Royal HaskoningDHV

Port of Ardrossan

Asset Condition Survey

20 April 2016
Final Report
PB3783

Royal HaskoningDHV
Enhancing Society Together

HASKONINGDHV UK LIMITED
MARITIME & AVIATION

10 Bernard Street
Leith
Edinburgh EH6 6PP
United Kingdom
+44 131 555 0506 Telephone
Fax
info@edinburgh.rhdhv.com E-mail
www.royalhaskoningdhv.com Internet

Document title	Port of Ardrossan Asset Condition Survey
Document short title	Ardrossan Asset Condition Survey
Status	Final Report
Date	20 April 2016
Project name	Ardrossan Asset Condition Survey
Project number	PB3783
Client	CMAL
Reference	PB3783/R106/301998/Edin

Drafted by	[redacted]	
Checked by		
Date/initials check		.....
Approved by		
Date/initials approval		.....

Royal HaskoningDHV

CONTENTS

1 INTRODUCTION

1.1 General

Royal HaskoningDHV (RHDHV) was commissioned by Caledonian Maritime Assets Limited (CMAL) to undertake an Asset Condition Survey of the ferry berths and all associated infrastructure at the Port of Ardrossan.

The Port of Ardrossan is owned by Peel Ports and serves the year round lifeline ferry service to Brodick on the Isle of Arran as well as a weekly service to Campbeltown in Kintyre which operates from May to September. The ferry service is operated by Calmac Ferries Limited (CFL).

CMAL has recently placed an order for the construction of two new 102m ferries. These are due for delivery in 2018 and the intention is that one of these vessels will operate the Ardrossan to Brodick route. The purpose of this study is to establish the condition of the infrastructure at Ardrossan and provide a basis for planning of future maintenance, renewal and enhancement works.

This report will further comment upon an audit of the site in accordance with the Health and Safety Executive's Approved Code of Practice "Safety in Docks".

1.2 Port of Ardrossan

The Port of Ardrossan comprises two operational Ro-Ro ferry berths. These are referred to as the Calmac Berth and the Irish Berth. The length of quay wall linking these berths is referred to as the Overnight Berth.

The harbour is protected from the elements to the South and West by the sea wall and breakwater structures. A further offshore breakwater structure creates an entrance to the harbour.

1.3 Inspection Details

Location: Port of Ardrossan

Client: Caledonian Maritime Assets Limited (CMAL)

Building / Structure: Calmac Berth, Irish Berth, Overnight Berth and Sea Wall

Date of Inspection: 13th and 14th April 2016

Prevailing Weather Conditions: Dry, cold and breezy

Inspected By: [redacted]

Dive Contractor: Shearwater Marine Services Ltd

1.4 Previous Reports

Prior to conducting this inspection a number of previous reports were made available.

- East Linkspan Inspection Report – April 2014
- West Linkspan Inspection Report – April 2014
- Repairs to Island Breakwater – December 2014
- Fender Inspection at Calmac Berth – March 2016.

No as-built or record drawings were made available for review.

2 CALMAC BERTH

The Calmac Berth is the normal operating berth for the Ardrossan to Brodick service. The quay wall forming the berth is typically steel sheet piles with the exception of the first 31m adjacent to the linkspan which is an older masonry block wall. The quay wall is fendered along its length by 15 No. Trellex MV type fenders.

The linkspan is located at the South end of the berth. This is a single lane structure approximately 50 years old. The ramp is pivoted at the shore-end on steel bearing wheels and is lifted and lowered by a winch lifting mechanism at its seaward end.

There is no cathodic protection system provided to the quay wall or linkspan piles.

2.1 Quay Wall

2.1.1 Masonry Wall

The 30m long section of masonry wall is in a reasonable condition for its age (photo 1). There are however a number of small voids and gaps between the blocks apparent along its length (photos 2 & 3). The largest such void identified measured 450mm x 500mm x 410mm deep.

There is no significant scour or undercutting of the wall. The only minor scour identified was 3m long and 300mm deep. The location is identified in the dive report in Appendix B

A number of vertical timber members have been removed and replaced by brick and a number of older voids have been filled with either brick or more recently with concrete.

Photo 1

Photo 2

Photo 3

The details and location of all defects identified by the dive survey can be found in the Diver's Report in Appendix B.

2.1.2 Steel Sheet Piles

The steel sheet piles along the length of the berth to the roundhead are in a poor condition. Outwith the tidal zone near the soffit, the piles are corroding with delamination and loss of section evident (photo 4).

Photo 4

Photo 5

With reference to 'Management of Accelerated Low Water Corrosion in Steel Maritime Structures' (CIRIA publication C634, 2005), cathodic potentials within the region of -0.900V to -1.100V (vs Ag/AgCl) are recommended for maritime structures cathodic protection systems. Cathodic potential readings taken during the dive survey were typically in the region of -0.620V. Readings in this range are generally indicative of an increased potential for Accelerated Low Water Corrosion (ALWC).

In the intertidal zone and splash zone the orange deposit associated with ALWC is clearly evident along the length of the wall (photo 5). The piles were holed in a number of locations including adjacent to fender 2, at the ladder between fenders 5 and 6 (photo 6) and at the ladder between fenders 6 and 7 (photo 7). Each of these holes was typically of the order of 100mm x 100mm although one measured 600mm x 100mm.

Photo 6

Photo 7

Ultrasonic thickness (UT) readings were taken at three levels every 5m along the berth. Pile thickness readings ranged from 9.25mm to 12.95mm.

The details and location of all defects identified and all recorded UT readings taken during the dive survey can be found in the Diver's Report in Appendix B.

2.2 Fendering

The berth has 15 No. Trellex MV type fenders located along its length. The fenders are formed from pairs of MV type modular elements fixed to the quay structure. A UHMW-PE face shield is mounted on the berthing face.

The fenders along the berth are MV600 type in a combination of 5.0m and 6.5m lengths. The fenders to the roundhead are 6.5m long MV750 type fenders (photo 8).

The fenders are generally in a fair condition however a number of defects were observed. These defects include loose and missing bolts at the connections between the MV elements and the quay (photo 12), face shields pulling from the MV elements (photo 9), abrasion damage to face shields and missing bolts at the connection between the MV elements and the face shield. In addition fenders 10 and 14 on the roundhead structure have been completely removed (photo 8).

The UHMW-PE face shield is intended to act as a structural component of the fender and is bolted directly to the MV element. This should generally be a single length to facilitate transfer of berthing energy loads between elements. It was observed on the fenders along the Calmac Berth that many have two or more shorter lengths of shield making up the necessary length. In addition to the failure to transfer load this makes the shield more susceptible to being pulled from the MV elements (photos 9 & 10).

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

Photo 13

The defects recorded for the Calmac Berth fenders are summarised in table 2.1 below.

Table 2.1 Fender Defects to Calmac Berth

Fender No	Fender Type	Defects
1	MV600	6No bolts to MV's missing, 1No bolt to shield missing
2	MV600	Numerous loose and missing bolts to MV's. MV elements not in matching pairs. Steel strap around perimeter. Face shield in 2 sections. 1No bolt to shield missing, 2No pulling through at bottom of top section.
3	MV600	5No bolts to MV's missing including 3 of 4 to bottom 1m section. 1No bolt to MV loose.
4	MV600	6No bolts to MV's missing. Face shield is in 2 sections and pulled off slightly at 3rd pair down.
5	MV600	1No bolt to MV's missing. Shield pulling off at centre, bolts protruding.
6	MV600	4No bolts to MV's missing. Face shield in 4 sections. Section of shield missing and further sections pulling off. 5No missing bolts to remaining face shield sections. MV's damaged where shield missing.
7	MV600	
8	MV600	1No bolt to MV's missing. Face shield in 2 sections, top section pulling off.
9	MV750	1No bolt to MV's missing. 1No MV element has come off its fixings. Abrasion to shield.
10	MV750	FENDER REMOVED
11	MV750	2No bolts to MV's missing. Face shield in 2 sections.
12	MV750	2No bolts to MV's missing. Face shield in 2 sections and pulling off at join.
13	MV750	2No bolts to MV's missing. Face shield in 2 sections.
14	MV750	FENDER REMOVED
15	MV750	2No bolts to MV's missing. Face shield in 2 sections and pulling off at join. Damaged MV element.

2.3 Linkspan

The linkspan is supported on two suspended reinforced concrete decks at its seaward end. These reinforced concrete decks are in the order of 750mm thick and are supported on a series of H-section steel piles.

The steel piles are generally in a fair condition above the tidal zone and towards the deck soffit. There is rust staining but there does not appear to be significant loss of section (photo 16). Within the intertidal zone the piles are generally covered in hard and soft marine growth with orange deposit indicative of ALWC to the flanges over the full length of the piles (photos 14 & 15).

Cathodic potential readings taken during the dive survey were as high as -0.572V. This is generally indicative of Accelerated Low Water Corrosion (ALWC).

UT readings were taken on every pile. These ranged from 19.2mm to 10.0mm indicating up to 50% loss of section in isolated locations.

The reinforced concrete decks appear in a relatively good condition however a patch of concrete on the soffit on the West side of the ramp has spalled (photo 17). This section is approximately 1m x 1m in area and the reinforcement is visible and clearly corroding.

Photo 14

Photo 15

Photo 16

Photo 17

The details and location of all defects identified and all recorded UT readings taken during the dive survey can be found in the Diver's Report in Appendix B.

2.4 Rescue and Life-Saving Equipment

2.4.1 Emergency Ladders

There are five emergency ladders located on the linkspan and along the length of the berth. The ladder suspended on the inner dolphin at the linkspan has a broken bracket and is misaligned following an impact (photo 18).

The ladder between fenders 3 and 4 is corroding and covered in marine growth (photo 19). It is slightly misaligned following an impact but remains secure. There are however traces of ALWC to the ladder stiles and brackets.

The ladders between fenders 5 and 6 (photo 20) and fenders 6 and 7 are corroding and covered in marine growth but remain secure. There are again traces of ALWC to the ladder stiles and brackets.

Photo 18

Photo 19

Photo 20

Photo 21

2.4.2 Life Buoys

There are two life buoys located on the Calmac Berth. The first is located adjacent to the linkspan (photo 22). The instructions are fading and not clearly legible and the rope is weathered. The second is located adjacent to fender 4 (photo 23). This has no instructions and again the rope is weathered. Furthermore the position of this life buoy is not clearly visible.

Photo 22

Photo 23

2.5 Deck Surface and Furniture

The linkspan operators building is generally in a fair condition. The paint to the door is dry and weathered and there are settlement cracks to some of the masonry walls (photo 24).

The gate at the entrance to the linkspan and the handrailing along the ramp are corroding (photo 25).

Photo 24

Photo 25

There is a timber cope along the edge of the masonry block section of the quay. This is generally rotting and the first section appears loose (photo 26).

The grab rail from an old ladder has been removed from the deck but the bolts have not been cut flush. These present a trip hazard on the edge of the deck (photo 27).

Photo 26

Photo 27

The surfacing to the deck area is a combination of block paving, tarmac and concrete. The surfacing is generally in a fair condition throughout the berth although the tarmac areas are beginning to break up and become uneven in places (photos 28 & 29).

Photo 28

Photo 29

There are ten mooring bollards located along the length of the berth (photo s 30 & 31). The capacity of these is unknown. All of the bollards remain in sound condition with no defects apparent.

Photo 30

Photo 31

3 IRISH BERTH

The Irish Berth is used occasionally for the Ardrossan to Brodick service when inclement weather prevents the use of the Calmac Berth. The original quay wall forming the berth was a precast concrete block wall.

The alignment of the berth has subsequently been altered by the addition of a triangular shaped suspended deck section supported on hexagonal steel box piles. These piles are braced back to the wall at the head and at the low water mark by beams comprising back to back channel sections. Longitudinally the deck is suspended on steel I-beams connected to the head of the piles. There is no cathodic protection system provided to steel piles.

The quay wall is fendered along its length by 11 No. Fentek Super Cone and panel type fenders whilst there are 7 No cylindrical fenders suspended on chains on the roundhead structure.

The linkspan is located at the South end of the berth. This is a single lane structure approximately 40 years old. The ramp is supported on steel hinges at the shore-end with hoist units supported on mass concrete dolphins at the seaward end.

3.1 Quay Wall and Suspended Deck

The original precast concrete block wall is generally in a good condition. The only observed defect is a large vertical crack at the joint with the roundhead.

The section of suspended deck is in an extremely poor condition throughout its length. The longitudinal edge beams are extremely corroded with significant loss of section evident (photo 33). This is especially prominent at the North end of the berth above the old stairs. This first section of deck is supported by a single H-section steel pile and the longitudinal beam has completely corroded away on either side of the pile (photo 32).

Photo 32

Photo 33

The transverse bracing members are also corroding with loss of section evident. This is particularly prominent to the lower braces (photo 35). These are in the intertidal zone and orange deposits are clearly visible. One of the members towards the linkspan end has failed completely and is no longer connected to the pile (photo 34) whilst another has become detached from the quay wall.

Photo 34

Photo 35

The hexagonal box piles supporting the deck are 100% covered in hard marine growth. Where this growth was removed the steel surface was uneven. Extensive orange deposit indicative of ALWC is typically evident over the length of the piles.

Cathodic potential readings taken during the dive survey were typically around -0.610V. This is generally indicative of an increased potential for Accelerated Low Water Corrosion (ALWC).

UT readings were taken on every pile. These ranged from 12.05mm to 6.8mm indicating up to 50% loss of section. Holes were found in two of the piles, typically 70mm in diameter and voided behind.

There are numerous patches on the suspended deck soffit where concrete has spalled (photos 36 & 37). At each of these locations the reinforcement is clearly corroding. It would appear that there is minimal cover to the reinforcement at these locations and this may be a significant contributing factor.

Photo 36

Photo 37

3.2 Linkspan

The linkspan ramp and lifting equipment are supported on large mass concrete lifting dolphins. These are generally in fair condition with only superficial damage identified to the surface of the concrete.

The linkspan operator and equipment buildings are generally in a fair-poor condition. Defects observed include corroded supports (photo 39), dry and weathered exterior paintwork (photo 38), blocked roof gutters. The gully in the area outside the buildings is blocked and a large amount of standing water was evident (photo 43).

The gate at the entrance to the linkspan and the handrailing along the ramp are corroding (photo 40) with impact damage to the handrails at the nose of the ramp (photo 41).

The fixed access equipment is generally in a poor condition, especially an open grate platform on the landward face which has completely corroded away and presents a hazard (photo 42).

Photo 38

Photo 39

Photo 40

Photo 41

Photo 42

Photo 43

3.3 Fendering

The 11 No. main fender panels along the berth consist of a 6.5m x 1.0m steel panel with an HDPE shield comprising individual 1m x 0.5m HDPE panels. These panels have a Fentek SCN400 super cone fender top and bottom and are braced back to the quay wall and suspended deck with diagonal CHS struts.

The fendering to the roundhead consists of 7 No. cylindrical fenders (600mm OD, 300mm ID) suspended on chains fixed to the quay wall.

The fendering along the berth is generally in a fair condition. It is noted however that the bolts to each of the individual HDPE panels are not stainless steel. These bolts have completely corroded in the lower tidal zone (photo 45) and one panel is missing from fender 45, two panels missing from fender 49 (photo 44) and one panel loose on fender 40.

Photo 44

Photo 45

The steel frames to the fenders are suffering from minor surface corrosion at deck level (photo 46). It was further noted that the SCN400 fenders are all split or beginning to split (photo 47).

Photo 46

Photo 47

One of the cylindrical fenders has been removed completely from the structure (fender 36 – photo 48) whilst the lower bracket to fender 37 has two missing bolts and is loose (photo 49).

Photo 48

Photo 49

The single timber fender adjacent to the linkspan had loose sections over its full length.

3.4 Rescue and Life-Saving Equipment

3.4.1 Emergency Ladders

There are three emergency ladders situated along the length of the Irish Berth. The ladder nearest the linkspan has suffered minor impact damage yet remains secure and serviceable. The other two ladders have suffered more significant impact damage and the bottom brackets have sheared on both (photos 50 & 51).

It was observed that the ladder grab rails on the deck have been positioned behind the timber cope making their use more difficult for an ascending climber (photo 52).

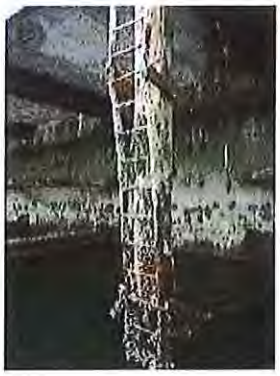


Photo 50

Photo 51

Photo 52

3.4.2 Life Buoys

There are two life buoys located on the Irish Berth. The first is located between fenders 47 and 48 on a fence approximately 20m from the cope (photo 53). The other is hung on the mobile gangway (photo 54). Neither of the life buoys are located in a particularly prominent position nor do they have instructions on display. In addition the ropes are weathered.

Photo 53

Photo 54

3.5 Deck Surface and Furniture

The surfacing to the deck area is a combination of tarmac and concrete. The surfacing is generally in a fair condition throughout the berth although the tarmac areas are beginning to break up and are uneven at a number of locations (photo 55). There is some cracking evident to the concrete slab.

It was noted that there is an area of the deck between fenders 48 and 50 which is subsiding. This area is 3m to 10m from the cope (photo 56).

Photo 55

Photo 56

There are ten mooring bollards located along the length of the berth. The capacity of these is unknown. All of the bollards remain in sound condition with no defects identified.

4 OVERNIGHT BERTH

The Overnight Berth is the 130m long section of quay wall linking the roundheads at the end of the two Ro-Ro berths. The quay wall forming the berth is a combination of steel sheet pile and precast concrete block wall.

The quay wall is fendered along its length by 17 No. Trellex MV600 type fenders. There is no cathodic protection system provided to the quay wall.

4.1 Quay Wall

4.1.1 Steel Sheet Piles

The steel sheet piles along the length of the berth to the roundhead are in a poor condition. Outwith the tidal zone near the soffit, the piles are corroding with delamination and loss of section evident (photos 57 & 58).

Photo 57

Photo 58

In the intertidal zone and splash zone the orange deposit associated with Accelerated Low Water Corrosion (ALWC) is clearly visible along the entire length of the wall. The piles were holed in a number of locations along the berth (photos 59 - 62). The most significant of these holes measured approximately 900mm x 260mm x 600mm deep.

Photo 59

Photo 60

Photo 61

Photo 62

Cathodic potential readings taken during the inspection were typically around -0.610V. Readings in this range are generally indicative of an increased potential for Accelerated Low Water Corrosion.

Ultrasonic thickness (UT) readings were taken at three levels every 10m along the berth. Pile thickness readings ranged from 8.4mm to 13.45mm indicating up to 40% loss of section.

The details and location of all defects identified and all recorded UT readings taken during the dive survey can be found in the Diver's Report in Appendix B.

4.1.2 Concrete Wall

The concrete quay wall is generally in a good condition with only minor cracking identified during the inspection and minor impact damage to the roundhead structure (photo 63).

Photo 63

Photo 64

At seabed the wall is founded on a poured footing that extends 1.7m from the edge of the wall. There is one small length of undercutting to the wall. This is 3m long x 190mm high and 350mm deep.

4.2 Fendering

The berth has 17 No Trellex MV600 type fenders located along its length in a combination of 5.0m and 6.5m lengths. The fenders are formed from pairs of MV type modular elements fixed to the quay structure. A UHMW-PE face shield is mounted on the berthing face.

The fenders are generally in a fair condition however a number of defects were observed. These defects include loose and missing bolts at the connections between the MV elements and the quay (photo 65), face shields pulling from the MV elements (photo 66), abrasion damage to face shields and missing bolts at the connection between the MV elements and the face shields. In addition fenders 21 and 26 have been completely removed and all but three MV elements are missing at fender 24 where the bolts are still protruding from the quay wall.

The UHMW-PE face shield is intended to act as a structural component of the fender and is bolted directly to the MV element. This should generally be a single length to facilitate transfer of berthing energy loads between elements. It was observed on the fenders along the Overnight Berth that many have two shorter lengths of shield making up the necessary length. In addition to the failure to transfer load this makes the shield more susceptible to being pulled from the MV elements.

Photo 65

Photo 66

The defects recorded for the Calmac Berth fenders are summarised in table 4.1 below.

Table 4.1 Fender Defects to Overnight Berth

Fender No	Fender Type	Defects
16	MV600	
17	MV600	
18	MV600	
19	MV600	Face shield in 2 sections.
20	MV600	6No bolts to MV's missing, including all 3 to 3rd MV down on LHS.
21	MV600	FENDER REMOVED
22	MV600	2No bolts and 1No missing nut to MV's.
23	MV600	1No bolt to MV's missing. Face shield in 2 sections.
24	MV600	Fender removed except 3No MV elements. Bolts protruding from wall. Face shield in 2 sections.
25	MV600	Face shield in 2 sections.
26	MV600	FENDER REMOVED
27	MV600	Face shield in 2 sections.
28	MV600	1No bolt to MV's missing. Face shield in 2 sections.
29	MV600	
30	MV600	Face shield pulled off bottom 4No MV elements
31	MV600	
32	MV600	

4.3 Rescue and Life-Saving Equipment

4.3.1 Emergency Ladders

There are five emergency ladders situated along the length of the Overnight Berth. The ladders are all generally covered in marine growth and corrosion. The southernmost ladder has suffered minor impact damage yet remains secure and serviceable (photo 68). The second ladder is free from defects. The bottom bracket to the third ladder is covered in orange deposit and is holed (photo 67). The two remaining ladders remain free from defects and are serviceable.

Photo 67

Photo 68

4.3.2 Life Buoys

There are two life buoys located on the Overnight Berth. The first is located adjacent to the fender 19 and the second is located on a concrete sponson 50m North East along the berth (photo 69). Neither of these life buoys has instructions displayed and the ropes to both are weathered. Both life buoys are in prominent positions and are clearly visible.

Photo 69

Photo 70

4.4 Deck Surface and Furniture

The surfacing along the berth is predominantly tarmac. This is generally in a poor condition and breaking up (photo 71). Furthermore the uneven surface and poor drainage results in large areas of standing water (photo 72).

Photo 71

Photo 72

There are nine mooring bollards located along the length of the berth (photo 73). The capacity of these is unknown. All of the bollards remain in sound condition with no defects apparent.

Photo 73

5 SEA WALL AND BREAKWATER

The sea wall at Ardrossan commences adjacent to the entrance to the long stay car park and runs in a North Westerly direction. The wall is predominantly a sandstone block wall with a revetment to the seaward face along its highest points. A description of the wall and observed condition is as follows with the chainages referred to commencing from the blue storage containers at the South East corner of the site.

5.1 Chainage 0m – 22m

The first section of wall is 2m high and is a narrow sandstone block wall. The pointing to this section of the wall is generally in a fair condition. The coping stones were observed to be loose and missing in places.

5.2 Chainage 22m – 72m

The second section of wall is 0.9m high (on the landward face) and is constructed from stone block (photo 74). This section of the wall is generally in a good condition with no observed defects.

Photo 74

5.3 Chainage 72m – 109m

This section of wall is 1.15m high (on the landward face) and is constructed from stone block (photo 75). There is moderate erosion of the stone blocks on the seaward face of the wall and much of the pointing has failed and is missing. Several of the stone blocks have fallen from the wall leaving substantial voids (photos 76 & 77).

The coping stone at the steps leading to the next section of wall is loose (photo 78).

Photo 75

Photo 76

Photo 77

Photo 78

5.4 Chainage 109m – 172m

This section is a two tier sandstone block wall on the landward face. There is a stone stair providing access onto the wall but two concrete blocks have been placed at the top of these to deter people from climbing on the wall. There is also a 'Danger – Keep Off' sign at the bottom of the stairs however this is weather damaged and the text is peeling.

A section of the wall has come down between chainage 160m – 172m. The top stones on either side of this section also appear loose (photos 79 & 80).

Photo 79

Photo 80

The seaward face of this section is in a relatively good condition with only minor erosion of the blocks, some failed pointing and one slightly displaced block.

Photo 81

Photo 82

5.5 Chainage 172m – Breakwater

This section of wall is a continuation of the previous section. This section however has a rock revetment to the seaward face to offer protection and provide stability (photo 83). There is some minor erosion of the blocks on the seaward face however the revetment and its concrete infill to the seaward face remain sound with no defects observed.

The final 25m length of the wall to the junction with the breakwater has had concrete blocks built into the upper section. The joints between these blocks are beginning to fail and some movement of the blocks is apparent (photos 84 & 85).

Photo 83

Photo 84

Photo 85

Photo 86

A stone stair provides access to the second tier of the wall on the landward face. The bottom steps are displaced and present a hazard to anyone ascending or descending the wall (photo 86).

5.6 Breakwater

The landward face of the breakwater is a 4.2m high two tier block wall (photo 87). The seaward face is partially protected by a rock revetment with concrete infill.

The breakwater is generally in a good condition with minor erosion of the block work and some failed and missing pointing.

The bottom steps have been removed at the far end of the breakwater, presumably to deter the public from climbing on the structure (photo 88).

Photo 87

Photo 88

Photo 89

Photo 90

6 MARSHALLING AREA

The marshalling area at Ardrossan Ferry Terminal currently has 7 lanes providing a total length of 878m for vehicles. Lanes 1 and 2 are specifically for commercial vehicles and are separated from the others by a thin verge surfaced with red stone chippings.

A large overhead gantry sign clearly shows the lane layout and where the commercial lanes are located. The steel frame to the gantry is in a fair condition with only minor surface corrosion to the fame and the holding down bolts (photo 91).

A small modular building serves as a check-in booth at the entrance to lanes 3 to 7. This appears to be in a good condition (photo 92).

Photo 91

Photo 92

The tarmac surfacing to the marshalling area is generally in a good condition with only occasional damage or pot holing of the surface (photo 93). This is typically found in lanes 1 and 2.and at the entrance to lanes 3 and 4 where all cars queue to pass the check-in booth.

The white lining throughout the marshalling area is clear and in a good condition (photo 94).

Photo 93

Photo 94

7 REVIEW OF PORT INFRASTRUCTURE AND SIGNAGE AGAINST HSE 'SAFETY IN DOCKS'

The 'Safety in Docks' is an Approved Code of Practice (ACOP) issued by the Health and Safety Executive. The document provides guidance covering all aspects of dock operations from large industrial sites to small harbours.

During the site inspection an assessment was made of the harbour at Ardrossan against all relevant sections of the document. These aspects are described in more detail in the sections below.

7.1 Pedestrian Walkways

The ACOP states that pedestrian walkways should be laid out so that they do not cross cargo handling areas. It further states that vehicles and pedestrians should be separated where they share the same workspace by excluding pedestrians from certain areas or providing separate pedestrian routes.

During the visit to Ardrossan it was observed that the pedestrian route from the long stay car park to the terminal building is generally satisfactory. The only place pedestrians have to cross a vehicle road is at the entrance to the Calmac linkspan (photo 95). There are signs warning drivers that pedestrians may be crossing and vice versa. In addition anti-collision bollards are provided on both sides of the crossing area.

Photo 95

Whilst it is acknowledged that the pedestrian route from the town centre into the ferry terminal is by the walkway past the railway station it should be noted that there is no formal pedestrian access from the marshalling area for motorists wishing to access the terminal building. The only pedestrian routes are either the red chipped area between lanes 2 and 3 (photo 96), the verge between lane 7 and the access road (photo 97) or the unsurfaced path on the far side of the access road.

Photo 96

Photo 97

It is further noted that there is no pedestrian crossing from the short stay car parking outside the terminal building to the building itself (photos 98 & 99).

Photo 98

Photo 99

Pedestrians accessing the site via the designated walkway from the railway station and town centre are required to cross a section of the marina yard that is also used as a vehicular access to the Irish Berth linkspan (photo 101). They are further required to cross the road into the staff parking and taxi rank behind the terminal building (photo 100). This crossing is at a junction and there are no formal pedestrian crossings at either of these locations.

Photo 100

Photo 101

7.2 Vehicle Movements

The ACOP states that appropriate road signs and markings should be provided and that appropriate speed limits should be set around site.

There are two overhead gantry signs that provide clear instruction to vehicles entering the harbour (photos 102 & 103). These initially locate the long term parking, ferry and terminal and latterly the correct lanes within the marshalling area. These signs are reinforced by road markings although these are beginning to wear away (photos 104 & 105).

Photo 102

Photo 103

Photo 104

Photo 105

Where the access road crosses the route used by vehicles disembarking the ferry, 'STOP' markings have been provided on the road. The sign used at the junction however is a 'Give Way' sign (photo 106).

Photo 106

Photo 107

The remainder of the road signage around the one-way system outside the terminal building is considered adequate. There is however a single 'No Entry' sign which has faded and would benefit from replacement (photo 107).

The speed limit within the site is 5mph. This is communicated by both signs and roundels at the entrance to the site (photos 108 & 109).

There are only two speed ramps within the site, both located at the entrance. These are mono-block structures and have settled such that they are no longer effective (photos 110 & 111). During the site survey it was clearly apparent that very little traffic obeys the advertised limit.

Photo 108

Photo 109

Photo 110

Photo 111

7.3 Working at Height

The ACOP correctly states that working at height is one of the biggest causes of work related fatalities and major injuries.

Pedestrian access to the ferries at Ardrossan is either by the Passenger Access System, mobile gangway or, during certain tides, via the linkspan. All of these methods are considered satisfactory.

The ACOP states that fencing must be provided to prevent persons walking within 1m of an unprotected edge. Fencing is provided at Ardrossan to prevent members of the public accessing the berth areas (photos 112 & 113). It is noted however that this is only 1m high and none of the pedestrian gates are locked. All staff members entering the berth area are provided with suitable PPE including hard hats and life jackets.

Photo 112

Photo 113

It was noted during the site survey that site personnel access the top of the Passenger Access System lifting towers via a hooped ladder. This ladder has an anti-climb gate installed but this was never locked during the entire survey (photo 114). Given the relatively low fencing it would be prudent to keep this locked to prevent unauthorised persons accessing the ladder.

Photo 114

7.4 Rescue and Life Saving from Water

The ACOP provides guidance on the requirement for handholds, ladders and lifesaving equipment in docks.

Given the nature of the harbour and the relatively low fencing around the berth, we would consider it prudent to adhere to the recommendations for an unfenced quay edge. This means the inclusion of handholds on the quayside at water level (at any state of the tide), ladders on quay walls and life-saving equipment.

7.4.1 Ladders

The ACOP states that all ladders should be protected against accidental damage and should be well maintained. For quays constructed before January 1st 1989 the ACOP recommends that ladders are at intervals no greater than 50m.
The Calmac Berth has five ladders located on the linkspan and along the length of the berth. As stated in section 2.4.1 these ladders have broken brackets, impact damage or corrosion. Furthermore the ladders are not recessed, have no specific protection against accidental damage and are therefore susceptible to impact damage. The ladders are typically at spacings no greater than 43m.

There are three emergency ladders situated along the length of the Irish Berth. As stated in section 3.4.1, the ladder nearest the linkspan has suffered minor impact damage yet remains secure and serviceable. The other two ladders have suffered more significant impact damage and the bottom brackets have sheared on both. Furthermore the ladders are not recessed, have no specific protection against accidental damage and are therefore susceptible to impact damage. The ladders are typically at spacings no greater than 50m. It was further observed that the ladder grab rails on the deck have been positioned behind the timber cope making their use more difficult for an ascending climber.

There are five emergency ladders situated along the length of the Overnight Berth. As stated in section 4.3.1, the ladders are all generally covered in marine growth and corrosion. The southernmost ladder has suffered minor impact damage yet remains secure and serviceable. The second ladder is free from defects. The bottom bracket to the third ladder is covered in orange deposit and is holed. The two remaining ladders remain free from defects and are serviceable. Furthermore the ladders are not recessed, have no specific protection against accidental damage and are therefore susceptible to impact damage. The ladders are typically at spacings no greater than 31m.

7.4.2 Handholds

The ACOP states that handholds should be suitable for use and be protected where possible to avoid damage both to and from ships. Given that the berths have ladders at intervals within the recommended 50m, the ACOP states that intermediate handholds should be provided at intervals not exceeding 25m.

There are no specific handholds on any of the berths at Ardrossan. The ACOP states however that handholds may take the form of chains, fibre ropes, rubber tyres, fenders or other suitable material hung from the quayside. It is therefore possible, although certainly not ideal, that the berth fenders could be considered handholds.

7.4.3 Life Saving Equipment

The ACOP states that lifesaving equipment should be conspicuous, properly maintained and provided at appropriate intervals. It further states that instructions for the use of each piece of equipment should be given or displayed. Finally it states that lifesaving equipment should be provided at intervals no greater than 100m.

As stated in section 2.4.2, there are two life buoys located on the Calmac Berth. Only one of these has instructions and this is fading and not clearly legible. The drag ropes on both are weathered and the life buoy located adjacent to fender 4 is not clearly visible. These life buoys are approximately 44m apart.

There are two life buoys located on the Irish Berth. As stated in section 3.4.2, the first is located between on a fence approximately 20m from the cope. The second is hung on a mobile gangway. Neither of these are particularly prominent nor are there display instructions. The drag ropes on both are weathered.

As stated in section 4.3.2, there are two life buoys located on the Overnight Berth. These are located 50m apart on prominent positions on fender sponsons. Neither of these life buoys have instructions displayed and the ropes to both are weathered.

7.4.4 Lighting

The ACOP does not provide any guidance on desired lighting levels within a dock. It does however state that 'each part of the dock premises being used for dock operations should be suitably and adequately lit'.

Whilst the site was not surveyed during the hours of darkness it is noted that there is what appears to be relatively new LED lighting throughout all of the berths. There also appears to be adequate street lighting throughout the marshalling area, long-term car park and along all pedestrian routes.

8 PROPOSED FUTURE WIND WALL

As part of this commission RHDHV were asked to comment on the merits and estimated cost of constructing a wind wall on the existing breakwater.

Vessels berthing at Ardrossan often struggle to make the turn through the harbour entrance onto the Calmac berth and subsequently have to use the Irish berth or divert to a port of refuge. It had been proposed that the construction of a wind wall on top of the existing breakwater could improve conditions on the berth.

Anecdotal evidence from the ships masters who operate from Ardrossan suggests that the wind within the harbour is not the limiting factor. They suggest that sea state and swell when entering the harbour is the most significant factor and have questioned the benefit of a wind wall.

Notwithstanding the above, in order to shield the berth the wind wall would require to be a sizeable structure and would need to extend along the sea wall in order to protect the berth from the prevailing South Westerly winds. Similar structures in the Netherlands (such as the Rozenburg Wind Wall pictured below) can be in the order of 25m high.

Anecdotal evidence suggests that the existing breakwater is regularly overtopped in inclement weather. In order to provide an adequately robust structure it would be necessary to anchor into rock to achieve sufficient stability.

The estimated cost of providing such a wall at Ardrossan would likely be in excess of [redacted] Given the limited anticipated benefits of such a wall it may be more prudent to investigate the provision of an additional offshore breakwater to improve sea conditions at the entrance to the harbour.

9 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the visual inspection and dive survey, the following recommendations are made for remedial works.

9.1 Calmac Berth

9.1.1 Quay Structure

The section of masonry quay wall is generally in a fair condition. The voids identified during the inspection and any failed pointing should be filled with a proprietary non-shrinking grout to prevent further deterioration of the wall.

The steel sheet piles are generally in a poor condition with ALWC evident and loss of section and holing to many piles. As a matter of urgency the steel sheet piles should be cleaned and closely inspected to identify all areas that have suffered loss of section or are holed. Provided the findings of this investigation deem it suitable, all affected areas should be plated to maintain the structural integrity of the wall and prevent any substantial loss of fill material. We have assumed in the cost estimate provided in Appendix C that repairs are possible.

Should the existing sheet pile wall be deemed beyond repair then replacement would be necessary. The replacement wall would typically be constructed in front of the existing wall. This would have a significant impact on the operation of the berth. Placing a new wall in front of the existing berth will probably require the re-alignment/replacement of the linkspan structure to accommodate the larger vessels now being proposed by CFL.

Further to the repairs to the sheet pile wall specified above it would be prudent to install a sacrificial anode cathodic protection system on the quay wall. This would help to arrest the corrosion seen to the piles on this berth.

9.1.2 Fenders

The list of defects in table 2.1 should be addressed to reinstate the existing fender system. This is particularly important to prevent the structure from being overloaded or to prevent any potential damage to a berthing vessel.

9.1.3 Linkspan

The H-piles supporting the linkspan are suffering from moderate corrosion with significant loss of section identified in places. As a matter of urgency it would be prudent to carry out a structural appraisal of the linkspan support structure to determine its capacity in relation to current design standards. Further to this appraisal, the piles should be cleaned and closely inspected to identify all areas that have suffered significant loss of section. Based on the findings of this appraisal and inspection exercise, as a minimum it is expected that the corroded areas should be strengthened to maintain the structural integrity of the linkspan support system.

Further to the repairs to the piles it would be prudent to install a sacrificial anode cathodic protection system on the piles. This would help to arrest the corrosion to the piles.

The spalled area of concrete on the deck soffit should be repaired. The affected area should be saw-cut and any exposed reinforcement de-rusted and primed or replaced as necessary. Finally, the area should be reinstated with a proprietary non-shrinking cement repair system.

The gate and handrailing to the linkspan should be prepared and painted to prevent further deterioration.

9.1.4 Miscellaneous Items

The emergency ladder at the nose of the linkspan and the 3 No ladders along the berth should be repaired or replaced as necessary. It would be prudent to provide protective fendering on either side of these to protect them from future impact damage.

The existing life-buoys should be placed in proprietary housings in prominent locations on the berth. Clear instructions for the use of this equipment should be sited adjacent to each life-buoy. These items are important lifesaving equipment and should be checked and serviced at regular intervals.

The loose and rotting sections of timber coping at the masonry section of the quay wall should be replaced with like for like greenheart sections.

9.2 Irish Berth

9.2.1 Quay Structure

The suspended deck along the edge of the berth is in a poor condition. There is a real possibility that a sudden failure could occur, especially under load from a berthing vessel. As a matter of urgency, an option study should be undertaken to investigate the requirements for the berth and to determine the most economical means of reinstating the necessary berthing line. Possible outcomes could be:

- Major refurbishment of existing structure;
- New sheet pile quay wall;
- Replace suspended deck with similar structure;
- New tubular steel pile alignment structure.

As a minimum a sacrificial anode cathodic protection system should be incorporated within the chosen scheme given the conditions identified at the harbour.

For the purposes of the cost estimates in Appendix C we have assumed that the existing structure is demolished and replaced with a similar structure i.e. a suspended deck supported on piles.

9.2.2 Fenders

The existing fenders require some refurbishment. It is assumed that these could be reused in any future scheme to repair the berth. In the short term the defects identified to the fenders during the inspection should be repaired. It would also be prudent to

prepare and paint all steel elements during refurbishment to prevent further deterioration.

9.2.3 Linkspan

The gate and hand railing to the linkspan should be prepared and painted to prevent further deterioration.

The fixed access system on the linkspan should be refurbished. All open grate flooring panels should be replaced and the support members prepared and painted or replaced as necessary.

The blocked gully should be cleared to prevent water from standing adjacent to the linkspan operator's building.

9.2.4 Miscellaneous Items

There are a number of miscellaneous items that require attention on the berth. It is likely that these would be considered within the option study recommended in section 9.2.1.

Three new emergency ladders should be provided along the berth including protective fendering on either side to protect them from future impact damage.

The timber cope along the edge of the deck should be replaced. Gaps should be left adjacent to the emergency ladder grab rails to avoid impeding an ascending climber.

The existing life-buoys should be placed in proprietary housings in prominent locations on the berth. Clear instructions for the use of this equipment should be sited adjacent to each life-buoy. These items are important lifesaving equipment and should be checked and serviced at regular intervals.

The loose and rotting sections of timber coping at the masonry section of the quay wall should be replaced with like for like greenheart sections.

9.3 Overnight Berth

9.3.1 Quay Structure

There are a significant number of holed sheet piles along the length of the berth. As a matter of urgency steel sheet piles should be cleaned and closely inspected to identify all areas that have suffered loss of section or are holed. If the condition of the wall permits, all such areas should be plated to maintain the structural integrity of the wall and prevent any substantial loss of fill material. Based on the findings of this inspection however it is likely that the sheet pile wall on the overnight berth will require replacement. The cost estimate provided in Appendix C therefore assumes that the wall is replaced.

If it is considered appropriate to repair the wall, it would be prudent to install a sacrificial anode cathodic protection system on completion of the works. This would arrest the corrosion and prevent further deterioration of the piles.

9.3.2 Fenders

The list of defects in table 4.1 should be addressed to reinstate the existing fender system. This is particularly important to prevent the structure from being overloaded or to prevent any potential damage to a berthing vessel.

9.3.3 Miscellaneous Items

The emergency ladders along the berth are generally serviceable at this time. The brackets to the 3rd ladder however should be repaired or replaced as necessary. It would be prudent to provide protective fendering on either side of the existing ladders to protect them from future impact damage.

The existing life-buoys should be placed in proprietary housings in prominent locations on the berth. Clear instructions for the use of this equipment should be positioned adjacent to each. These items are important lifesaving equipment and should be checked and serviced regularly as required.

9.4 Sea Wall and Breakwater

The sea wall and breakwater are generally in a fair condition however there are defects that require to be rectified.

All loose or displaced masonry or concrete blocks should be re-set and all voids should be filled with proprietary non-shrinking grout. This is particularly pertinent on the seaward face to avoid further deterioration. All damaged or missing pointing should be reinstated.

It may be prudent to block or remove the access steps to prevent unauthorised personnel from climbing on the structure. All weathered warning signs should also be replaced.

9.5 Access Road, Marshalling Area and Car Parks

The surfacing to the roads within the harbour is generally in a good condition. There are however a few sections of damaged surfacing, particularly in the marshalling area. These should be repaired as necessary. The surfacing in the short term car park is poor and may benefit from being planed off and resurfaced in the not too distant future.

It is noted that the surfacing along each of the three berths is generally in a poor condition. Consideration should be given to resurfacing operational areas on each berth as deemed necessary.

The speed humps at the entrance to the site should be reinstated to better enforce the 5mph limit in the harbour. Furthermore it would be prudent to provide additional humps along the access road to the terminal building.

The white lining at the entrance to the site is beginning to fade and would benefit from being reinstated. Notwithstanding the above, the car parking bays (particularly the disabled bays) in the short term car park are poorly marked and would benefit from being reinstated.

The fading 'No Entry' sign at the short term cark exit should be replaced and the 'Give Way' sign at the junction of the linkspan disembarkation lane and the access road should be replaced with a 'Stop' sign to match the existing road markings.

9.6 Offshore Breakwater

We would recommend that a wave modelling exercise is carried out to investigate wave conditions in the entrance and at the Calmac and Irish Berths within Ardrossan Harbour. This will require the use of a wave penetration model to accurately simulate the diffraction of waves around the head of the existing breakwaters and reflection from the quays. Based on anecdotal evidence from the ships masters the model would need to extend offshore and include the reflection of swell waves from Horse Isle.

The wave penetration modelling package MIKE21 BW developed by DHI would be utilised for preparing this model. In setting up the model the following would be required:

- Local bathymetry which we would obtain from Admiralty Charts. This could be supplemented by any local surveys of the harbour.

- Layout of the harbour i.e. plan of the breakwaters and quays together with outline details of the structures so their wave reflection characteristics can determined. We assume that this could be provided by the harbour master or alternatively it could be taken from OS mapping. A site visit may be required to record structure types.

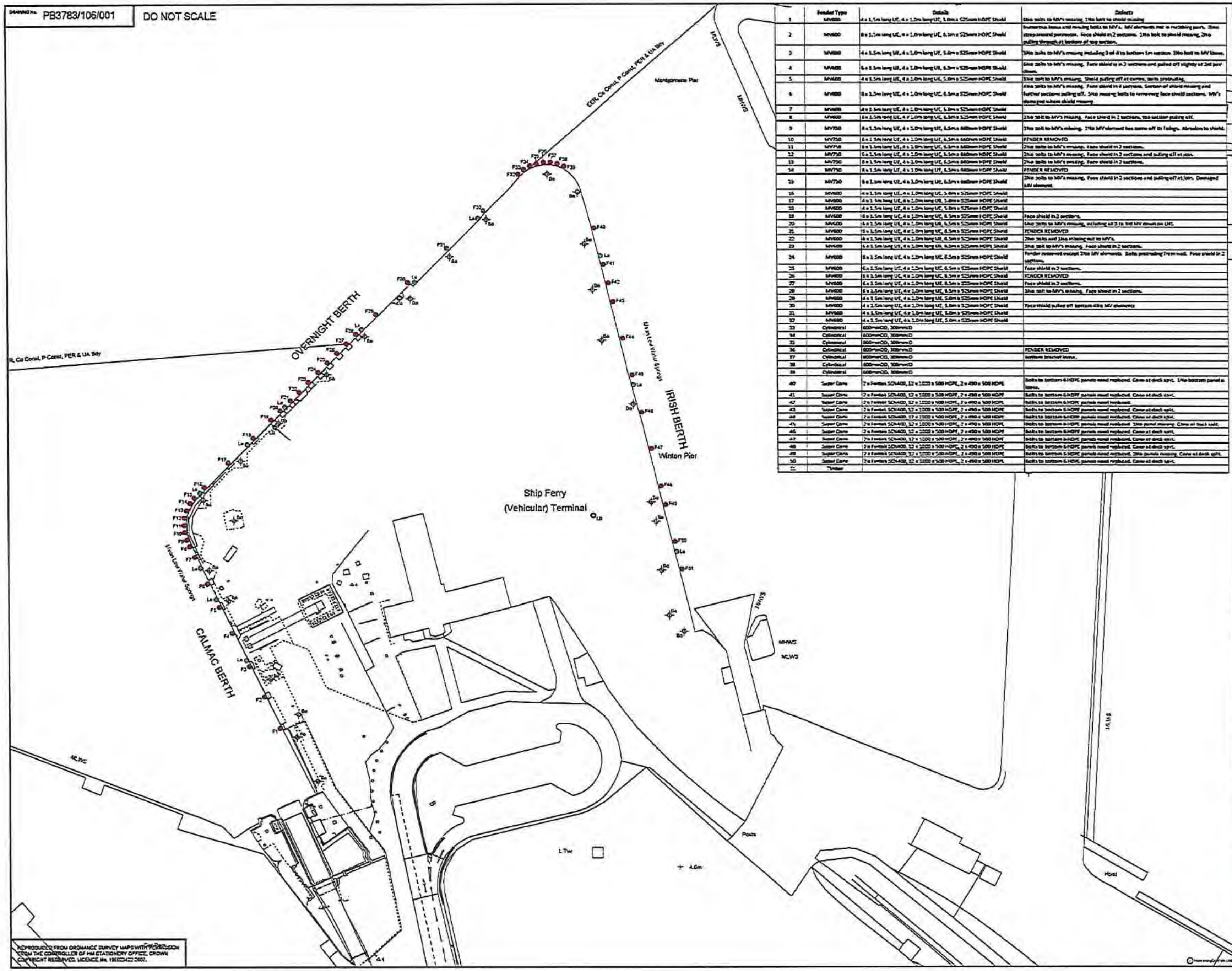
- Inshore wave conditions as input to the model. We have a wave transformation model covering the North Ayrshire coast which was developed for the Council and assume that permission would be given to use the results from this model. This would mean that a wave transformation model would not need to be set-up especially for this study.

Once set-up, the wave penetration model would be run with operational conditions (monthly and annual waves) for the existing layout of the harbour. To provide some verification of the model the results would be compared with operational experience from the harbour. Once we were satisfied that the model was performing satisfactorily it would be used to assess a number of potential improvements to the existing layout. Further recommendations would be given in a report prepared following this modelling exercise.

=O=O=O=

Appendix A – Drawing

DRAWING No. PB3783/106/001 | DO NOT SCALE



	Fender Type	Details	Defects
1	MV600	4 x 1.5m long UE, 4 x 1.0m long UE, 5.0m x 525mm HDPE Shield	6No bolts to MV's missing. 1No bolt to shield missing
2	MV600	8 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	Numerous loose and missing bolts to MV's. MV elements not in matching pairs. Steel strap around perimeter. Face shield in 2 sections. 1No bolt to shield missing, 2No pulling through at bottom of top section.
3	MV600	4 x 1.5m long UE, 4 x 1.0m long UE, 5.0m x 525mm HDPE Shield	5No bolts to MV's missing including 3 of 4 to bottom 1m section. 1No bolt to MV loose.
4	MV600	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	6No bolts to MV's missing. Face shield is in 2 sections and pulled off slightly at 2nd pair down.
5	MV600	4 x 1.5m long UE, 4 x 1.0m long UE, 5.0m x 525mm HDPE Shield	1No bolt to MV's missing. Shield pulling off at corner, bolts protruding.
6	MV600	8 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	4No bolts to MV's missing. Face shield in 4 sections. Section of shield missing and further sections pulling off. 5No missing bolts to remaining face shield sections. MV's damaged where shield missing.
7	MV600	4 x 1.5m long UE, 4 x 1.0m long UE, 5.0m x 525mm HDPE Shield	
8	MV600	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	1No bolt to MV's missing. Face shield in 2 sections, top section pulling off.
9	MV750	8 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 660mm HDPE Shield	1No bolt to MV's missing. 1No MV element has come off its fixings. Abrasion to shield.
10	MV750	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 660mm HDPE Shield	FENDER REMOVED
11	MV750	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 660mm HDPE Shield	2No bolts to MV's missing. Face shield in 2 sections.
12	MV750	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 660mm HDPE Shield	2No bolts to MV's missing. Face shield in 2 sections and pulling off at join.
13	MV750	8 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 660mm HDPE Shield	2No bolts to MV's missing. Face shield in 2 sections.
14	MV750	8 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 660mm HDPE Shield	FENDER REMOVED
15	MV750	8 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 660mm HDPE Shield	3No bolts to MV's missing. Face shield in 2 sections and pulling off at join. Damaged MV element.
16	MV600	4 x 1.5m long UE, 4 x 1.0m long UE, 5.0m x 525mm HDPE Shield	
17	MV600	4 x 1.5m long UE, 4 x 1.0m long UE, 5.0m x 525mm HDPE Shield	
18	MV600	4 x 1.5m long UE, 4 x 1.0m long UE, 5.0m x 525mm HDPE Shield	
19	MV600	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	Face shield in 2 sections.
20	MV600	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	6No bolts to MV's missing, including all 3 to 3rd MV down on LHS.
21	MV600	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	FENDER REMOVED
22	MV600	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	2No bolts and 1No missing nut to MV's.
23	MV600	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	1No bolt to MV's missing. Face shield in 2 sections.
24	MV600	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	Fender removed except 2No MV elements. Bolts protruding from wall. Face shield in 2 sections.
25	MV600	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	Face shield in 2 sections.
26	MV600	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	FENDER REMOVED
27	MV600	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	Face shield in 2 sections.
28	MV600	6 x 1.5m long UE, 4 x 1.0m long UE, 6.5m x 525mm HDPE Shield	1No bolt to MV's missing. Face shield in 2 sections.
29	MV600	4 x 1.5m long UE, 4 x 1.0m long UE, 5.0m x 525mm HDPE Shield	
30	MV600	4 x 1.5m long UE, 4 x 1.0m long UE, 5.0m x 525mm HDPE Shield	Face shield pulled off bottom 4No MV elements
31	MV600	4 x 1.5m long UE, 4 x 1.0m long UE, 5.0m x 525mm HDPE Shield	
32	MV600	4 x 1.5m long UE, 4 x 1.0m long UE, 5.0m x 525mm HDPE Shield	
33	Cylindrical	600mmOD, 300mmID	
34	Cylindrical	600mmOD, 300mmID	
35	Cylindrical	600mmOD, 300mmID	
36	Cylindrical	600mmOD, 300mmID	FENDER REMOVED
37	Cylindrical	600mmOD, 300mmID	Bottom bracket loose.
38	Cylindrical	600mmOD, 300mmID	
39	Cylindrical	600mmOD, 300mmID	
40	Super Cone	2 x Fentek SCN400, 12 x 1000 x 500 HDPE, 2 x 490 x 500 HDPE	Bolts to bottom 6 HDPE panels need replaced. Cone at deck spec. 1No bottom panel is loose.
41	Super Cone	2 x Fentek SCN400, 12 x 1000 x 500 HDPE, 2 x 490 x 500 HDPE	Bolts to bottom 6 HDPE panels need replaced. Cone at deck spec.
42	Super Cone	2 x Fentek SCN400, 12 x 1000 x 500 HDPE, 2 x 490 x 500 HDPE	Bolts to bottom 6 HDPE panels need replaced.
43	Super Cone	2 x Fentek SCN400, 12 x 1000 x 500 HDPE, 2 x 490 x 500 HDPE	Bolts to bottom 6 HDPE panels need replaced. Cone at deck spec.
44	Super Cone	2 x Fentek SCN400, 12 x 1000 x 500 HDPE, 2 x 490 x 500 HDPE	Bolts to bottom 6 HDPE panels need replaced. Cone at deck spec.
45	Super Cone	2 x Fentek SCN400, 12 x 1000 x 500 HDPE, 2 x 490 x 500 HDPE	Bolts to bottom 6 HDPE panels need replaced. 1No panel missing. Cone at deck spec.
46	Super Cone	2 x Fentek SCN400, 12 x 1000 x 500 HDPE, 2 x 490 x 500 HDPE	Bolts to bottom 6 HDPE panels need replaced. Cone at deck spec.
47	Super Cone	2 x Fentek SCN400, 12 x 1000 x 500 HDPE, 2 x 490 x 500 HDPE	Bolts to bottom 6 HDPE panels need replaced. Cone at deck spec.
48	Super Cone	2 x Fentek SCN400, 12 x 1000 x 500 HDPE, 2 x 490 x 500 HDPE	Bolts to bottom 6 HDPE panels need replaced. Cone at deck spec.
49	Super Cone	2 x Fentek SCN400, 12 x 1000 x 500 HDPE, 2 x 490 x 500 HDPE	Bolts to bottom 6 HDPE panels need replaced. 2No panels missing. Cone at deck spec.
50	Super Cone	2 x Fentek SCN400, 12 x 1000 x 500 HDPE, 2 x 490 x 500 HDPE	Bolts to bottom 6 HDPE panels need replaced. Cone at deck spec.
51	Timber		

NOTES

KEY
- FENDER
- BOLLARD
- LADDER
- LIFE BUOY

REV | DATE | DESCRIPTION | BY | CHK | APP

REVISIONS

CLIENT: CMAL Caledonian Maritime Assets Ltd

PROJECT: ARDROSSAN HARBOUR

TITLE: ASSET CONDITION SURVEY

Royal HaskoningDHV — Enhancing Society Together

DRAWN: GB | CHECKED: D.C.H | APPROVED: JF
DATE: APR 16 | SCALE AT A1: 1:1000 | CAD REF: Ardrossan Harbour
DRAWING No.: PB3783/106/001 | REVISION: –

Appendix B – Diver's report

ARDROSSAN FERRY TERMINAL

SEAWALL AND PILE INSPECTION

INSPECTION REPORT

Location	***Ardrossan Ferry Terminal***	*Issue*	***01***
Client	***CMAL***	*Date*	***13th & 14th April 2016***
Client Reference		*SMS Reference*	***1489***

Registered in Scotland - No. 137036; V.A.T. REG No.801 5536 58; H.S.E. REG. No. 0332

Distribution and Issue Record:

Recipient	*Issue*	*Issue Date*
[redacted]	01	20th April 2016
	01	20th April 2016

Authorisation:

Prepared By	*Signature*	*Date*
[redacted]		20th April 2016
Authorised By		
[redacted]		20th April 2016

CONTENTS

1 Overview

Shearwater Marine Services Limited was contracted by Royal Haskoning DHV to carry out an underwater GVI of the seawall and associated structures on three berths at Ardrossan ferry terminal. The three berths were the Irish Berth, Overnight Berth and the Cal Mac Berth with both the Irish and Cal Mac berths having associated link-span structures. As well as a GVI, ultrasonic thickness (UT) readings were taken at regular intervals along the sheet pile seawall sections on the Cal Mac and overnight berths as well as the Hex piles along the Irish berth and the 'H' piles at the Cal Mac link-span.

Extensive orange deposits were found on all metal work, as there is no CP system installed on the berths, with some holing of piles also evident. The UT readings taken were generally consistent with some low points noted. All concrete sections of the seawall were generally in good condition with minor isolated undercut visible. Full survey results are included within this report.

2 General Contract Details

Client:	CMAL
Contractor:	Royal Haskoning DHV
Client Contact:	Stuart Hannell
General Scope:	GVI & Ultrasonic Thickness Readings
Location:	Ardrossan Ferry Terminal
Dive Supervisor:	[redacted]
Dive Engineer:	
Dates:	13th & 14th April 2016

3 Environmental

Weather:	Cloudy/ Sunny Spells
General Visibility:	Good
In-water Visibility:	up to 6m
Water Depth:	up to 7m
Water Temperature:	9°C
Access/ Egress:	Jetty Ladders

4 Survey Record

4.1 Cal Mac Berth

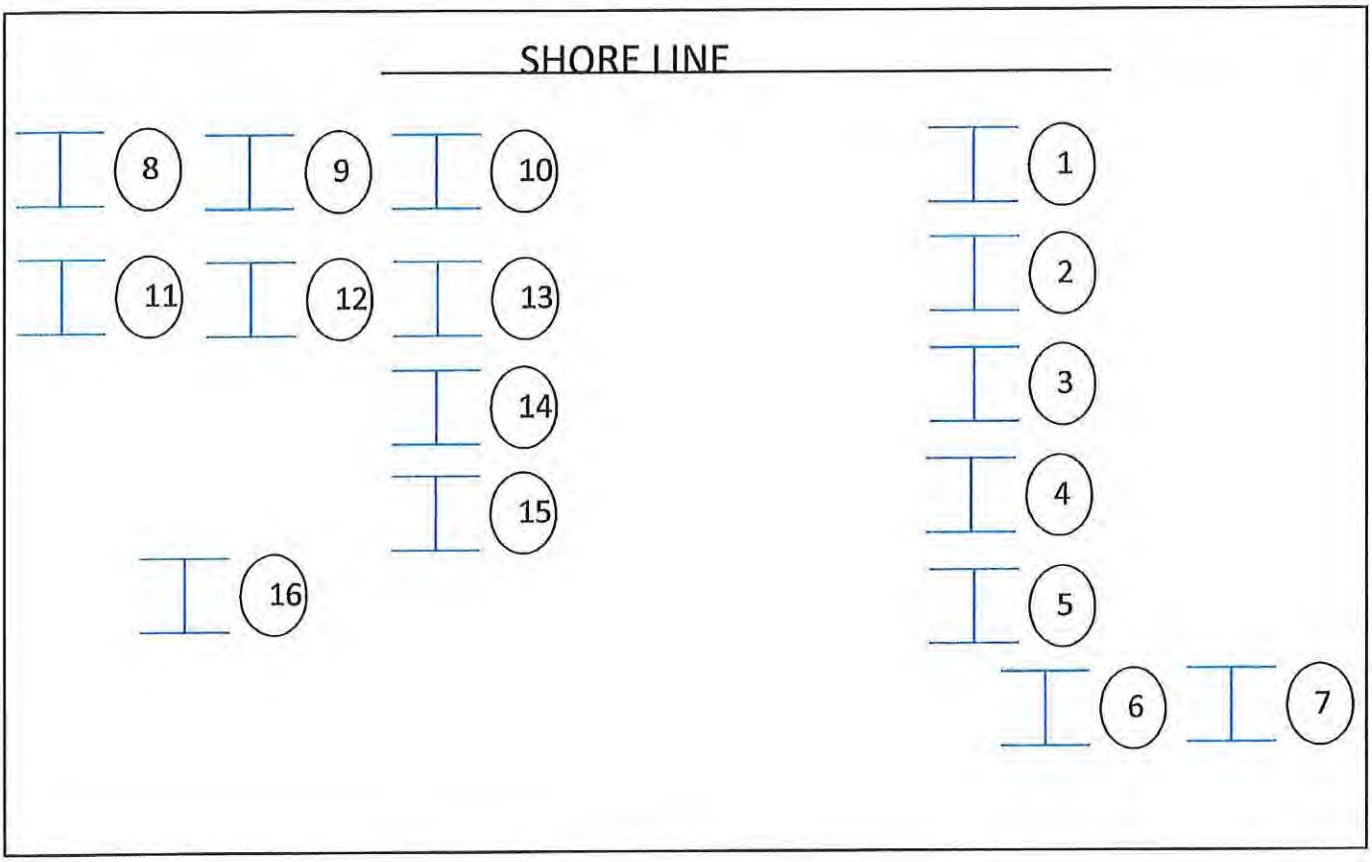


Diagram 1 – Pile Numbering Details

West Link-span Piles **Disc 1 Recording 1**

Pile No.	Comments
1	Pile out of water extensive corrosion product evident.
2	100% cover of hard and soft marine fouling, Orange deposits evident on flanges over full length of the pile. Where marine growth is removed an uneven metallic surface is visible.
3	100% cover of hard and soft marine fouling, Orange deposits evident on flanges over full length of the pile. Where marine growth is removed an uneven metallic surface is visible.
4	100% cover of hard and soft marine fouling, Orange deposits evident on flanges over full length of the pile. Where marine growth is removed an uneven metallic surface is visible. Orange deposits evident on the support structure for the link-span riser plate
5	100% cover of hard and soft marine fouling, Orange deposits evident on flanges over full length of the pile. Where marine growth is removed an uneven metallic surface is visible.
6	100% cover of hard and soft marine fouling, Orange deposits evident on flanges over full length of the pile. Where marine growth is removed an uneven metallic surface is visible.
7	100% cover of hard and soft marine fouling, Orange deposits evident on flanges over full length of the pile. Where marine growth is removed an uneven metallic surface is visible.

East Link-span Piles **Disc 1 Recording 2**

Pile No.	Comments
8, 9, 10, 11	Piles out of water extensive corrosion product evident.
12	100% cover of hard and soft marine fouling, Orange deposits evident on flanges over full length of the pile. Where marine growth is removed an uneven metallic surface is visible.
13	100% cover of hard and soft marine fouling, Orange deposits evident on flanges over full length of the pile. Where marine growth is removed an uneven metallic surface is visible.
14	100% cover of hard and soft marine fouling, Orange deposits evident on flanges over full length of the pile. Where marine growth is removed an uneven metallic surface is visible
15	100% cover of hard and soft marine fouling, Orange deposits evident on flanges over full length of the pile. Where marine growth is removed an uneven metallic surface is visible. . Orange deposits evident on the support structure for the link-span riser plate, large holes on the riser plate face over full length.
16	100% cover of hard and soft marine fouling, Orange deposits evident on flanges over full length of the pile. Where marine growth is removed an uneven metallic surface is visible.

UT Readings

Link Span Piles			
Pile No	Level Below Chart Datum (m)	UT Reading (mm)	CP Reading (-veV)
1		in dry	
2	0.2	15.50	
3	+0.3	13.40	0.572
	0.4	12.75	
	1.2	17.25	
4	+0.3	18.10	
	1.2	16.90	
	2.7	18.70	
5	+0.3	13.50	
	1.7	13.90	
	3.6	17.75	
6	+0.3	10.00	
	1.7	17.65	
	3.6	17.90	
7	+0.3	13.20	
	1.7	18.30	
	3.6	18.30	
8		in dry	
9		indry	
10		in dry	
11		in dry	
12	0.0	17.45	0.623
13	0.0	15.30	
14	+0.4	15.65	
	1.2	17.60	
15	+0.4	18.55	
	0.4	17.50	
	1.5	17.90	
16	+0.4	16.75	
	0.8	18.00	
	2.0	19.20	

Seawall

NB – Diver worked from South to North along the seawall. 0m chainage was taken at the start of the block work level with the end of the link span.

Block Work Section **Disc 1 Recording 3**

Video Timer (min.sec)	Level below chart datum (m)	Chainage (m)	Comments
00.00	3.2	0	100% cover of marine fouling. Step in block work protruding 600mm. Grouting in good condition, no evidence of scouring or under cut at the base. Continues along the length of the seawall.
02.50	3.2	10	Tie Back plates ≈ 4x1.5m, slight orange deposit evident.
07.30	Seabed	25	Slight undercut 3m long up to 150mm height and 300mm deep.
09.30	+0.9	25	Grouting missing in tidal zone
11.00	+0.3	30	Void in blockwork 450x500mm, 410mm deep.

Sheet Pile Section **Disc 1 Recording 4**

Video Timer (min.sec)	Level below chart datum (m)	Chainage (m)	Comments
00.00		**30**	100% cover of marine fouling. Where marine fouling is removed a shiny uneven metal is visible with large, frequent areas of orange deposit evident. Continues along the length of the seawall.
22.00		**55**	Sheet piles continue to be in a similar condition as before with the areas of orange deposit becoming smaller and less frequent.
26.00	**3.7**	**60**	Hole on side pan – 600x150mm, 100mm deep. Rock back fill visible in void. Orange deposit evident around the hole.
40.25		**75**	Sheet piles continue to be in a similar condition as before with the areas of orange deposit becoming smaller and less frequent around 1 area every 4 outpans.

UT Readings

Sheet pile wall	UT Readings (mm)				
Chainage (m) (from south)	Top (+1.0m CD)	Middle (-1.5m CD)	Bottom (-4.1m CD)	CP Reading (-veV)	OD Area (Depth below CD)
0					
5					
10					
15					
20					
25					
30	11.50	11.25	11.65	0.626	9.65 (1.1m)
35	12.00	12.00	11.10`		10.05 (+0.8m)
40	9.25	11.70	11.00		8.75 (3.9m)
45	10.35	12.05	10.95		10.2 (4.1m)
50	10.00	12.80	12.10		n/a
55	12.25	12.70	12.20		10.3 (+1.0m)
60	11.65	12.20	12.40		10.65 (0.7m)
65	12.45	11.95	12.95		10.65 (0.7m)
70	11.20	11.95	12.05	0.614	10.6 (4.7m)
75	11.95	12.35	12.15		n/a
80	11.75	12.05	12.10		n/a

4.2 Overnight Berth

Seawall

NB – Diver worked from West to East along the seawall. 0m chainage was taken at the corner of the round head where the chainage stopped on the Cal Mac berth. Where the piles are holed, orange deposit was evident round the void.

Sheet Pile Section **Disc2 Recording 1**

Video Timer (min.sec)	Level below chart datum (m)	Chainage (m)	Comments
00.00		0	100% cover of marine fouling. Extensive orange deposit in the tidal zone. Where marine fouling is removed an uneven metal is visible. Continues along the length of the wall with infrequent areas of orange deposit at seabed.
06.50		8	Ladder – orange deposit evident to both ladder and securing bracket. Bracket corroded and disconnected on east side.
07.78	0.9	8	Hole – 170x700mm, 180mm deep in side-pan, rock backfill evident.
		10	Orange deposit evident on side pans. Tie rods visible, in good condition.
15.10	+0.2	11	Hole – 260x900mm, 600mm deep. Rock backfill evident.
	0.0	18	Holes – 140x200mm, 600mm deep. 140x240, 300mm deep. In adjacent side pans
20.18	0.2	18	Holes – 150x420mm, 210mm deep. 150x150mm, 400mm deep.
21.13		20	Ladder – orange deposit evident to both ladder and securing bracket. Ladder is secure.
31.00	+0.1	34	Hole – 450x150mm backfill visible.
34.00	+0.5	38	Hole – 140x300mm, 600mm deep.
34.32		40	Ladder – orange deposit evident to both ladder and securing bracket. Ladder is secure.

	0.0	**45**	Hole – 280x800mm, rock backfill visible.
40.42		**50**	100% cover of marine fouling. Extensive orange deposit in the tidal zone. Where marine fouling is removed an uneven metal is visible. Continues along the length of the wall with infrequent areas of orange deposit at seabed.
46.11	**0.6**	**61**	170x300mm, 210mm deep. Rock backfill visible.
50.24		**74**	Ladder – orange deposit evident to both ladder and securing bracket. Corrosion evident on east side of the bracket. Ladder is secure.
	+0.3	**76**	Holes – 200x50mm, 600mm deep 120x300mm, 600mm deep. In adjacent side-pans.
56.32	**+0.3**	**78**	Hole – 130x320mm, 300mm deep.
		85	Sheet piles stop. Concrete block work continues.

Sheet pile wall	**UT Readings (mm)**				
Chainage (m) (from south)	**Top (+2.3m CD)**	**Middle (0.7m CD)**	**Bottom (3.7m CD)**	**CP Reading (-veV)**	**O/D Reading (below CD)**
0	11.1	12.65	12.70		
10	9.30	8.40	9.75	0.601	8.4 (0.9m)
20	13.40	12.3	12.40		5.85 (2.7m)
30	13.15	9.30	11.90		10.95 (+0.3m)
40	12.65	10.00	11.35	0.616	
50	13.15	11.90	12.05		8.3 (+1.5m)
60	13.45	12.15	13.40		7.9 (4.1m)
70	12.10	10.55	12.50		7.2 (0.4m)
80	13.40	12.30	11.50	0.62	-

Block work section **Disc 2 Recording 2**

Video Timer (min.sec)	Level below chart datum (m)	Chainage (m)	Comments
00.00		**85**	Concrete block work (precast) to 0.9m above chart datum. Below this block work is very irregular in shape and size (appears to be natural rock with no grouting visible. Generally there is no scouring or undercut visible along the length of the seawall.
05.00		**120**	Ladder – orange deposit evident to both ladder and securing bracket. Ladder is secure.
07.00	**3.1**	**135**	Joint between pre-cast concrete block work in good condition. Lower pre-cast block continues to seabed. At seabed block work is on a poured footing that extends 1.7m from the edge of the wall.
	5.5	**135**	Seabed
10.32	**5.5 (Seabed)**	**143**	Slight undercut – 190mm height 350mm deep, 3m long.

4.3 Irish Berth

Seawall

NB – Diver worked from North to South along seawall. 0m chainage was taken at the south side of the round head with the overnight berth.

No defects were evident along the length of the seawall.
All Piles - 100 % cover of hard marine fouling, where removed paint coat breaking down with an uneven metal visible. Extensive orange deposit over full length of the pile. Horizontal members show signs of corrosion and orange deposit, corrosion mainly on web. Any other defects mention below.

Jetty Piles

Hexagonal Pile **Disc 2 Recording 3**

Video Timer (min.sec)	Level below chart datum (m)	Pile Number	Comments
		1	Out of water at time of inspection, extensive corrosion product evident.
	+0.3	2	3 Holes below where horizontal member is attached to the pile. Up to 70mmØ voided behind.
		3	Ladder – Loose, extensive orange deposit evident.
			Fender 1 - secure.
			Fender 2 – secure
			Fender 3 – secure
			Fender 4 – secure
		9	Ladder – poor condition, rungs detached, unsecure and buckled. Horizontal member at an angle and detached from the seawall.
			Fender 5 – 2nd bottom south fender section missing.

Hexagonal Piles **Disc 3 Recording 1**

Video Timer (min.sec)	Level below chart datum (m)	Pile Number	Comments
00.00			Fender 6 – secure, fixings corroded and sheared.
10.26	**+0.5**	**12**	Hole – 70mmØ voided behind. Wrapping round base of pile
			Fender 7 – secure, orange deposit to fixings
20.33		**14**	Horizontal beam – corroded, holed and buckled. Unsecure on south side
Rec 2			
00.00			Fender 7 – Fender pads at bottom missing. Fixings corroded and sheared.
08.10			Fender 8 – 2nd bottom fender pads proud at bottom, fixings corroded and sheared.
		18	Ladder – secure, orange deposit evident
15.43			Timber fender – loose sections over full length.

Linkspan Footings

West

Blockwork has an irregular surface, although no voiding is visible at joints. No defects visible.

East

Blockwork has an irregular surface, although no voiding is visible at joints. No defects visible.

UT Readings

Hex piles		UT Readings (mm)						
Pile No from north	Depth Below CD (m)	N	NE	SE	S	SW	NW	CP
	+0.5	10.90	9.30	8.00	6.80	7.05	8.25	
2	4.7	10.30	8.65	8.15	8.90	7.90	8.55	0.607
	+0.5	10.50	8.70	7.55	10.05	10.20	9.15	
4	4.4	6.45	7.45	8.90	6.80	8.90	7.65	0.613
	+0.5	8.85	8.90	8.65	7.85	9.75	9.65	
6	4.4	9.40	8.45	9.10	8.50	9.90	8.90	0.615
	+0.5	8.05	9.45	9.55	9.55	10.00	10.00	
8	4.5	11.65	10.50	11.95	11.80	11.20	12.00	0.621
	+0.5	9.60	9.90	9.40	9.95	7.95	9.50	
10	4.7	10.40	10.60	10.60	9.30	11.60	11.80	0.610
	+0.5	10.70	8.75	10.05		9.05	8.45	
12	4.7		Wrapped					
	+0.5	11.05	12.00	11.75	12.00	11.95	11.40	
14	4.7	11.20	11.00	11.05	10.95	11.45	11.50	
	+0.5	11.10	10.20	10.70	10.10	9.80	10.20	
16	4.4	11.80	12.15	12.05	11.55	11.50	11.95	0.608
	+0.5	11.05	9.95	10.50	10.00	9.05	10.15	
18	4.0	11.25	11.95	12.00	11.45	11.30	11.45	0.607
	+0.5	9.70	6.30	7.30	7.20	8.30	8.30	
20	4.0	8.25	8.10	8.50	7.25	8.70	8.30	

5 Video Record

The enclosed DVDs record the findings and should be viewed in conjunction with reading this report.

Appendix C – Recommended Maintenance Programme

Table C.1 Recommended Maintenance to Calmac Berth

Ferry Terminal		Ardrossan				
Asset	Defect	Priority of Defect				
		Black	Red	Amber	Green	N/A
Masonry Quay Wall	Infill voids to masonry section of quay wall (approximate length 20m)					
Sheet Pile Quay Wall	Clean all sheet piles, inspect and plate as necessary (approximate length 60m)					
	Install sacrificial anode cathodic protection system on sheet pile quay wall.					
Fenders	Refurbish and reinstate all Trellex MV fenders					
Linkspan Support Structure	Carry out structural appraisal of linkspan support structure.					
	Concrete repair to spalled section of outer dolphin soffit (approx 1m x 1m)					
	Clean and inspect all H Piles. Carry out repairs as necessary.					
	Install sacrificial anode cathodic protection system on H piles.					
Linkspan Deck	Prepare and paint gate at entrance to approach and handrailing on ramp (approx 50m length)					
Timber Cope	Remove and replace loose and rotting section of timber cope (20m length)					

Ferry Terminal		Ardrossan				
Asset	Defect	Priority of Defect				
		Black	Red	Amber	Green	N/A
Emergency Ladders	Provide 3No emergency ladders with fender protection along berth and 1No at nose of linkspan.					
Lifesaving Equipment	Provide proprietary stand in prominent location for all life buoys including instructions.					
	Estimated Repair Cost*					
	Estimated Eng, Management and Supervision					

Table C.2 Recommended Maintenance to Irish Berth

Ferry Terminal		Ardrossan				
Asset	Defect	Priority of Defect				
		Black	Red	Amber	Green	N/A
Suspended Deck	Carry out Option Study to determine most economic means of refurbishment. Cost estimate assumes replacement of suspended deck with similar structure inclusive of cathodic protection system.	[redacted]				
Fenders	Replace missing cylindrical fender on roundhead.		[redacted]			
	Reattach loose bracket to cylindrical fender on roundhead.					
	Replace 11No SCN400 cone fenders			[redacted]		
	Replace all bolts to HDPE panels on Super Cone fenders with stainless steel bolts (76No M16 per fender).		[redacted]			
	Replace 3No missing 1m x 0.5m HDPE face shield panels to Super Cone fenders.					
Deck Surface	Plane off existing deck surfacing and relay with 45mm HRA (approx. 100m x 10m)			[redacted]		
Emergency Ladders	Provide 3No emergency ladders with fender protection along berth.	[redacted]				

Ferry Terminal		Ardrossan				
Asset	Defect	Priority of Defect				
		Black	Red	Amber	Green	N/A
Lifesaving Equipment	Provide proprietary stand in prominent location for all life buoys including instructions.					
Timber Cope	Replace all timber coping to edge of deck.					
	Cut timber cope adjacent to emergency ladder grab rails.					
Linkspan	Replace fixed access platforms to deck					
	Prepare and paint gate at entrance to approach and handrailing on ramp (approx 50m length)					
	Estimated Repair Cost*					
	Estimated Eng, Management and Supervision					

Table C.3 Recommended Maintenance to Overnight Berth

Ferry Terminal		Ardrossan				
Asset	Defect	Priority of Defect				
		Black	Red	Amber	Green	N/A
Sheet Pile Wall	Replace existing sheet piled quay wall including sacrificial anode cathodic protection system.					
Deck Surface	Plane off existing deck surfacing and relay with 45mm HRA (approx. 130m x 10m)					
Fenders	Refurbish and reinstate all Trellex MV fenders					
Emergency Ladders	Repair holed brackets to 3rd ladder on berth.					
Lifesaving Equipment	Provide proprietary stand in prominent location for all life buoys including instructions.					
	Estimated Repair Cost*					
	Estimated Eng, Management and Supervision					

Table C.4 Recommended Maintenance to Harbour Infrastructure

Ferry Terminal		Ardrossan				
Asset	Defect	Priority of Defect				
		Black	Red	Amber	Green	N/A
Access Road	Reinstate white lining at entrance to site and marshalling area			[redacted]		
	Reinstate speed humps at entrance to site	[redacted]				
	Provide additional speed humps within site (say 3No)					
	Replace 'Give Way' sign with 'Stop' sign					
	Replace fading 'No Entry' sign at short term parking area					
Short Term Car Park	Reline parking bays outside terminal building.			[redacted]		
	Plane off existing surfacing and relay with 45mm HRA (approx 180m2)				[redacted]	
Sea Wall / Breakwater	Replace weathered warning signs		[redacted]			
	Replace all loose/missing masonry/blocks					
	Repoint wall, filling any voids on seaward face					

Ferry Terminal		Ardrossan				
Asset	Defect	Priority of Defect				
		Black	Red	Amber	Green	N/A
Offshore Breakwater	Carry out an option study including wave modelling to determine the benefit and cost of providing a new offshore breakwater.					
Marshalling Area	Repair potholes/damaged surfacing as necessary					
	Estimated Repair Cost*					
	Estimated Eng, Management and Supervision					

Key

Defect Category	Definition
Black	The element is non-functional/failed. Repair within 0-1 years.
Red	Severe defect/damage, significant loss of functionality and/or element is close to failure/collapse. Repair within 1-2 years.
Amber	Moderate defect/damage, some loss of functionality could be expected. Repair within 2-5 years.
Green	Early signs of deterioration, minor defect/damage, no reduction in functionality of element. Repair within 5+ years.
N/A	As new condition or defect has no significant effect on the element (visually or functionally). No repair required.

Table C.5 Recommended Maintenance Summary

The following table is a summary of all costs from Tables C1 – C4. These costs are all estimated based on the limited inspection carried out and are subject to further investigation and ground investigation works as necessary.

No contingency has been added to any estimates.

	Priority of Defect				
	Black	Red	Amber	Green	N/A
Estimated Repair Cost*	[redacted]	[redacted]	[redacted]	[redacted]	
Estimated Eng, Management and Supervision					
TOTAL					