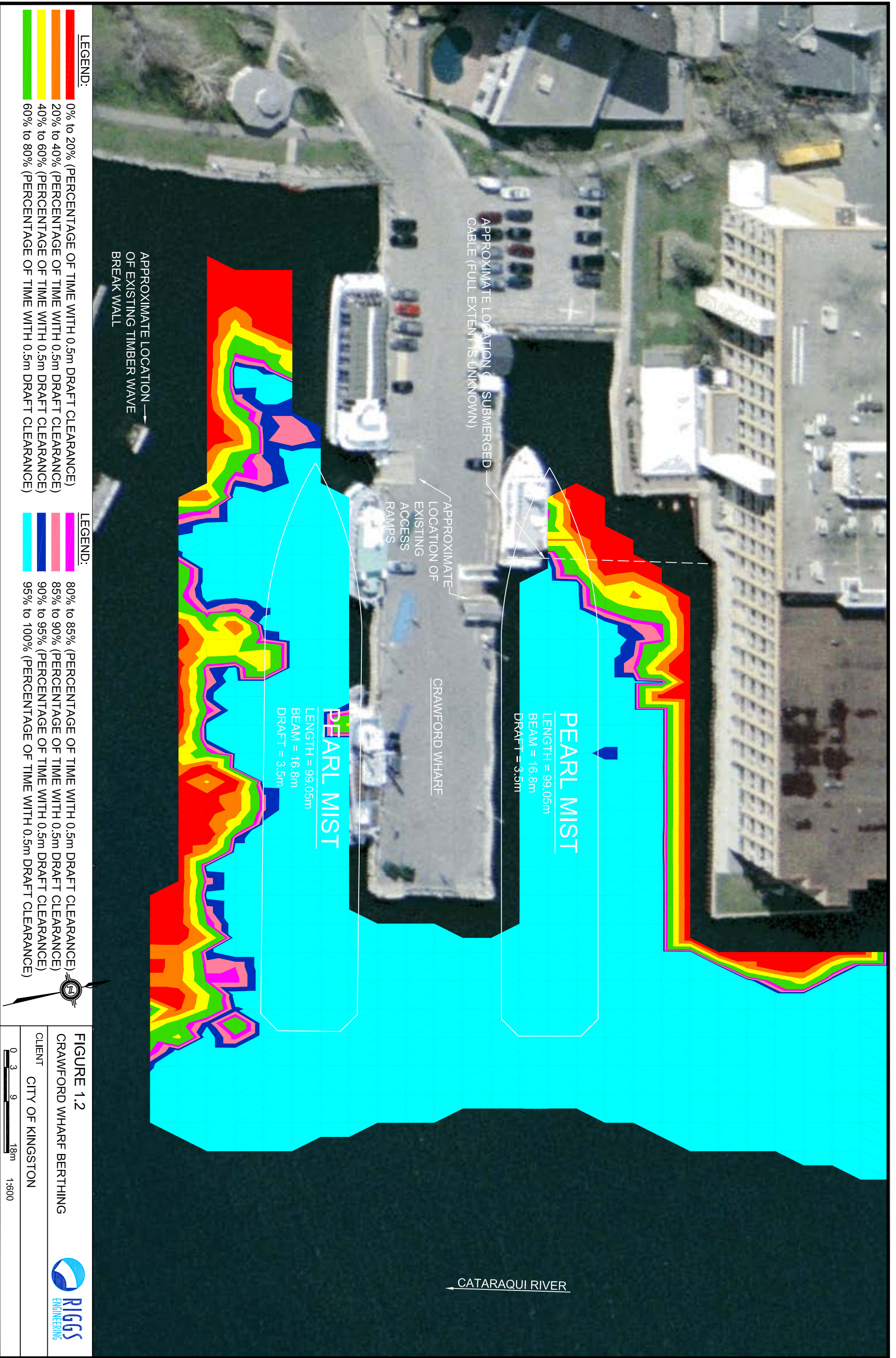
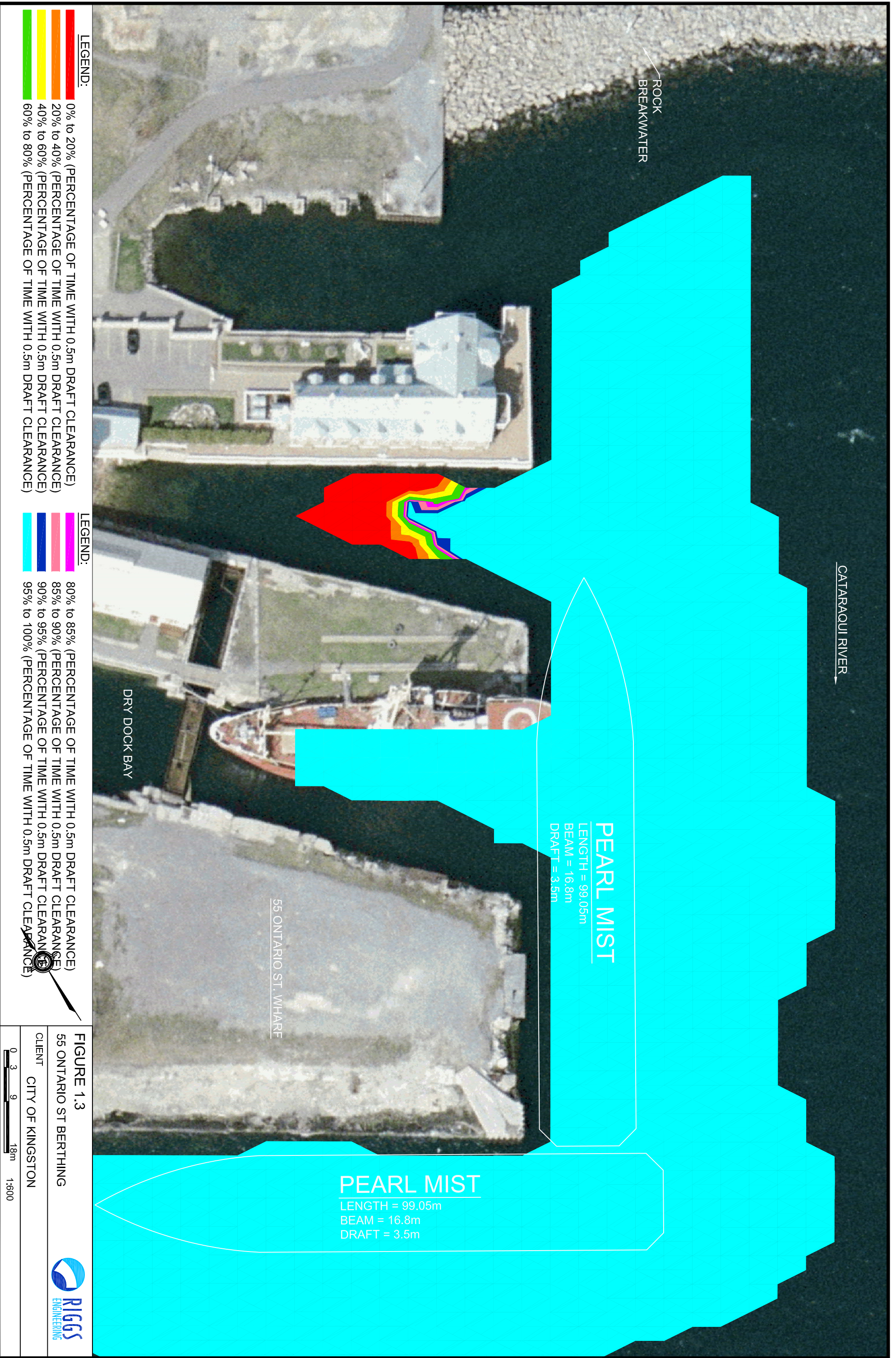
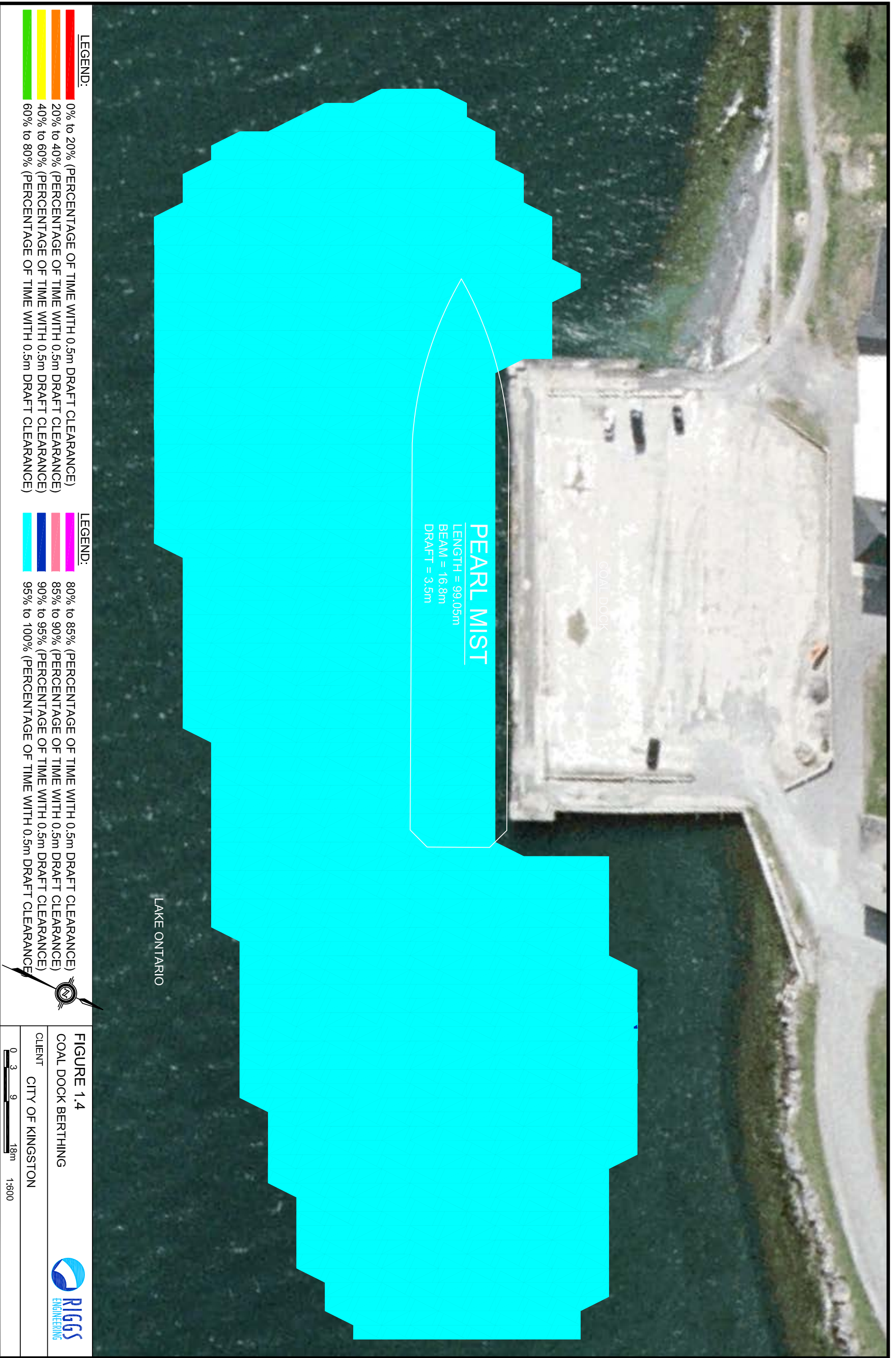
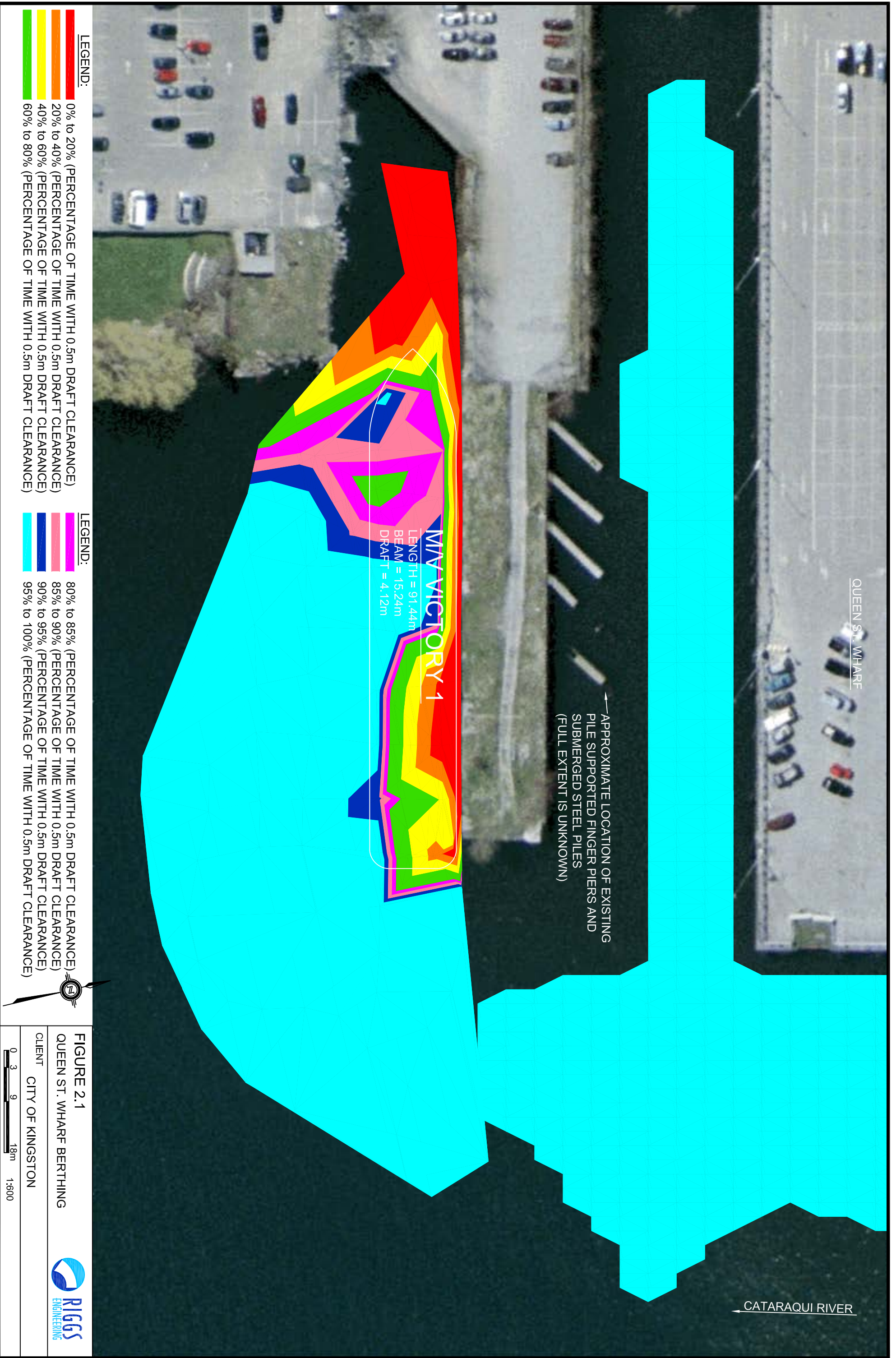


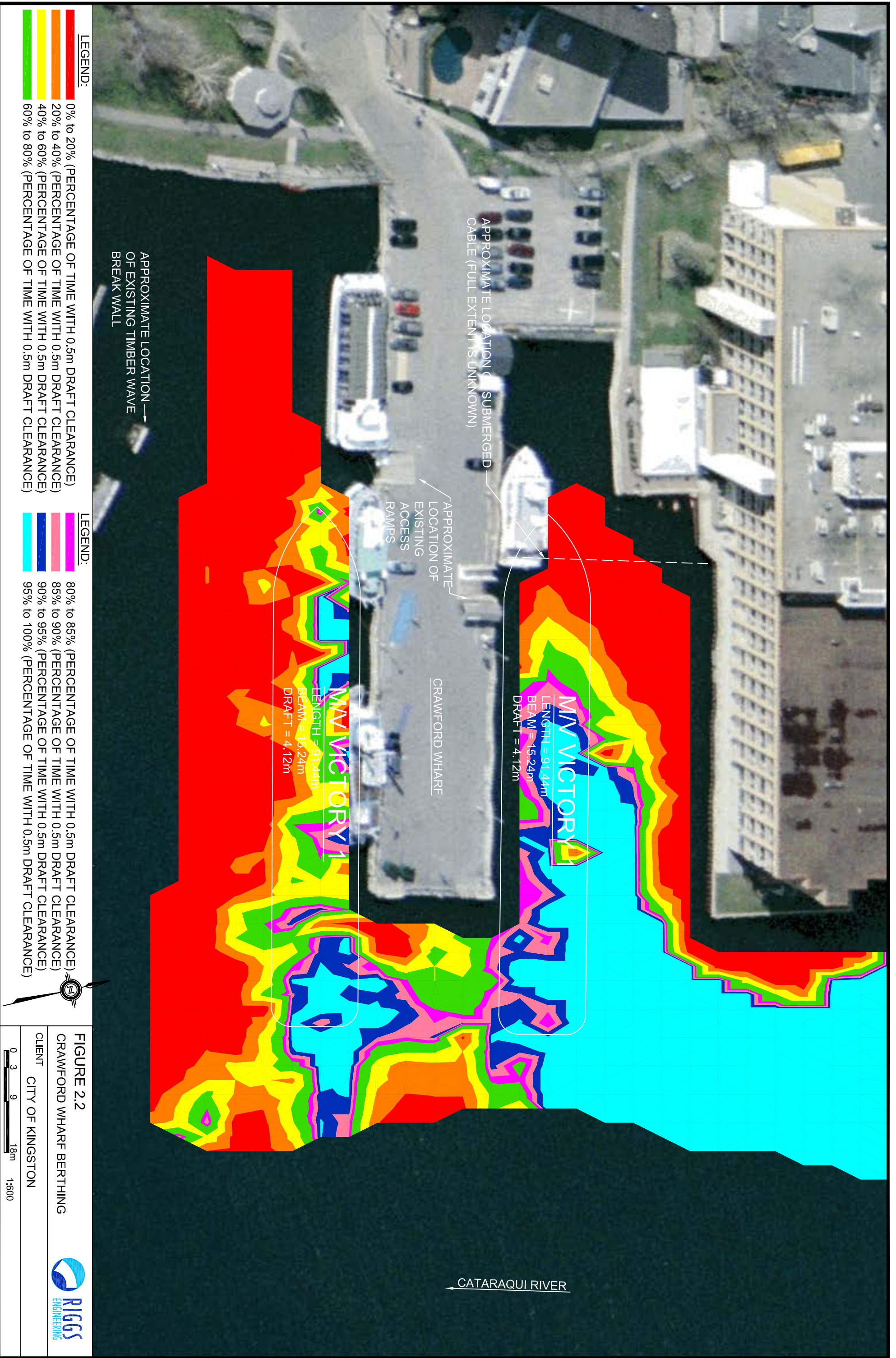
FIGURE 1.2  
CRAWFORD WHARF BERTHING  
CLIENT CITY OF KINGSTON

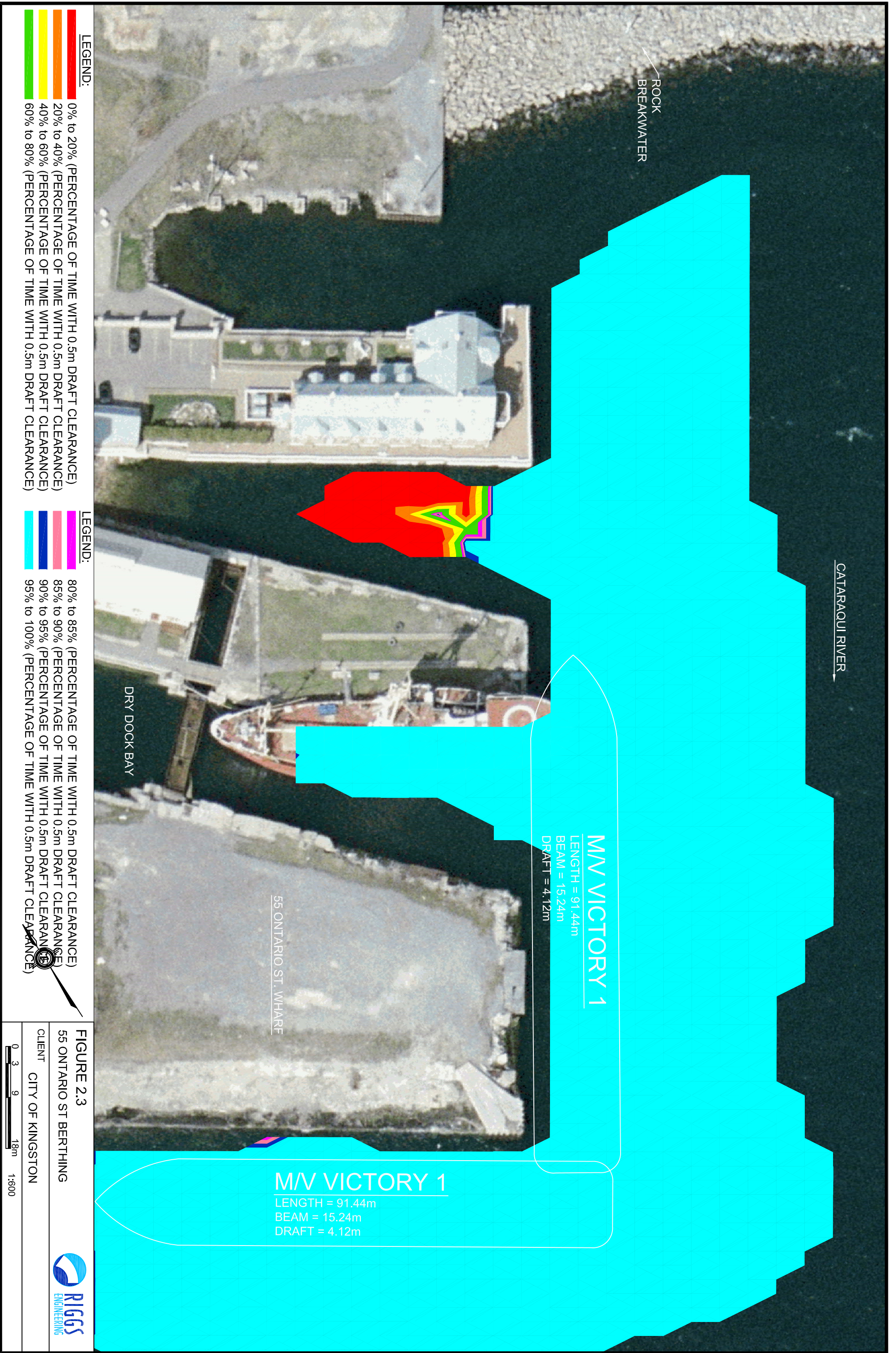


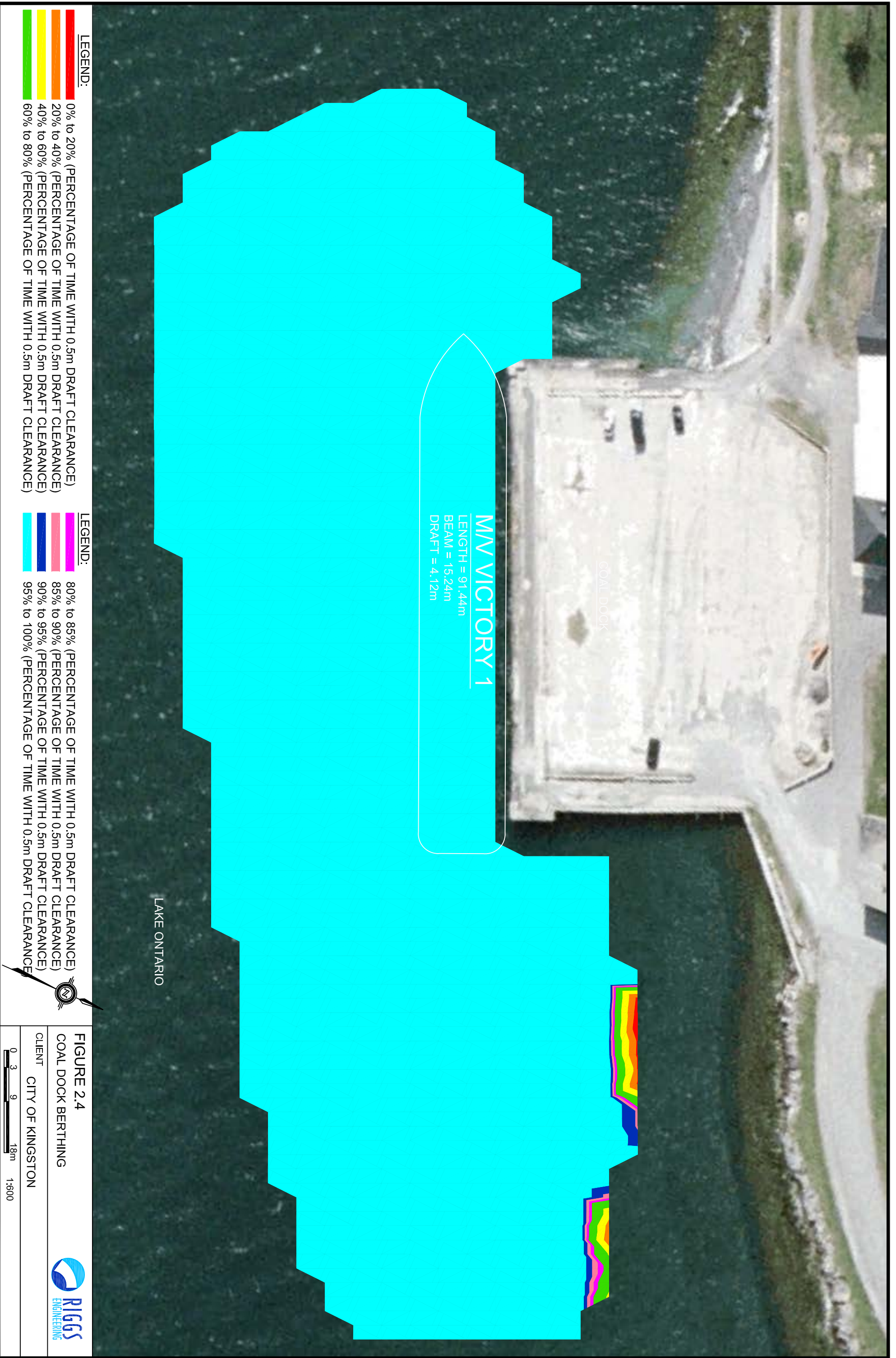


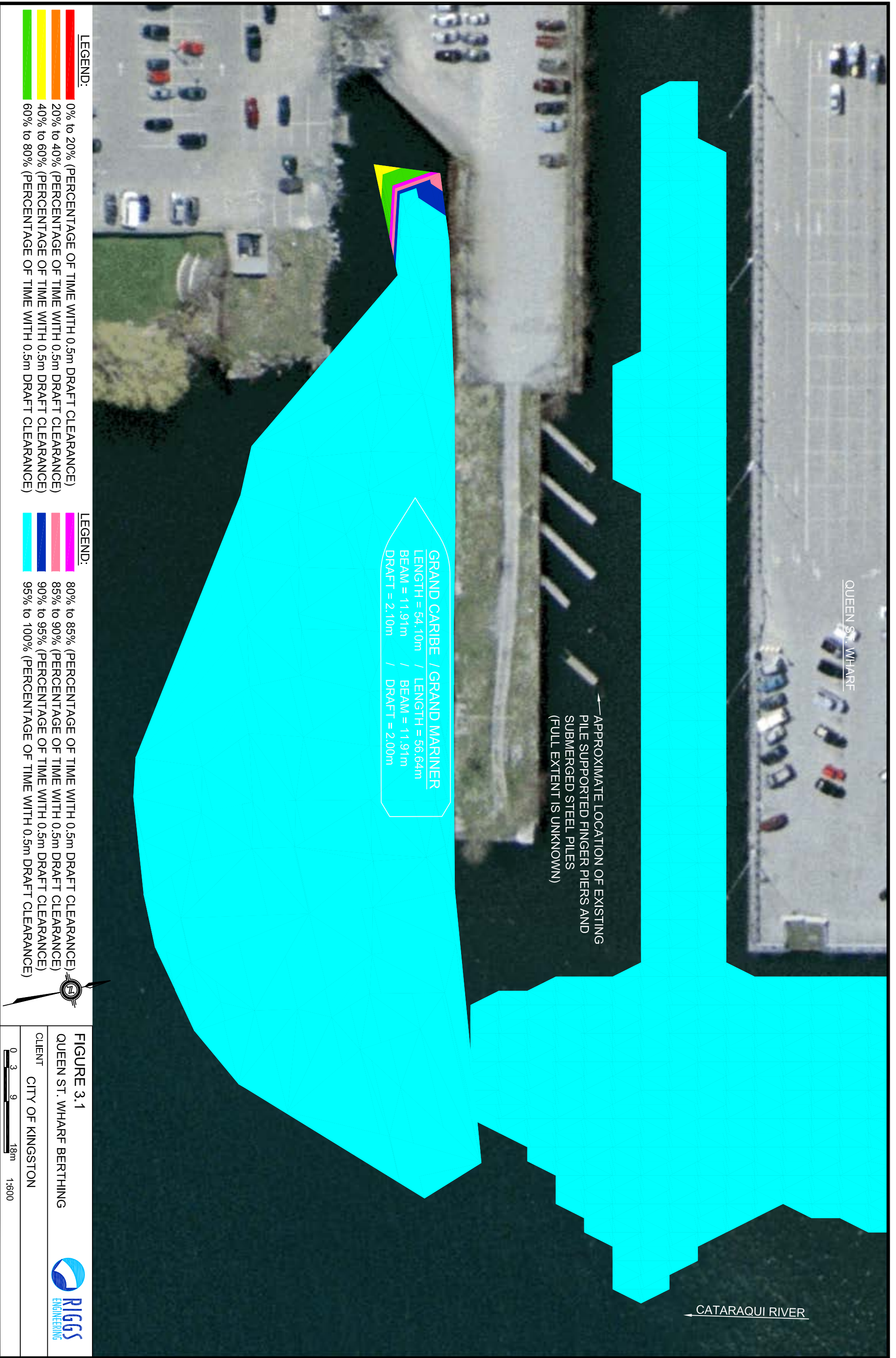




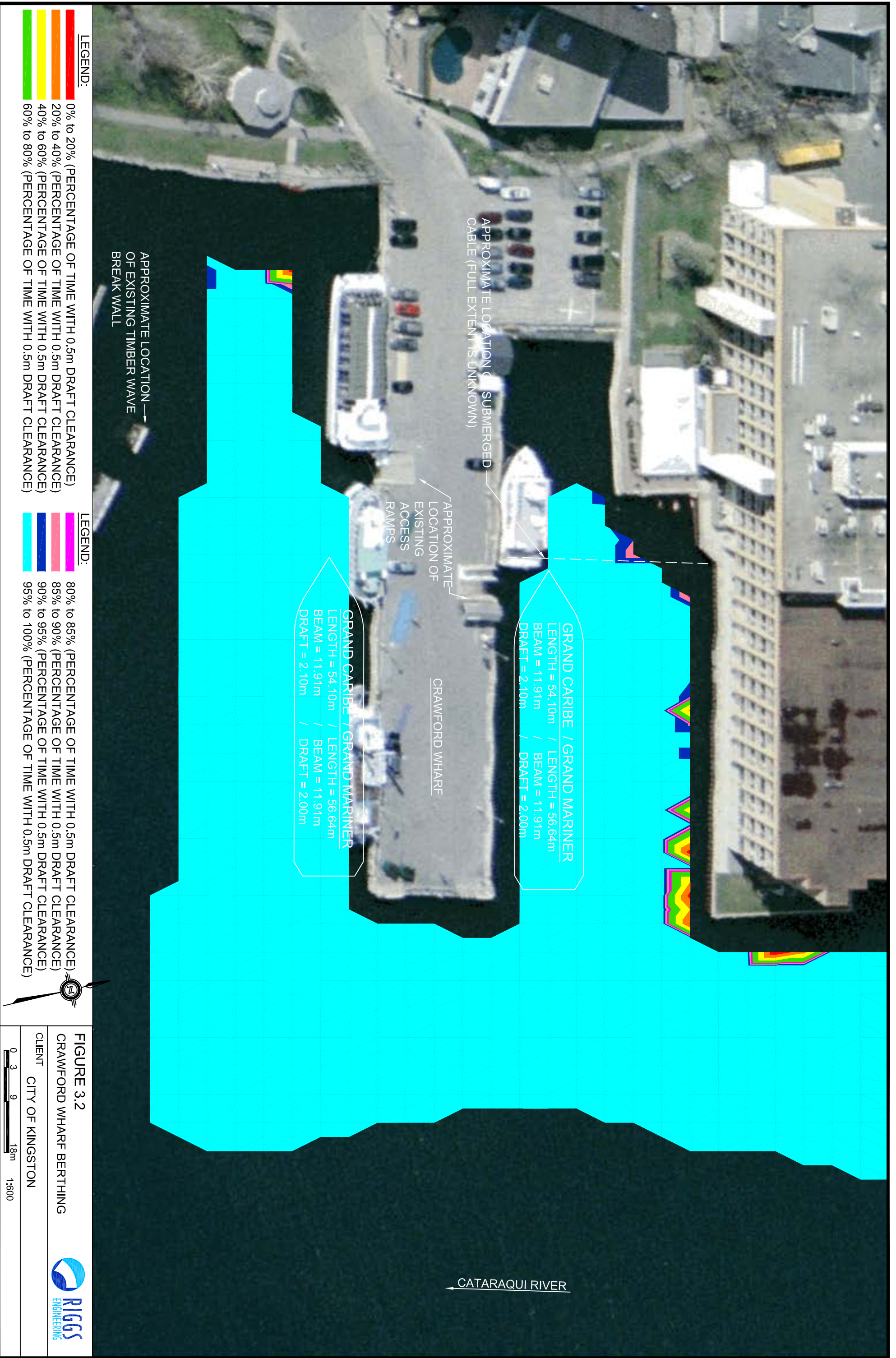


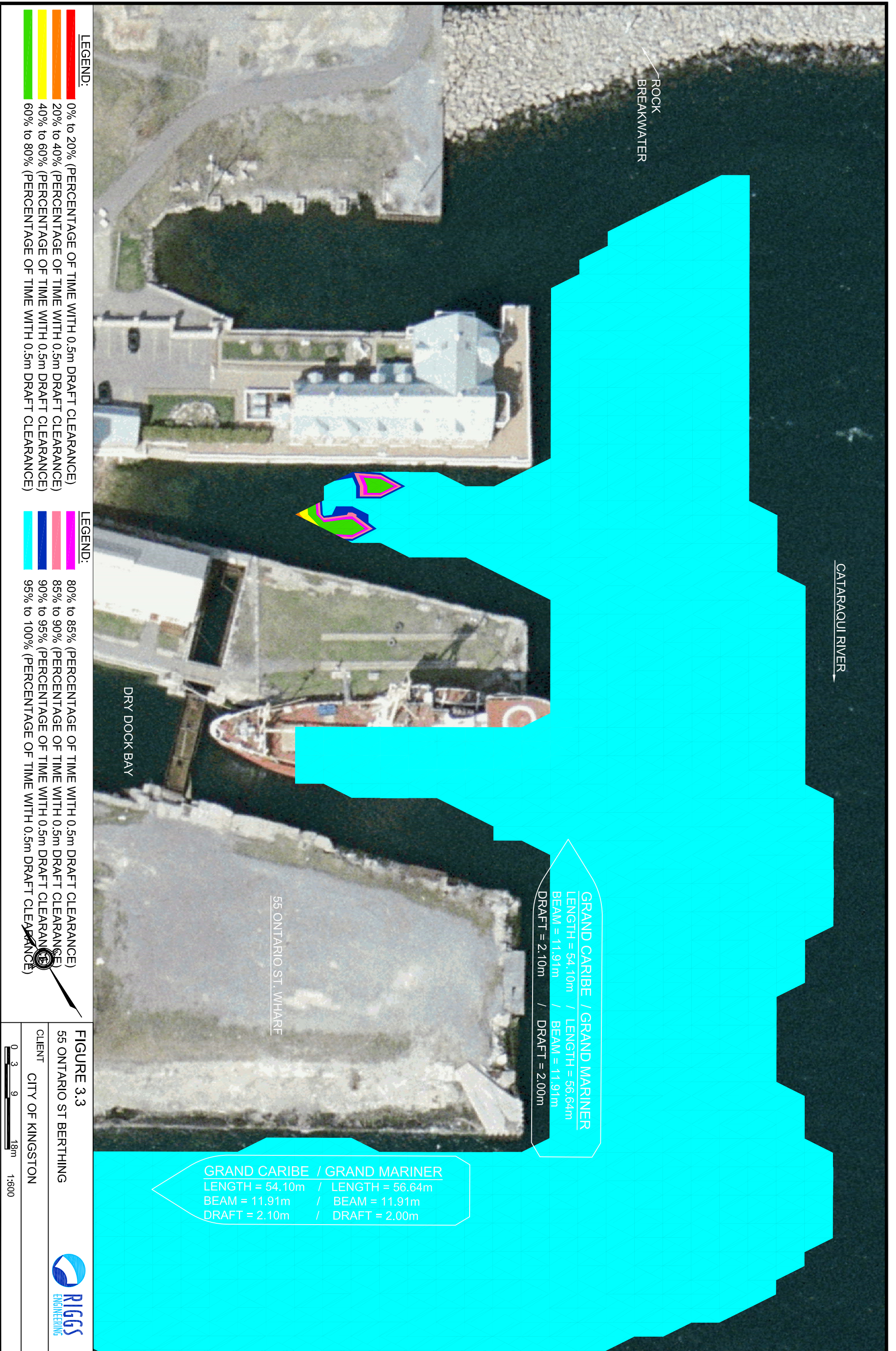








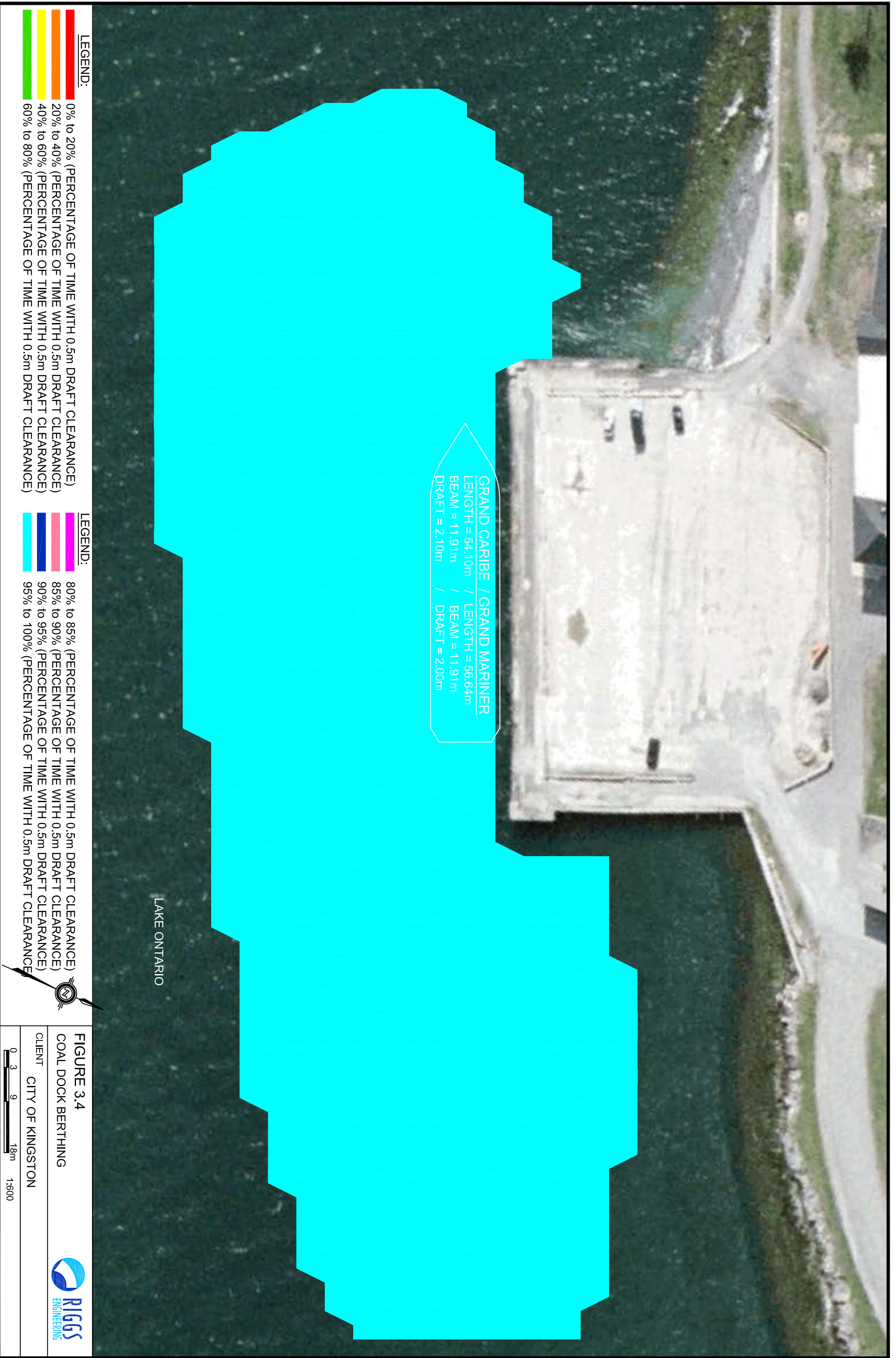


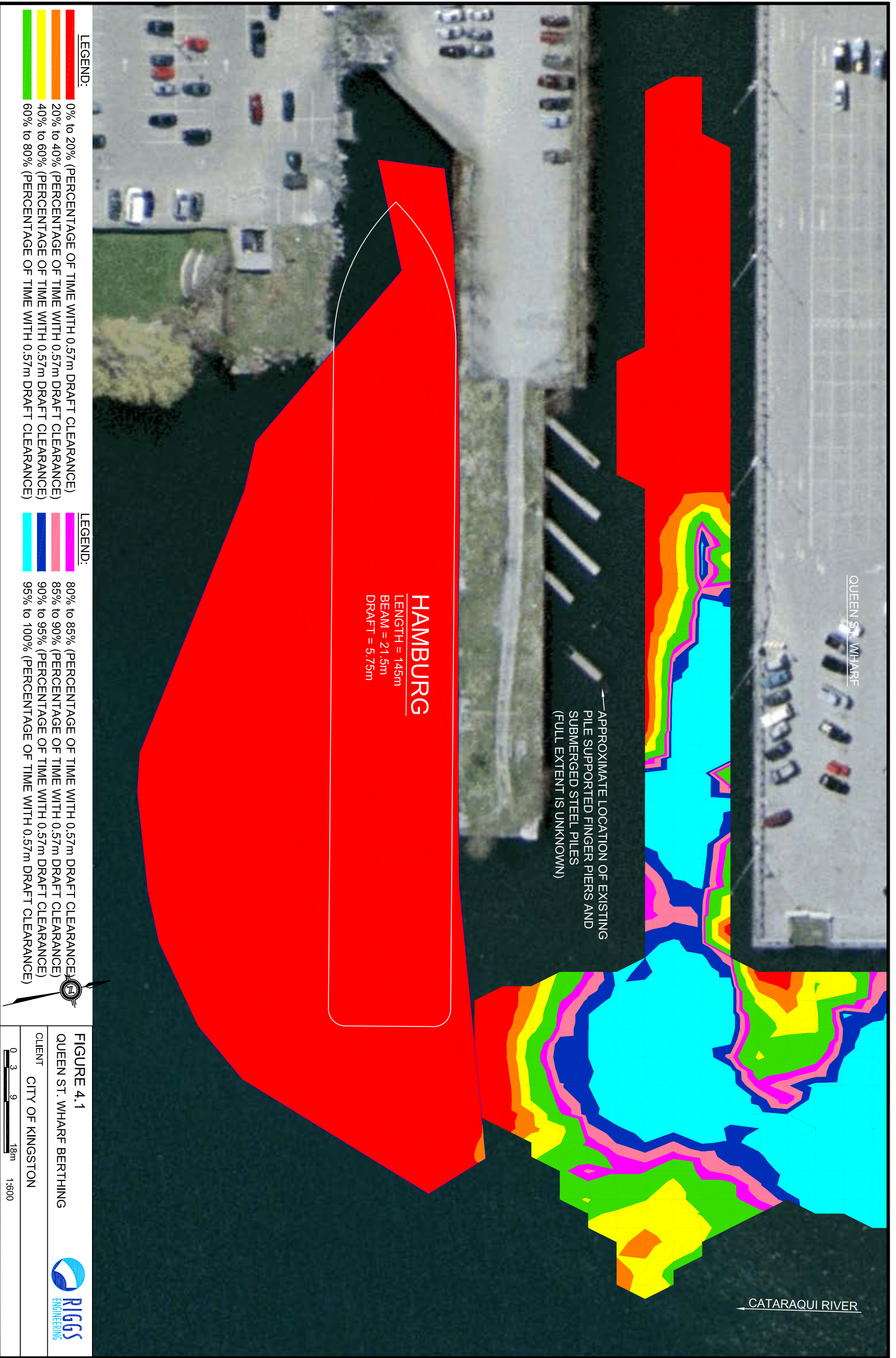


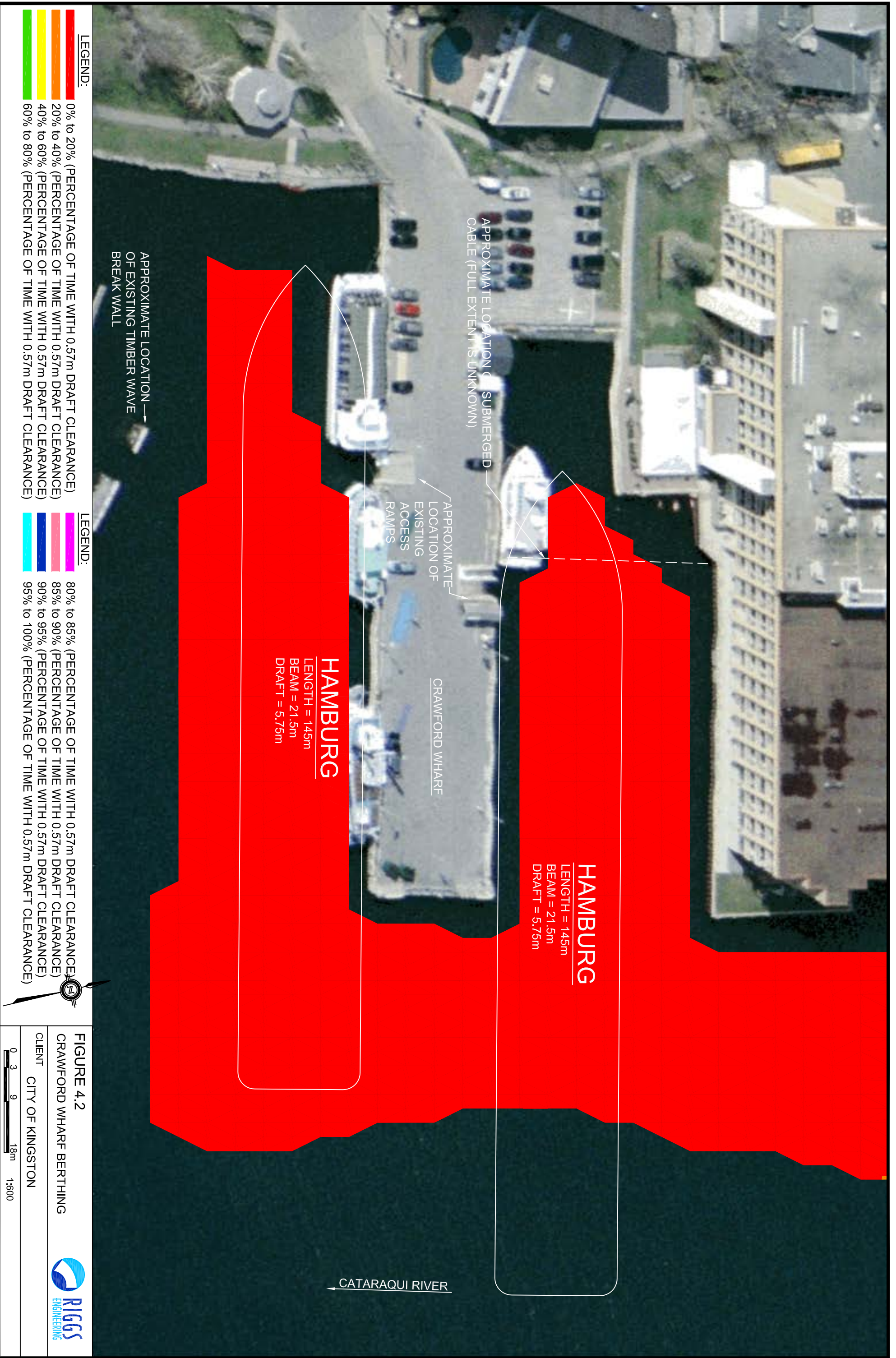
**FIGURE 3.3**  
 55 ONTARIO ST BERTHING  
 CLIENT CITY OF KINGSTON

0 3 9 18m 1:600

**RIGGS**  
 ENGINEERING



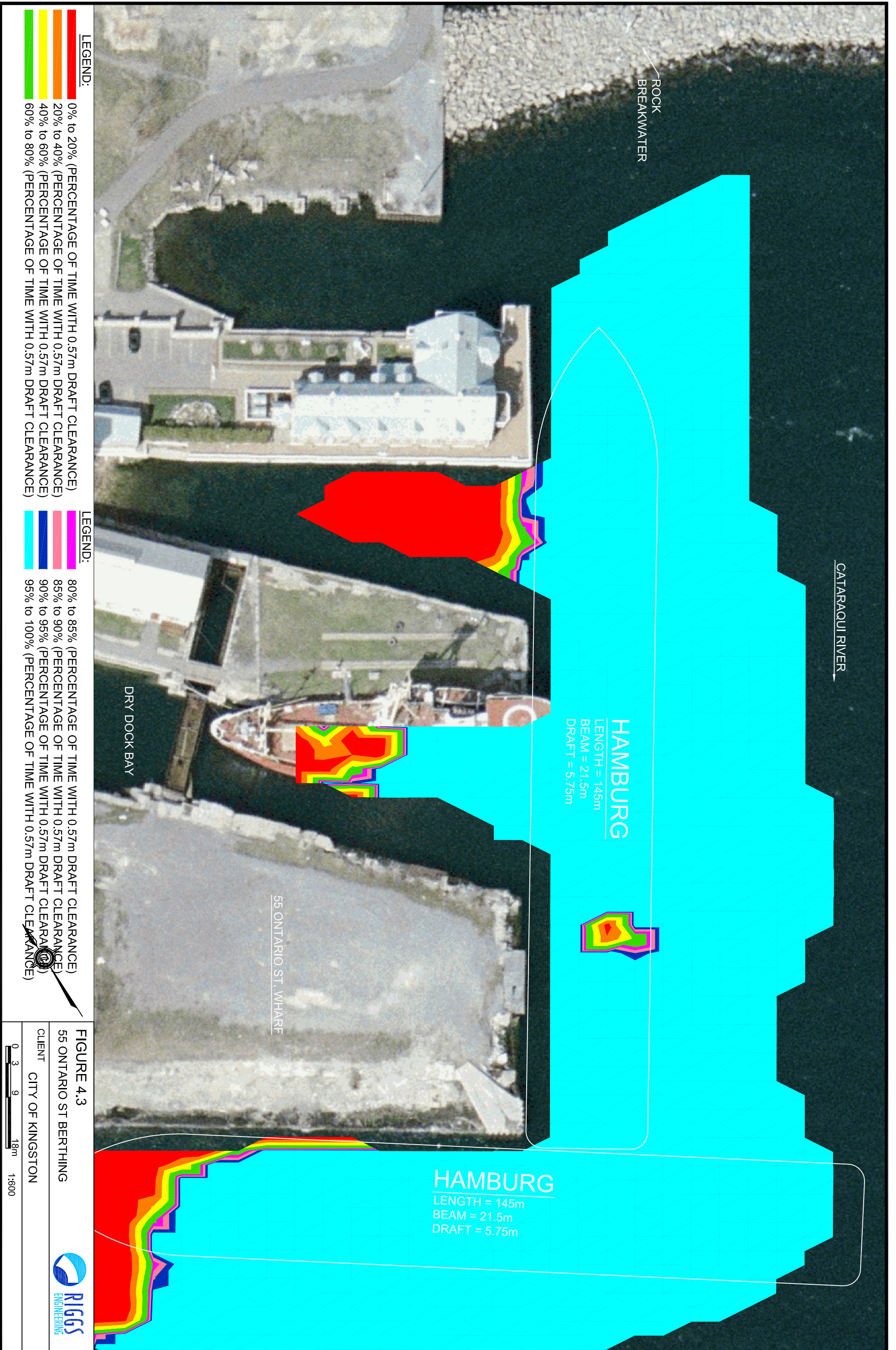




**FIGURE 4.2**  
CRAWFORD WHARF BERTHING  
CLIENT CITY OF KINGSTON

**RIGGS ENGINEERING**

0 3 9 18m 1:600



LEGEND:

- █ 0% to 20% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- █ 20% to 40% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- █ 40% to 60% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- █ 60% to 80% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)

LEGEND:

- █ 80% to 85% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- █ 85% to 90% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- █ 90% to 95% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- █ 95% to 100% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)

FIGURE 4.3

55 ONTARIO ST BERTHING

CLIENT CITY OF KINGSTON



