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**PORTS OF AUCKLAND LIMITED**

# Queens Wharf Mooring Dolphin Risk Review Options Risk Report

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## EXECUTIVE SUMMARY

Panuku Development Auckland is considering the modification of Queen's Wharf to allow for mooring of larger cruise ships than are currently possible. Cruise passengers from these larger ships are restricted to disembarkation by smaller boats from a location further offshore. Such a modification would make Auckland a more attractive destination for larger cruise ships, with resultant economic benefits to the city.

The modification requires a mooring dolphin to be installed approximately 75 m from the end of the wharf, allowing it to accommodate the larger ships. Mooring operations would be managed and undertaken by Ports of Auckland Limited (POAL).

The original design was for the dolphin to be accessed via a gangway for mooring and for carrying out maintenance on equipment.

Due to the potential visual and amenity impact of the gangway, consideration has also been given to alternative options. Alternatives involve accessing the dolphin via some temporary means. Such access inevitably introduces new risks, particularly where marine operations are involved. Of particular concern are obligations to provide a safe working environment for POAL staff, including relevant statutory obligations under the Health and Safety at Work Act 2015 (HSWA).

All options were subject to a risk assessment to determine which may be preferable and to consider its acceptability under HSWA. Key risks related to accessing the dolphin from a boat, particularly for maintenance operations where potentially bulky equipment would have to be transferred to and from the dolphin. Additional operational risks and costs were also introduced by the alternative approach.

Costs of the preferred alternative option were higher than the gangway. Identified risks were also higher. Where both costs and risks are higher, it can be considered that an activity is not reducing risk sufficiently to meet legal obligation under HSWA unless there are other relevant factors that may outweigh these. The other key relevant factor is the visual and environmental impact of the gangway. Given that the harbour is already a well used operational space, it is not considered that this impact is sufficient to outweigh the safety risks and the alternative option is not considered reasonably practicable.

## TABLE OF CONTENTS

<b>1.</b>	<b>ABBREVIATIONS .....</b>	<b>1</b>
<b>2.</b>	<b>INTRODUCTION .....</b>	<b>2</b>
<b>3.</b>	<b>METHODOLOGY .....</b>	<b>3</b>
3.1	Baseline option risk assessment .....	3
3.2	Option identification .....	3
3.3	Initial screening.....	3
3.4	Risk identification and assessment.....	3
3.5	Risk comparison .....	3
3.6	SFAIRP (so far as is reasonably practicable) review.....	3
<b>4.</b>	<b>OPTIONS .....</b>	<b>5</b>
4.1	Option 1 – base line.....	5
4.2	Option 2 – boat access.....	5
4.3	Option 3 – modified dolphin.....	5
<b>5.</b>	<b>RISK ASSESSMENT .....</b>	<b>8</b>
5.1	Screening risk assessment.....	8
5.2	Dolphin access risk.....	8
5.3	Other risk considerations.....	8
<b>6.</b>	<b>SFAIRP REVIEW .....</b>	<b>10</b>
6.1	Availability and suitability.....	10
6.2	Cost .....	10
6.3	Reasonable practicability.....	10
<b>7.</b>	<b>CONCLUSIONS .....</b>	<b>11</b>

## APPENDICES

**APPENDIX 1. RISK MATRIX**

**APPENDIX 2. OPTION RISK MAPS**

**APPENDIX 3. RISK REGISTERS**

## 1. ABBREVIATIONS

HSWA	Health and Safety at Work Act
LTI	Lost Time Injury
POAL	Ports of Auckland Limited
SFAIRP	So Far As Is Reasonably Practicable

## 2. INTRODUCTION

Panuku Development Auckland is considering the modification of Queen's Wharf to allow for mooring of larger cruise ships than are currently possible. Cruise passengers from these larger ships are restricted to disembarkation by smaller boats from a location further offshore. Such a modification would make Auckland a more attractive destination for larger cruise ships, with resultant economic benefits to the city.

The modification requires a mooring dolphin to be installed approximately 75 m from the end of the wharf, allowing it to accommodate the larger ships. Mooring operations would be managed and undertaken by Ports of Auckland Limited (POAL).

The original intention was for the dolphin to be accessed via a gangway for mooring and for carrying out maintenance on equipment. An initial design included a narrow gangway with access for POAL staff only. A subsequent design widened the gangway to allow public access. Access to the dolphin would be prevented by locked gates, but the gangway would otherwise be available for public use except during mooring operations.

The proposed installation will require a resource consent.

Due to the potential visual and amenity impact of the gangway, consideration has also been given to alternative options. Alternatives involve accessing the dolphin via some temporary means. Such access inevitably introduces new risks, particularly where marine operations are involved. Of particular concern are obligations to provide a safe working environment for POAL staff, including relevant statutory obligations under the Health and Safety at Work Act 2015 (HSWA).

All options were subject to a risk assessment to determine which may be preferable and to consider its acceptability under HSWA. This report details the findings of the risk assessment.

### **3. METHODOLOGY**

The following methodology was used in undertaking the risk assessment.

#### **3.1 Baseline option risk assessment**

A risk assessment of the baseline option had been undertaken during the initial design phase. This was reviewed and streamlined to include only those risks associated with accessing the dolphin for the purposes of providing a direct comparison with other options.

Risks were assessed using the POAL risk matrix (Appendix 1).

#### **3.2 Option identification**

Port operations in other locations, including Australia and Canada, were reviewed to identify potential alternative options – either different ways of accessing a dolphin, or different methods for attaching mooring lines. Appropriate alternatives were collated for further review.

#### **3.3 Initial screening**

Options were reviewed and a first cut made removing those that were clearly impractical (e.g. an extending gangway was dismissed as the distance from the wharf to the dolphin was too large for any practical extending design). A desktop review was undertaken comparing the dolphin access risks across all remaining viable options. Options reviewed are presented in Section 4.

Initial findings were reviewed and corroborated by POAL and a best alternative option selected.

#### **3.4 Risk identification and assessment**

The preferred option was subject to a risk identification and assessment workshop. This considered not only those directly comparable access risks, but also additional risks that may be introduced through the alternative approach.

#### **3.5 Risk comparison**

Once the risk assessments were complete a direct comparison could be made between options.

#### **3.6 SFAIRP (so far as is reasonably practicable) review**

While a direct comparison of risks provides a considerable input into decision making, there may be benefits arising from a particular option that make an increased risk acceptable. Direct risk comparison is not, therefore, necessarily the only factor to consider in the acceptability of an option.

Under HSWA, POAL has a primary duty of care to its workers to eliminate risks to their health and safety. Or, if it is not reasonably practicable to eliminate them, then to minimise them so far as is reasonably practicable (SFAIRP).

Reasonably practicable means that which is, or was, at a particular time, reasonably able to be done in relation to ensuring health and safety, taking into account and weighing up all relevant matters, including:

- (a) The likelihood of the hazard or the risk concerned occurring; and
- (b) The degree of harm that might result from the hazard or risk; and
- (c) What the person concerned knows, or ought reasonably to know, about

- (i) the hazard or risk; and
  - (ii) ways of eliminating or minimising the risk; and
  - (d) The availability and suitability of ways to eliminate or minimise the risk;
- and
- (e) After assessing the extent of the risk and the available ways of eliminating or minimising the risk, the cost associated with available ways of eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk.

In practical terms, under HSWA any risk reduction method which is known to be effective should be implemented unless the cost of implementation can be shown to be grossly disproportionate to the risk reduction gained. It is general industry practice for non-financial costs to be included in this discussion – such as introduction of new risks, environmental cost and societal cost – however there is not yet any case law in New Zealand under HSWA to determine definitively whether this would be acceptable, although the use of “all relevant matters” in the definition suggests it could be.

For a new design, such as this, HSWA also places obligations on the designer to reduce risks SFAIRP.

## **4. OPTIONS**

### **4.1 Option 1 – base line**

As noted above the baseline option is a gangway route to the dolphin with public access to the gangway except during mooring operations.

Capstans and bollards would be installed on the dolphin, which would be provided with a power supply running along the gangway to power the capstan and local lighting.

Workers would simply access the dolphin via the gangway for both operations and maintenance requirements and could do so quickly in the event of, for example, a requirement to cast off quickly in bad weather. Maintenance would involve both routine servicing of the capstan and load testing of the bollard, which requires heavy equipment to perform.

Emergency egress would also be via the gangway and emergency services could access the dolphin in the event of an accident or medical emergency involving the workers.

### **4.2 Option 2 – boat access**

Option 2 removes the gangway and requires access to the dolphin by boat. Other than providing an access ladder, the design of the dolphin remains the same. Power supply could be via cable laid along the sea bed, or could potentially be provided via local solar power.

This option introduces a personnel transport method (boat) not currently used by POAL for any mooring operations at the port. Access would take significantly longer than for the gangway and introduces significant delays in response to emergency situations.

Key new risks introduced are around embarking and disembarking from the boat and the use of the access ladder from the boat. This includes crushing hazards when stepping between them as well as the potential to slip and fall into the water. This is increased when equipment transfer is required.

### **4.3 Option 3 – modified dolphin**

Option 3 also requires boat access, but incorporates a modified dolphin to assist with access and the addition of quick release hooks. These allow emergency release of mooring lines, although this introduces additional maintenance requirements. There were 5 sub-options to option 3, each with a different variation on the dolphin modification.

#### **4.3.1 Option 3a – floating platform and ladder**

A floating platform alongside the dolphin allows access from the boat to the platform and then to the ladder. This makes for a more stable route from the boat to the dolphin, intended to reduce access risk.

#### **4.3.2 Option 3b – floating platform and fixed gangway**

As for option 3a, but with a gangway from the platform to the dolphin rather than a vertical ladder. This should reduce access risk still further, particularly when taking maintenance equipment on to the dolphin.

#### **4.3.3 Option 3c – counterbalanced access gangway**

Option 3c introduces a counterweighted ramp onto the dolphin that can be pulled down when access is required, similar to that shown in Figure 1. This still requires access by boat as for options 2 and 3 but

increases accessibility when compared to a vertical ladder, reducing risks associated with climbing the ladder and making it more straightforward to carry maintenance equipment on and off the dolphin.



**Figure 1 – Counterweight ramp example**

#### **4.3.4 Option 3d – davit arm**

Option 3d utilises a davit arm on the dolphin, similar to that shown in Figure 2.



**Figure 2 – Davit Arm**

This provides a way for the mooring line to be attached via the davit directly from the access boat at a distance from the dolphin. This removes the requirement to access the dolphin for normal operations, although the need for maintenance access remains unchanged. The davits themselves also increase the maintenance requirements, although they do not require a lot of maintenance.

#### **4.3.5 Option 3e – Floating dolphin**

The final option uses a floating dolphin rather than a fixed structure. This allows the dolphin and access boat to move up and down together with tide and weather movements, reducing the distance between the two for improved accessibility.

## 5. RISK ASSESSMENT

### 5.1 Screening risk assessment

The various options were subject to an initial screening review to determine which should have a more detailed comparison with the baseline option. The screening assessment focussed on the dolphin access risk.

Principal risks identified were crushing injuries between the boat and the dolphin while attempting access, or falling into the water while attempting the transfer from the boat (in either direction). This risk was increased by the following factors:

- Carrying equipment for maintenance work.
- Severe weather during transfer.
- Requirement for quick release of lines.
- Wash from ferries.
- Medical or accident emergency.

While all options provided some risk reduction, the highest level of reduction achieved was for option 3d, using the davit arms as this removed the need for operational access to the dolphin. However, no options had any significant impact on the risk of access for maintenance operations – this was noted as the highest risk given the requirement to transfer equipment for testing onto the dolphin.

Of the modified dolphin options, option 3d was taken forward for detailed comparison with the baseline option (option 1) and with the unimproved boat option (option 2).

### 5.2 Dolphin access risk

Risk comparison between the baseline and the alternative option initially centred on access requirements and the presence of the catwalk (impact on harbour activities).

The findings of this risk assessment are presented in Appendix 2 as risk maps to allow easy comparison. The numbers on the map relate to the specific hazards identified for each option. These are presented in the detailed risk registers provided in Appendix 3. Note that Options 2 and 3d are presented on the same risk register. Option 1 has significantly different risks and so is in its own different register.

It can be clearly seen from the risk maps that the boat access option introduces a significant number of risks in comparison to the catwalk, the most severe of which is the maintenance access. Many of these risks are removed by the davit arm option, however, the most severe risk is not removed. In fact, due to the requirement for maintenance of the davits, this actually increases, although this movement was not considered sufficient to move the risk from a 'high' to an 'extreme' category on the matrix.

Thus, the use of the boat access option unavoidably increases the risk to workers to a level that is considered 'high' on the POAL matrix. For an increase in risk such as this, there must be a strong justification to choose the higher risk option when considered against the requirements of HSWA.

### 5.3 Other risk considerations

The risks reported above were limited to direct comparison around dolphin access as the core difference between a catwalk and a boat option. However, a number of other considerations were raised during the risk assessment process. These are discussed below:

### **5.3.1 Interface with the public**

The potential for public interference with mooring equipment is increased with the use of the catwalk. Although gates will be locked, inappropriate access to the dolphin will nevertheless be easier with the catwalk in place. Access to the dolphin by boat is unchanged for either option.

The visual impact of the gangway extending into the harbour is a negative for some members of the public, however, it should be noted that the harbour is already an active commercial and operational area, rather than a pristine environment.

For others, the utility value of public access to the gangway may outweigh the visual impact.

### **5.3.2 Reliability and efficiency**

The use of the gangway rather than the boat for access provides significant benefits for reliability and efficiency, including:

- Power supply is far easier to install and maintain, reducing supply reliability risk and decreasing maintenance cost.
- The requirement for more equipment on the dolphin when there is no gangway (e.g. quick release hooks) increases maintenance requirements, adding to both cost and reinforcing the most severe access risk identified.
- Time to deploy workers for mooring and time to undertake mooring are both significantly increased for the boat access option, increasing operational cost and reducing efficiency.
- Should weather or sea conditions prevent safe boating operations, ships will be unable to moor. As boat transfer of passengers would also be affected, this could have significant impact both on the economic impact of the cruise ship and also the experience of Auckland as a destination.
- If at any point the boat became unavailable due to breakdown or failure of some sort, the cruise ships would be unable to moor at the wharf.

### **5.3.3 Lines handling and boat operations**

Any boat operation introduces immediate risks associated with working on the water. Transferring any activity from a land base to being completed on the water intrinsically increases risk. The boat will need to be launched and navigated through the harbour. There is the risk of collision with other vessels or structures.

With the davit arm option, the use of the boat for line handling also introduces significant risk with line handling. The reduced stability of the boat compared to a gangway increases the likelihood of ergonomic issues during handling and the likelihood of lines fouling in the water. Handling lines, pulling them into position and securing them successfully becomes a challenging activity on the water with the potential for wash from other vessels and from cruise ship thrusters increasing the instability. Although the use of skilled and experienced workers will help, such activities are not currently undertaken and the procedures and approaches will need to be developed together with appropriate training.

## **6. SFAIRP REVIEW**

Having reviewed the options that exist, it is necessary to determine whether they reduce risk SFAIRP based on the information available in order to satisfy the obligations of HSWA. The initial concern that prompted the option related to the visual and amenity impact of the gangway.

It should be noted that HSWA is solely concerned with health and safety impacts of work. While the environmental and public impact may classify as a 'relevant matter' for consideration, the reduction of this type of risk is not, in itself, subject to the SFAIRP obligation. Nevertheless POAL have an obligation to ensure that any risks they impose on their workers can be shown to be reduced SFAIRP.

### **6.1 Availability and suitability**

Options have been identified and shown to be available through comparison with ports in other locations.

Key risks introduced by the alternative option are access to the dolphin for maintenance activities and general use of water based rather than land based operations. These suggest that although options are available, they may not be suitable, given that the risk has been identified as 'high'.

Where similar boat access arrangements have been used elsewhere, local circumstances have driven their adoption in a similar way. This has been due, for example, to highly sensitive local marine environments requiring minimal impact or significant disruption to local vessel movements by fixed structures.

### **6.2 Cost**

The cost of installation of the gangway has been estimated at \$0.45m.

Currently, POAL do not have a suitable boat for carrying out these operations. Procurement of a vessel will be in excess of \$1m. In addition to this, maintenance and ongoing operational costs will be higher for the boat access option.

Therefore, the alternative option to the gangway both increases health and safety risk to workers and is more expensive than the safer option of the gangway.

### **6.3 Reasonable practicability**

The primary duty of care under HSWA for POAL requires they adopt a lower risk option unless the costs of doing so can be demonstrated to be grossly disproportionate. In this case the lower risk option also has lower cost of implementation and operation. Other relevant matters may also be taken into account in the assessment of reasonable practicability. In this case, the other key factor is the environmental and societal impact of the gangway.

Given that the risks are considered high, the cost difference is substantial and the environmental impact limited given that the harbour is already a commercial and operational space, it is not considered that the alternative option is reasonably practicable.

## 7. CONCLUSIONS

This risk assessment has considered the impact of alternative options for accessing the dolphin required to increase capacity at Queen's Wharf to accommodate longer cruise ships.

Taking into account the risks associated with each option, the costs of those options and other relevant matters, it is considered that the alternative option of using a boat rather than a gangway cannot be considered reasonably practicable.



## Appendix 1. Risk Matrix

The POAL risk matrix is reproduced below. Note that only the safety component of the consequence description has been included.

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Critical
Almost certain	9	12	20	23	25
Likely	4	11	17	21	24
Possible	3	10	16	18	22
Unlikely	2	6	13	14	19
Rare	1	5	7	8	15

Likelihood	Description of Likelihood
<b>Almost certain</b>	Almost certain to occur within the foreseeable future. Greater than 80% probability that the risk will occur within next 12 months (and likely to have multiple occurrences).
<b>Likely</b>	Likely to occur within the foreseeable future. 50% - 80% probability that the risk will occur within next 12 months
<b>Possible</b>	May occur within the foreseeable future. 20% - 50% probability that the risk will occur within next 12 months (between a 1 in 2 and a 1 in 5 year occurrence).
<b>Unlikely</b>	Not likely to occur within the foreseeable future. 2% - 20% probability that the risk will occur within next 12 months (between a 1 in 5 and a 1 in 50 year occurrence).
<b>Rare</b>	Will only occur in exceptional circumstances. Less than 2% probability that the risk will occur within next 12 months (less than 1 in 50 year occurrence).

Consequence	Insignificant	Minor	Moderate	Major	Critical
<b>Personal safety</b>	Very minor injury – if first aid required is self-administered – immediately back to work with no impact on performance	Minor injury requiring first aid treatment on site – back to work with no LTI	Injury requiring off-site medical treatment and/or LTI	Serious Harm Injury (as defined by Act) <sup>1</sup>	Fatality

<sup>1</sup> Note that HSWA effectively replaces 'serious harm' with 'notifiable injury' which is broadly similar from a consequence severity perspective



## Appendix 2. Option Risk Maps

**QUEENS WHARF MOORING DOLPHIN RISK REVIEW  
 OPTIONS RISK REPORT**
**Option 1 – Catwalk**

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Critical
Almost certain					
Likely					
Possible					
Unlikely			1, 5		4
Rare					2, 3

**Option 2 – Boat Access**

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Critical
Almost certain					
Likely		14			
Possible		5, 8, 15, 16	10	1, 3, 6	11
Unlikely					13
Rare					2, 4, 7, 9, 12, 17

**Option 3d – Davit Arm**

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Critical
Almost certain					
Likely		14, 15			
Possible		16			11
Unlikely					13
Rare			10		

## Appendix 3. Risk Registers

**Option 1 Risk Register**

No.	Activity	Identified hazard	Potential impact	Controls	Consequence	Likelihood	Risk
1	Accessing dolphin for normal operations	Slip/trip on catwalk	Personnel injury	Suitable footwear Appropriate flooring materials and drainage Hand rails / balustrades	Moderate	Unlikely	Medium
2			Fall into water - possible drowning	Suitable footwear Appropriate flooring materials and drainage Hand rails / balustrades Lifebuoy rings	Critical	Rare	Medium
3	Accessing dolphin for maintenance operations	Structural failure of catwalk due to weight of vehicle & equipment	Personnel injury Fall into water - possible drowning	Catwalk designed with adequate load capacity + safety margin	Critical	Rare	Medium
-	Accessing dolphin for recovery (eg failed capstan or quick release required)	No additional hazards identified					
4	Dolphin navigation hazard	Small vessels impact on dolphin	Personnel injury Fall into water - possible drowning	Navigation aids Lights on structure Catwalk and dolphin is a sizeable and visible structure	Critical	Unlikely	High
5	Handling mooring lines	Ergonomic / manual handling issues hauling lines along catwalk	Personnel injury		Moderate	Unlikely	Medium
-	Emergency egress from dolphin for medical or other reasons	No additional hazards identified					

**QUEENS WHARF MOORING DOLPHIN RISK REVIEW  
OPTIONS RISK REPORT**
**Options 2 and 3d Risk Register**

No.	Activity	Identified hazard	Potential impact	Controls	Consequence	Likelihood	Risk	Notes		Consequence	Likelihood	Risk
					<b>Option 2</b>				<b>Option 3d</b>			
1	Accessing dolphin for normal operations	Slipping while transferring from boat to dolphin	Crushing injury between boat and dolphin	Suitable footwear 3 points of contact	Major	Possible	High		Hazard removed	-	-	-
2			Fall into water - possible drowning	Life jacket	Critical	Rare	Medium		Hazard removed	-	-	-
3		Slipping while climbing ladder	Crushing injury between boat and dolphin	Suitable footwear 3 points of contact	Major	Possible	High		Hazard removed	-	-	-
4			Fall into water - possible drowning	Life jacket	Critical	Rare	Medium		Hazard removed	-	-	-
5		Boat impacts ladder - possible damage to ladder	Cost of repair and requirement for additional work over water. Unsafe access until repaired		Minor	Possible	Medium	Not considered as a separate option, but can add fendering	Hazard removed	-	-	-

**QUEENS WHARF MOORING DOLPHIN RISK REVIEW  
 OPTIONS RISK REPORT**

No.	Activity	Identified hazard	Potential impact	Controls	Consequence	Likelihood	Risk	Notes		Consequence	Likelihood	Risk
					<b>Option 2</b>				<b>Option 3d</b>			
6	Accessing dolphin for normal operations (cont.)	Wash from ferries causing boat movement during transfer	Crushing injury between boat and dolphin	Align access operations with ferry timetables	Major	Possible	High	Note cruise ship movements typically coincide with high ferry traffic	Hazard removed	–	–	–
7			Fall into water - possible drowning	Life jacket	Critical	Rare	Medium		Hazard removed	–	–	–
8		Marine growth on ladder	Personnel injury or slipping	Routine maintenance (cleaning)	Minor	Possible	Medium	Hazard removed	–	–	–	
9		Severe weather during transfer	Crushing injury between boat and dolphin Fall into water - possible drowning	Severe weather limits on access	Critical	Rare	Medium	Hazard removed	–	–	–	
10		Prevention of safe access leads to inability to carry out operations	Weather limits on cruise ship access into port	Moderate	Possible	High	Reputational / operational risk only if operations ceased	Less likely if limits are relaxed due to lower risk	Moderate	Rare	Low	

**QUEENS WHARF MOORING DOLPHIN RISK REVIEW  
 OPTIONS RISK REPORT**

No.	Activity	Identified hazard	Potential impact	Controls	Consequence	Likelihood	Risk	Notes		Consequence	Likelihood	Risk
					Option 2				Option 3d			
11	Accessing dolphin for maintenance operations	Transferring equipment to dolphin by boat	Potential for crushing injuries due to dropped load / manual handling of equipment	Appropriate lifting equipment	Critical	Possible	High	Maintenance requirements increased by probable need for power sources for quick release hooks.	No change	Critical	Possible	High
12	Accessing dolphin for recovery (eg failed capstan or quick release required)	Increased time to deploy leads to operational pressures and possible increased risk	Crushing injury between boat and dolphin Fall into water - possible drowning		Critical	Rare	Medium	Quick release hooks prevents this but increases maintenance requirements	Hazard removed	-	-	-
13	Dolphin navigation hazard	Small vessels impact on dolphin	Personnel injury Fall into water - possible drowning	Navigation aids Lights on structure	Critical	Unlikely	High		No change	Critical	Unlikely	High
14		Small vessels move between dolphin and wharf and get fouled in mooring lines	Damage to vessels and lines	Navigation aids	Minor	Likely	Medium		No change	Minor	Likely	Medium

**QUEENS WHARF MOORING DOLPHIN RISK REVIEW  
 OPTIONS RISK REPORT**

No.	Activity	Identified hazard	Potential impact	Controls	Consequence	Likelihood	Risk	Notes		Consequence	Likelihood	Risk
					<b>Option 2</b>				<b>Option 3d</b>			
15	Handling mooring lines	Using boat for lines leads to potential for fouling	Damage to vessels and lines		Minor	Possible	Medium	Increased risk due to manipulation of lines on the water and ship thrusters operating	No change	Minor	Likely	Medium
16		Lose lines in water	Damage to vessels and lines		Minor	Possible	Medium		No change	Minor	Possible	Medium
17	Emergency egress from dolphin for medical or other reasons	Emergency egress very difficult if unconscious, or if injury prevents climbing ladder	Consequences of event made worse due to inability to evacuate		Critical	Rare	Medium		Hazard removed	–	–	–