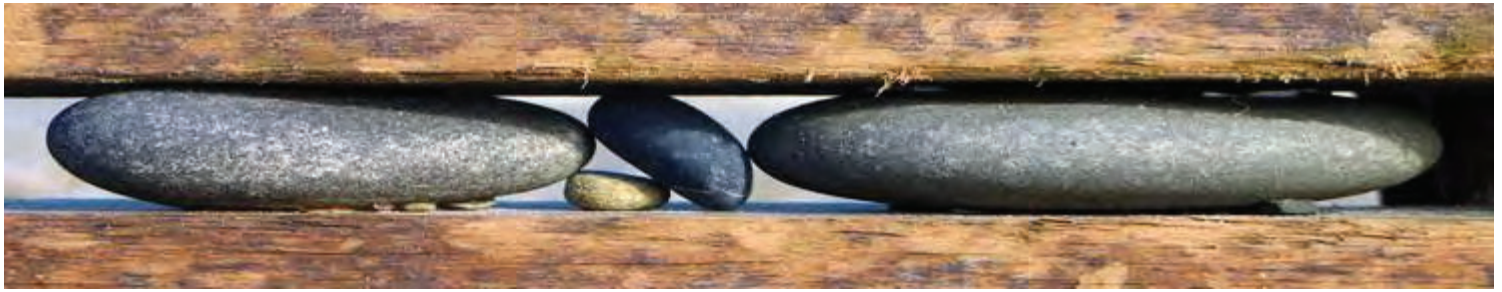




# The People's Project

Bramley-Moore Dock  
Bramley-Moore Dock Wall Visual  
Condition Report  
December 2019



**Bramley-Moore Dock Wall  
Visual Condition Report**

**Document Ref: 170701-01-200 - Rev. C**

**BUROHAPPOLD  
ENGINEERING**

July 2017



**Document details:**

Project name	Bramley-Moore Dock Wall - Visual Condition Report				
Project no.	170701				
Report no.	170701-01-200				
Client	BuroHappold				
Revision	Date	Status	Prepared by	Checked by	Reviewed by
A	31/07/17	Draft Issue	D. Ollier	R. Williams	H. Howell
B	07/08/17	Final Issue	D. Ollier <i>BEng(Hons)</i> <i>CEng</i> <i>MIStructE</i> <i>MICE</i>	R. Williams <i>MEng(Hons)</i>	H. Howell <i>BEng(Hons)</i> <i>CEng CEnv</i> <i>MIStructE FICE</i> <i>MInstLM</i>
C	16/08/17	Amended as per comments	D. Ollier <i>BEng(Hons)</i> <i>CEng</i> <i>MIStructE</i> <i>MICE</i>	R. Williams <i>MEng(Hons)</i>	H. Howell <i>BEng(Hons)</i> <i>CEng CEnv</i> <i>MIStructE FICE</i> <i>MInstLM</i>
Comments					

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		<b>Project number:</b>		<b>170701</b>	
		<b>Sheet no.</b>	<b>01</b>	<b>/ 200</b>	<b>/ 1 Rev. C</b>
			<i>Phase</i>	<i>Set</i>	<i>Sheet</i>
<b>Client:</b>	BuroHappold	<b>Source drawings nos.</b>			
<b>Project Name:</b>	Bramley-Moore Dock Survey	<b>Prepared by:</b>	D. Ollier	<b>Date:</b>	16/08/17
		<b>Checked by:</b>	R. Williams	<b>Date:</b>	16/08/17
<b>Structure:</b>	Dock Wall	<b>Reviewed by:</b>	H. Howell	<b>Date:</b>	16/08/17
		<i>dd / Mon / yy</i>			

**Site** Bramley-Moore Dock, Liverpool

**Scope** Pebble Engineering Ltd (Pebble) was commissioned by BuroHappold to undertake a visual inspection of the Bramley-Moore Dock Wall. The survey included the entire perimeter of the Bramley-Moore Dock plus the north quay wall to the adjacent Nelson Dock. The survey work was to include:

- A full visual survey of the dock walls below the water line to check for signs of distress, defects or excessive distortion of the wall face.
- Measurement of the bed level relative to the top of the wall.
- Preparation of a factual report including photographs.

**Material & Type of Structure** The dock wall inspection included approximately 980m length of the Bramley-Moore Dock and 290m length of Nelson Dock. Nelson Dock is located directly south of Bramley-Moore Dock. The dock walls are mass gravity retaining structure constructed from random coursed stonework with a granite coping stone.

**Method of Inspection** On the Client's instruction, Pebble Engineering employed Kaymac Marine and Civil Engineering Ltd to undertake a below water level inspection of the dock walls.

Kaymac provided a 5 man dive team and workboat to complete the inspection. Kaymac's Structural Condition Report is included as an appendix to this Technical Note. The inspection was completed during week commencing July 10<sup>th</sup> 2017. The weather during the survey was dry and sunny.

Pebble Engineering supervised the Kaymac survey and assessed the condition of the wall through CCTV footage. BuroHappold were on site during that week to inspect the wall above the water line including the coping stones, dock furniture such as bollards and mooring points, and the ground directly behind the dock wall. Kaymac provided assistance to BuroHappold to view the condition of the above water level section of the dock wall from within the workboat.

**Condition Survey** From Kaymac's survey, below the water line, the dock wall was found to be in good condition. However, there was extensive marine growth which limited the extent of the inspection. Open bed jointing was recorded to the stone masonry up to 5m below the waterline. There were also some small voids within the masonry



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			<i>Phase</i>	<i>Set</i>	<i>Sheet</i>
Client:	BuroHappold	Source drawings nos.			
Project Name:	Bramley-Moore Dock Survey	Prepared by:	D. Ollier	Date:	16/08/17
		Checked by:	R. Williams	Date:	16/08/17
Structure:	Dock Wall	Reviewed by:	H. Howell	Date:	16/08/17
		<i>dd / Mon / yy</i>			

and a vertical crack at chainage 773m. The wall did not appear to exhibit signs of bulging or distortion. A summary of the form of the wall and features below the waterline are as follows:

- The height of wall above the water level was recorded as 1.7m.
- A 0.2m wide toe was located approximately 7.5m below the coping line (top of coping).
- The bed level was found to be above the toe of the wall in some locations.
- Dense marine growth throughout.
- Open jointing over the entire length of wall.
- Vertical recesses and numerous steel pipe outlets

Refer to Appendix B for Soundings recorded during the survey

Recommendations Refer to Kaymac report in Appendix A

Photographs



General View of Bramley-Moore Dock

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dd / Mon / yy						



View of North Wall to Nelson Dock



Typical Wall Construction



<b>Client:</b> BuroHappold		<b>Project number:</b> 170701	
		<b>Sheet no.</b> 01 / 200 / 4 Rev. C <i>Phase Set Sheet</i>	
<b>Project Name:</b> Bramley-Moore Dock Survey		<b>Source drawings nos.</b>	
<b>Structure:</b> Dock Wall		<b>Prepared by:</b> D. Ollier	<b>Date:</b> 16/08/17
		<b>Checked by:</b> R. Williams	<b>Date:</b> 16/08/17
		<b>Reviewed by:</b> H. Howell	<b>Date:</b> 16/08/17
		<i>dd / Mon / yy</i>	

Appendix A

Kaymac Report No. 1 - Bramley-Moore Dock Wall







**BuroHappold Engineering**

**Report No. 1**

**Bramley–Moore Dock Wall**

**Underwater Inspection 2017**

## Document Control Sheet

<b>Title:</b> Bramley-Moore Dock wall Inspection Report	<b>Document No.</b> KM/B-M/DWS/14/07/17
<b>Originator:</b>   Kaymac Marine & Civil Engineering  Osprey Business Park Byng Street Landore Swansea SA1 2NX Tel: 01792 301818	<b>Client:</b>    Buro Happold Ltd  Camden Mill 230 Lower Bristol Road Bath BA2 3DQ United Kingdom <b>+44 1225 320 600</b>

### Authorisation

Prepared by:	J.Colcombe (Diving Supervisor)	Signature:	Date:14/07/17
Checked By:	R. Colcombe MSc, B.Eng(Hons)	Signature:	Date: 14/07/17
Approved by:	J. Lippiett BSc (Hons)	Signature:	Date: 14/07/17

### Distribution and Revision Status

Date	Description	Revision				
14/07/17	Bramley-Moore Dock Wall report	Draft	1	2	3	4
Copy No.	Issued to:					
1	Kaymac Marine Records	✓	✓	✓		
2		✓	✓	✓		
3						
4						
5						

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## 1 Overview

### 1.1 Structure Details

Masonry wall structure of Bramley-Moore dock is approximately 792m long and is located at grid reference OSG 51°23'48.68"N / 3°16'8.58"W. The Inspection carried out included the entire quay wall making up the dock and also the south facing wall of Nelson Dock. This is highlighted below. The water level was 1.7m from the top coping.



Figure 1: General aerial view of the dock wall.

## 2 Objective

Kaymac Marine and Civil Engineering were commissioned by BuroHappold Engineering to carry out an inspection of a wall at Bramley-Moore dock. The objective of the inspection was to carry out a conditional survey of the structure below water.

## 3 Access

Access to the areas beneath the structure was gained via the dock ladders with the assistance of an inflatable boat. Inspection of the wall was undertaken by a qualified five man diving team, in accordance with The Diving at Work Regulations, 1997.

Following the inspection, all equipment was washed down with Virkon 'S' disinfectant and clean water to prevent the spread of waterborne diseases between sites.

## 4 Site Conditions

Weather conditions on the days of the inspection were fine and underwater visibility varied throughout the inspection from 0 to 2m. Below the water line 95% of the structures were found to have dense marine growth ranging up to 150mm thick in some areas. Generally this density of marine growth was found from 3m up to the waterline. Below this marine growth averaged 50-70mm mainly of muscles with only some small sporadic areas clear. Any defects located were cleared of any growth to obtain accurate dimensions and photos.

## 5 Report

NOTE: Photographs referenced with the numbers in the text below can be found in Appendix A.

Code	Severity (S)	Code	Extent (Ex)
1	As new or defect has no significant effect on the element (Visually or functionally).	A	No significant defect.
2	Early signs of deterioration, minor defect / damage, no reduction in functionality of element.	B	Slight, not more than 5% of surface area / length / number.
3	Moderate defect / damage, some loss of functionality could be expected.	C	Moderate, 5% - 20% of the surface area / length / number.
4	Severe defect / damage, significant loss of functionality / or element is close to failure / collapse.	D	Wide, 20% - 50% of the surface area / length / number.
5	Element failed / collapsed.	E	Extensive, more than 50% of the surface area / length / number.
Code	Work (W)		
A	Add (new items to be provided e.g. waterproofing).	N	No Action at present, monitor.
C	Change (replacement of defective item e.g. parapet)	R	Repair / maintain (repair to concrete)
P	Paint (protective lining e.g. bitumen paint)		

Numbered references in the “Ref.” columns in the following tables cross-refer to the numbered points in the Discussion and Recommendations sections of this report (see Sections 6 and 7 respectively).

### 5.1 Bramley – Moore Dock Wall

Chainage	Description	S	Ex	W	Ref.
Throughout	-Dense marine growth was report throughout the entire length of the wall surveyed. The thickness of marine growth ranged from 100-300mm -Minimal areas of sporadic open joint was noted over the entire length with a maximum width of 40mm and penetration of no more than 50mm -A 0.2m wide toe located 7.5m below the coping line. This toe is suspected to continue over the length of the main walls surveyed however in some location the bed level raises over this toe.	-  <b>2</b>  <b>1</b>	-  <b>B</b>  <b>A</b>	-  <b>R</b>  <b>N</b>	-  <b>i.</b>  <b>-</b>
-20m	-Started the survey at the North East corner of the entry lock.	-	-	-	-
-18m	-Culvert 1msq was located 2m off the seabed and appear clear of any debris	<b>1</b>	<b>A</b>	<b>N</b>	-
-10m	-Vertical recess starting approximately 2m up of the seabed 0.25m x0.2m penetration running up the wall for 4m. Where the recess opens to 1msq with a penetration of 1m.	<b>1</b>	<b>A</b>	<b>N</b>	-
0m	-Vertical recess starting 1.8m below the waterline 1.4m wide continuing down the wall to the seabed. The recess contains 2x 0.4mØ steel pipes	<b>1</b>	<b>A</b>	<b>N</b>	-

5m	-Opening 1m up from the bed level 1m x1.2m x 2m plus penetration. Possible the guide housing for the pervious lock gate pulley system	1	A	N	-
6m-17m	- Lock gate had dense marine throughout	-	-	-	-
17m	-Approximate start of a 90° direction change in the wall	-	-	-	-
35m	-Approximate end of the corner	-	-	-	-
27m	-Vertical recess in the wall starts above surface running 4m below the waterline. 120mm wide x 90mm penetration.	1	A	N	-
31m	-Open jointing located 2.5m of the dock bottom 3m x80mm x0.15m penetration	2	B	R	i.
45m	- Vertical recess in the wall starts 1m of the dock bottom 2.5m height 0.5m wide. Containing a 0.3mØ pipe	1	A	N	-
46m	-Open jointing located 1.2m of the dock bottom 3m x60mm x0.1m penetration	2	B	R	i.
54m	-Open jointing located 2.5m of the dock bottom 1.5m x 0.1m x0.15m penetration	2	B	R	i.
57m	-Open jointing located 2m of the dock bottom 0.5m x80mm x0.1m penetration	2	B	R	i.
58m	-Open jointing located 1m of the dock bottom 0.3m x60mm x0.15m penetration	2	B	R	i.
64m	-Open jointing located 3m below the water 1.1m x80mm x0.2m penetration	2	B	R	i.
67m	-Area of open jointing located 2m of the dock bottom approximately 2msq. Maximum lengths of 1m widths 80mm penetration 0.2m	2	C	R	i.
87m	-Open jointing located 2m of the dock bottom 0.4m x100mm x0.25m penetration	3	B	R	i.
138m	- Vertical recess in the wall starts 1m of the dock bottom 2m height 1m wide. Containing a 0.3mØ pipe	1	A	N	-
144m	-Vertical recess in the wall starts above surface running 4m below the waterline. 0.5m wide x 0.5m penetration.	1	A	N	-
160m	-Open jointing located 2.5m up from the sea bed 0.6m Long 60mm wide 0.3m penetration	2	B	R	i.
162m	-Open jointing located 3.5m up from the sea bed 0.3m Long 70mm wide 0.3m penetration	2	B	R	i.
165m	-Open jointing located 1m up from the sea bed 0.4m Long 60mm wide 0.2m penetration	2	B	R	i.
176-185m	-Area of more sporadic open joint than found elsewhere. Start at the sea bed and continues up 3m. Maximum lengths 0.4m widths 40mm and penetration of up to 0.3m	2	C	R	i.
198m	-Void located 3m below water line 0.2m x0.4m x0.3m penetration	2	B	R	ii.
231m	-Open jointing located 3.5m up from the sea bed 0.3m Long 0.1m wide 0.2m penetration	2	B	R	i.
245m	-Open jointing located 2m up from the sea bed 0.8m Long 0.1m wide 0.2m penetration	2	B	R	i.
255m	-Open jointing located 3m up from the sea bed 0.2m Long	2	B	R	i.



	0.1mm wide 0.2m penetration				
260m	-Open jointing located 3m up from the sea bed 0.3m Long 0.1m wide 0.2m penetration	2	B	R	i.
263m	-Open jointing located 2.5m up from the sea bed 0.7m Long 80mm wide 0.2m penetration	2	B	R	i.
267m	-Open jointing located 2.5m up from the sea bed 0.3m Long 50mm wide 0.25m penetration	2	B	R	i.
270m	-Open jointing located 1.8m up from the sea bed 0.2m Long 0.1m wide 0.3m penetration	2	B	R	i.
274m	-Open jointing located 1m up from the sea bed 0.3m Long 0.15mm wide 0.2m penetration	2	B	R	i.
279m	-Open jointing located 1m up from the sea bed 0.3m Long 0.15mm wide 0.2m penetration	2	B	R	i.
297m	-Vertical pipe located into a 0.8m x 0.7m recess into the wall. The recess starts 1.7m from the sea bed and continues 1.9m up the wall. The pipe is approximately 450mmØ	1	A	N	-
325m	-Approximate start of a 90° direction change in the wall	-	-	-	-
330m	-Approximate end of the corner	-	-	-	-
337m-560m	-Area conducted with low visibility.	-	-	-	-
337m	-Vertical recess in the wall starts above surface running 0.7m below the waterline. 250mm wide x 120mm penetration	1	A	N	-
360m	-Void located 2m below the waterline 0.2m x 0.4m x over 0.5m penetration	2	B	R	ii.
363m	-Void located 1m below the waterline 0.7m x 70mm x 0.2m penetration	2	B	R	ii.
367m	-Void located 1.1m below the waterline 0.25m x 0.1m x 0.3m penetration - Vertical recess in the wall starts above surface running 1m below the waterline. 250mm wide x 120mm penetration.	2 1	B A	R N	ii.
385m	-Open jointing located 1m above seabed 600mm x 80mm x 300mm penetration	2	B	R	i.
397m	- Vertical recess in the wall starts above surface running 0.5m below the waterline. 250mm wide x 120mm penetration	1	A	N	-
407m	-Open jointing 4m below the waterline 0.3m x 80mm x 0.2m penetration.	2	B	R	i.
410m	-Vertical recess in the wall with pipe inside starts 2m below the waterline. 0.8m wide x 0.8m penetration, total length of 5.5m. pipe diameter 0.5mØ	1	A	N	-
411m	- Vertical recess in the wall starts above surface running 1.2m below the waterline. 0.8m wide x 0.6mm penetration. Dimensions reduce as it go further below the waterline tapering to nothing at 4m	1	A	N	-
417m	- Vertical recess in the wall starts above surface running 3m below the waterline. 0.8m wide x 0.6mm penetration. Dimensions reduce as it go further below the waterline tapering to nothing at 4m	1	A	N	-

423m	Void located 4m below the waterline 0.2m x0.1m x0.2m penetration.	2	B	R	ii.
421m	-Vertical recess in the wall starts above surface running 1.5m below the waterline. 0.4m wide x 0.2m penetration.	1	A	N	-
440m	-Open jointing located 2m below waterline 0.4m x40mm x0.2m penetration.	2	B	R	i.
445m	- Vertical recess in the wall starts above surface running 1m below the waterline. 0.5m wide x 0.4m penetration.	1	A	N	-
451m	- Dock Ladder recess into the wall all steel elements found heavily corroded.	3	D	C	-
450m	-Approximate start of a 90° direction change in the wall	-	-	-	-
455m	- Vertical recess in the wall starts above surface running 3m below the waterline. 150mm wide x 75mm penetration.	1	A	N	-
460m	-Approximate end of the corner	-	-	-	-
472m	-Open jointing located 1.5m below the waterline 0.65m x50mm x0.1m penetration	2	B	R	i.
475m	-Open jointing located 3.5m below the waterline 0.6m x40mm x0.15m penetration	2	B	R	i.
482m	-Open jointing located 3m below the waterline 0.4m x80mm x0.1m penetration	2	B	R	i.
505m	-Open jointing located 5m below the waterline 0.5m x100mm x0.3m penetration	2	B	R	i.
506m	-Open jointing has noticeable become more frequent from the water down 5m. They are averaging 0.4m L x70mm W x 0.2m Penetration. Typically in a 4msq area 40% of the jointing has failed. This continues up to chainage 689m	2	C	R	i.
528m	-Open jointing located 6m below the waterline 0.8m x180mm x0.3m penetration	2	B	R	i.
550m	-Open jointing located 3m below the waterline 1.5m x150mm x0.3m penetration	2	B	R	i.
552m-560m	-Area of large open joints up to 1.5m x0.2m x0.3m penetration	3	C	R	i.
571m-589m	-Area of large open joints up to 1.5m x0.2m x0.3m penetration	3	C	R	i.
572m	-Damage to masonry stone face 3.5m down from the waterline 0.7m x 0.22m x 0.32m Penetration	2	B	R	ii.
590m	-Area 2msq of large open joints up to 0.1m W x0.3m penetration	3	C	R	i.
605m	-Void located 2m below the waterline 0.15m x 0.4m x over 0.5m penetration	2	B	R	ii.
612m	-Area 1.5msq of large open joints up to 0.1m W x0.3m penetration	3	C	R	i.
650m-673m	-Area of large open joints up to 1.2m x0.1m x0.3m penetration	3	C	R	i.
689m	-Consistency of the open jointing has reduced and only minimal open jointing was report from this location onwards.	2	B	N	-
703m	-Approximate start of a 90° direction change in the wall	-	-	-	-
718m	-Approximate end of the corner	-	-	-	-

718m-729m	-Lock Gate	-	-	-	-
730m	-Culvert located 2m off the dock bottom 1m H x0.6m W	1	A	N	-
733m	-Both a change in direction by 90° and a construction change back masonry.	-	-	-	-
733m-752m	-All steel piles were found in good condition however a dense coverage of marine growth was throughout	1	A	N	-
735m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
737m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
739m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
740m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
742m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
744m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
746m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
747m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
752m	-90° directional change onto a more recently build structure formed with steel Larsen pile work	-	-	-	-
755m	-Culvert located 2m off the dock bottom 1m H x0.6m W	1	A	N	-
747m-769m	-Lock gate.	-	-	-	-
773m	-Vertical crack located 0.5m below the waterline and continues to the silts built up on the dock bottom. The crack is staggered down through a number of course. Average width of 40mm with a maximum of 100mm where jointing has all so opened and a penetration of 200mm. (14-16)	3	B	R	iii.
773m	-Approximate start of a 90° direction change in the wall	-	-	-	-
781m	-Approximate end of the corner	-	-	-	-
787m	-Approximate start of a 90° direction change in the wall	-	-	-	-
792m	-Approximate end of the corner	-	-	-	-
824m	-Void located 3.5m below the waterline 0.2m x0.1m x0.15m penetration.	2	B	R	ii.
961m	-Void located 3.5m below the waterline 0.5m x0.1m x0.15m penetration.	2	B	R	ii.
915m	-Approximate start of a 90° direction change in the wall	-	-	-	-
913m	-Dock ladder attach to the wall sitting 0.1m proud of the wall.	-	-	-	-
910m	-Approximate end of the corner	-	-	-	-
922m	-Approximate start of a 90° direction change in the wall	-	-	-	-



927m	-Approximate end of the corner	-	-	-	-
950m-932m	-Lock gate. (chainage was taken using the pre arrange makings)	-	-	-	-
951m	-Opening 3m up from the bed level 1m x1.2m x 2m plus penetration. Possible the guide housing for the pervious lock gate pulley system	1	A	N	-
956m	-Vertical recess starting 2m below the waterline 1.4m wide continuing down the wall to the seabed. The recess contains a 0.4mØ steel pipes	1	A	N	-
967m	-Void located 3.5m below the waterline 0.5m x0.2m x0.2m penetration.	2	B	R	ii.
966m	-Vertical recess starting approximately 2m up of the seabed 0.25m x0.2m penetration running up the wall for 4m. Where the recess opens to 1msq with a penetration of 1m.	1	A	N	-
969m-980m	-Lock Gate	-	-	-	-
980m	-End of the survey at the North West corner of the entry lock.	-	-	-	-
S = Severity, Ex = Extent, W = Work Required					

## 5.2 South Facing Wall of Nelson Dock

Chainage	Description	S	Ex	W	Ref.
Throughout	-Dense marine growth was report throughout the entire length of the wall surveyed. The thickness of marine growth ranged from 100-300mm -Minimal areas of sporadic open joint was noted over the entire length with a maximum width of 40mm and penetration of no more than 50mm	-	-	-	-
		2	B	N	i.
-3m	-Datum 1.7m from coping to water line -Rectangular culvert located at the bed level 6.2m below waterline with the invert being buried. Height from bed material was measured at 1.4m and a total width of 2m -Void located 3m below water line 0.1msq x 0.2m penetration	-	-	-	-
		-	-	-	-
		2	B	R	ii.
1m	-Dock Ladder recess into the wall all steel elements found heavily corroded.	3	C	C	-
8m	-Approximate start of a 90° direction change in the wall	-	-	-	-
12m	-Approximate end of the corner	-	-	-	-
18m	-Start of the lock gates and lock gate recess	-	-	-	-
18m-29m	-Lock gate had dense marine throughout	-	-	-	-
31.5m	-90° directional change onto a more recently build structure formed with steel Larsen pile work	-	-	-	-

32m-50m	-A total of 10 Anodes were located throughout the structure 3m H x180mm x150mm. Maximum depletion of 30%. -All steel piles were found in good condition however a dense coverage of marine growth was throughout	2 1	B A	N N	- -
32.5m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
34m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
36m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
38m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
40m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
42m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
44m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
47m	-Steel outlet located 1m below water 0.6m Ø. 10% full of marine growth.	1	A	N	-
50m	-Both a change in direction by 90° and a construction change back masonry.	-	-	-	-
50.5m	-Opening 1m up from the bed level 0.6msq x 2m plus penetration. Possible the guide housing for the pervious lock gate pulley system	1	A	N	-
52m-64.4m	-Lock gate. Dense marine growth throughout	-	-	-	-
64.4m	- Small area of the recess wall was visible and found to be in good condition with only some areas of minimal open jointing	2	B	R	i.
65m	-Approximate start of a 90° direction change in the wall -Start of a 0.2m wide toe located 7.5m below the coping line. This toe continues over the length of the structure surveyed however in some location the bed level raises over the toe.	- 1	- A	- N	- -
80m	-Approximate end of the corner	-	-	-	-
78m	-Void located 3m below waterline 0.4msq x 0.2m penetration	2	B	R	ii.
84m	-A recess culvert opening located 1m up from the bed. Measuring 4msq with a 0.4m recess before the start of a 3.6mØ barrel culvert opening. The Culvert opening was found in good condition with no debris.	1	A	N	-
87m	-Void located 4m below the waterline 0.5msq x0.3 penetration	2	B	R	ii.
117m	-Bed level rises over 200mm toe	-	-	-	-
195m	-Void located 4m below waterline 0.4m x0.3m x0.2 penetration	2	B	R	ii.
220m	-Void located 2.5m below waterline 0.3m x0.2m x0.1 penetration -Area of open jointing 2m below water line continues down to 6m. Maximum opening of 40mm and a penetration of up to	2 2	B C	R R	ii. i.

	150mm				
220m-250m	-Sunken skip barge approximately 5m wide sitting 2m of the dock wall.	-	-	-	-
290m	-Survey ended at the start of a direction change	-	-	-	-
S = Severity, Ex = Extent, W = Work Required					

## 6 Discussion

Overall, the structure remains in good condition with no bulging or failures found. Open jointing with varying widths, were found throughout the structure below water. This is mainly concentrated within 5m of the waterline. The South wall had a much larger concentration of open joint and was where the largest could be found. The most significant defect identified was a crack at 773m.

In areas a 0.2m masonry toe was located 7.5m down from the coping which when visible was found with no defects. Largely this toe was covered by the bed material and was only witnessed in a number of locations. The toe appeared identical throughout but can only be presumed to continue through the structure as it could not be surveyed due to the bed levels.

Ref. No.	Defect
i.	Numerous areas of open jointing were recorded throughout the structure.
ii.	Voids between masonry block work varying in size and penetration.
iii.	One vertical crack through number of the masonry courses was located with only a minimal penetration.

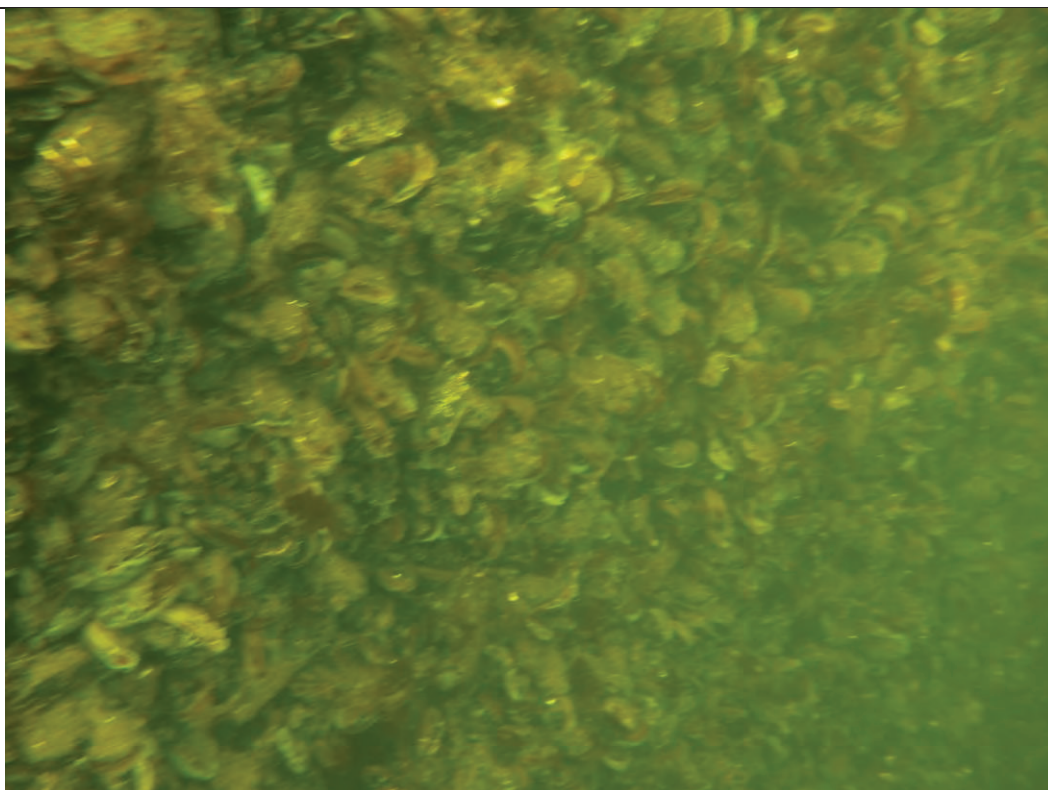
## 7 Recommendations

In order to maintain the integrity and functionality of the structure, and to minimise future repair and maintenance costs; the following repairs and maintenance could be carried out:

Ref. No.	Suggested Remedial Work	Priority
i.	All the open jointing will need to be repointed in order to reduce further open jointing and potential masonry loss.	L
ii.	Voids found need to be filled with an underwater cement/grout with the larger voids shuttering work will be required.	L
iii.	Crack to be monitored and further investigated.	L

High - Works required immediately, Medium - Works required within one year, Low - Works required within two years or more.
--

## Appendix A: Photographs



**Photograph 1.** General view of the wall



**Photograph 2.** General view of the wall





**Photograph 3.** General view of the wall

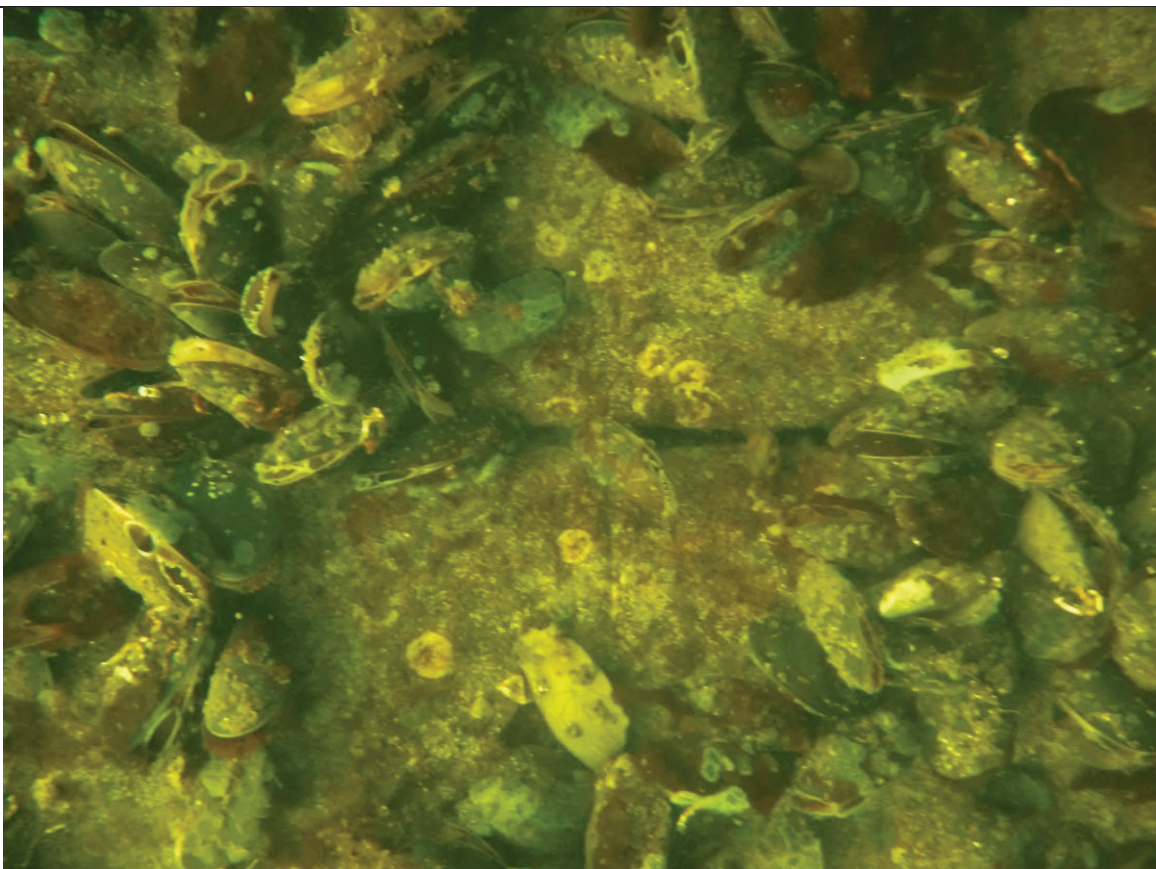


**Photograph 4.** Typical open jointing found throughout



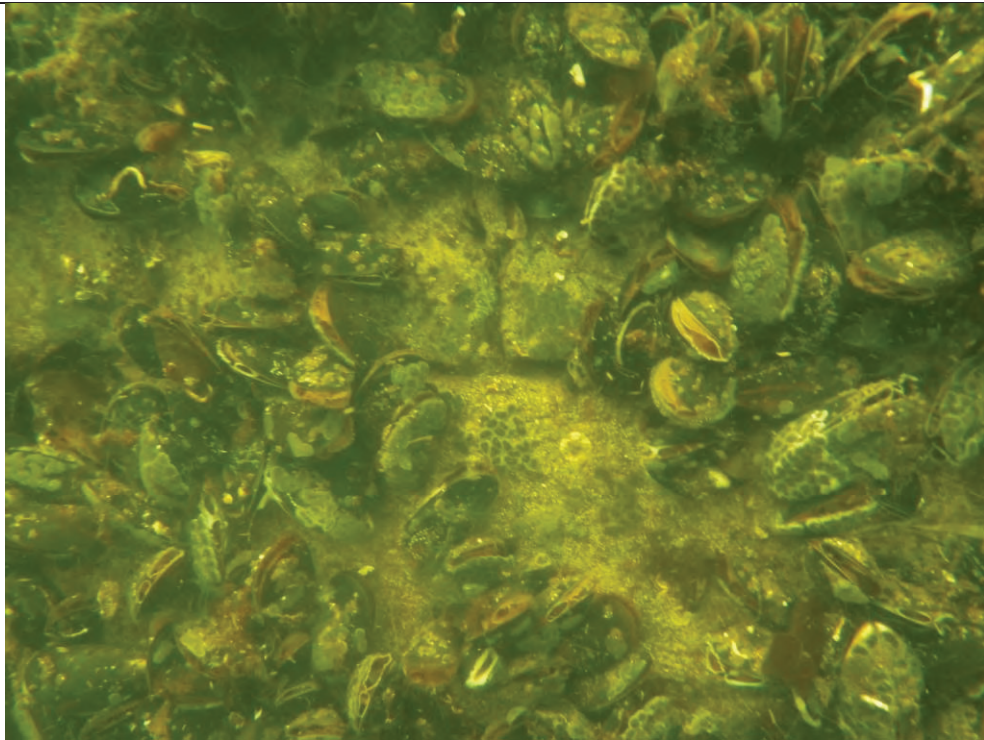


**Photograph 5.** Typical open jointing found throughout

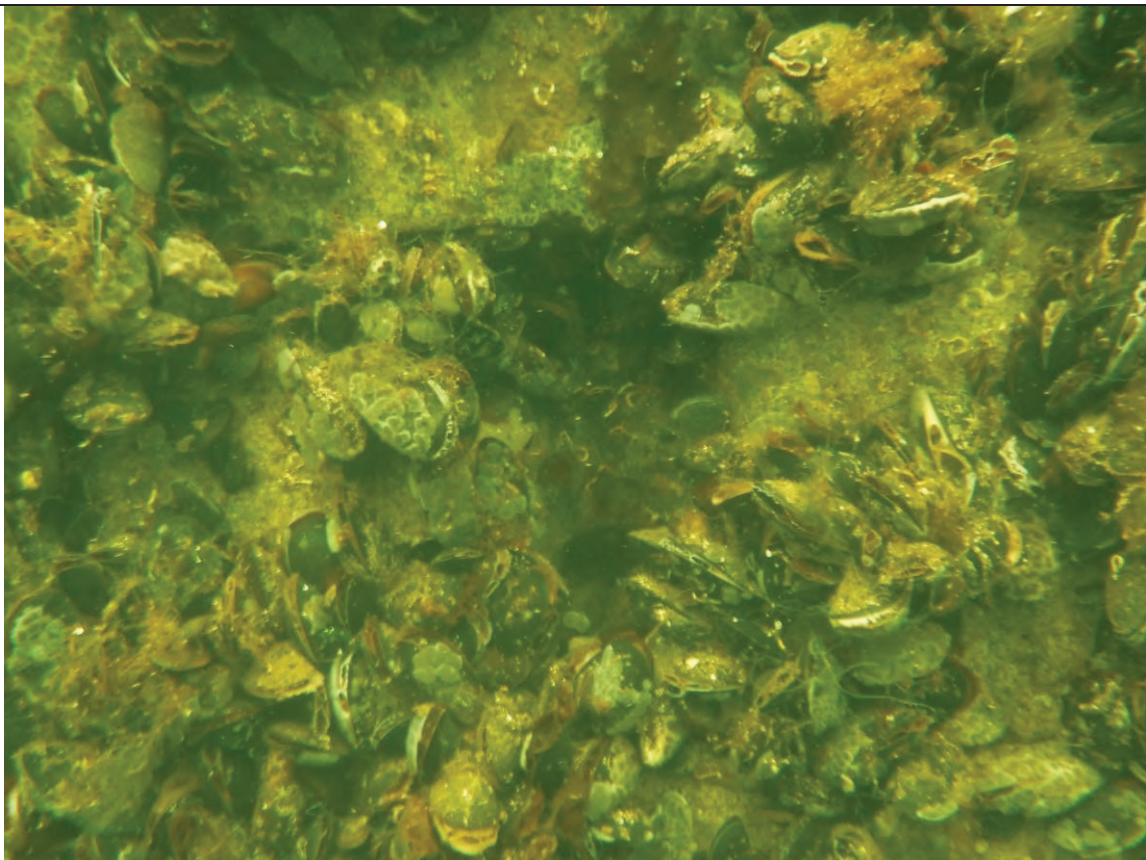


**Photograph 6.** Typical open jointing found throughout





**Photograph 7.** Typical open jointing found throughout



**Photograph 8.** Large open jointing

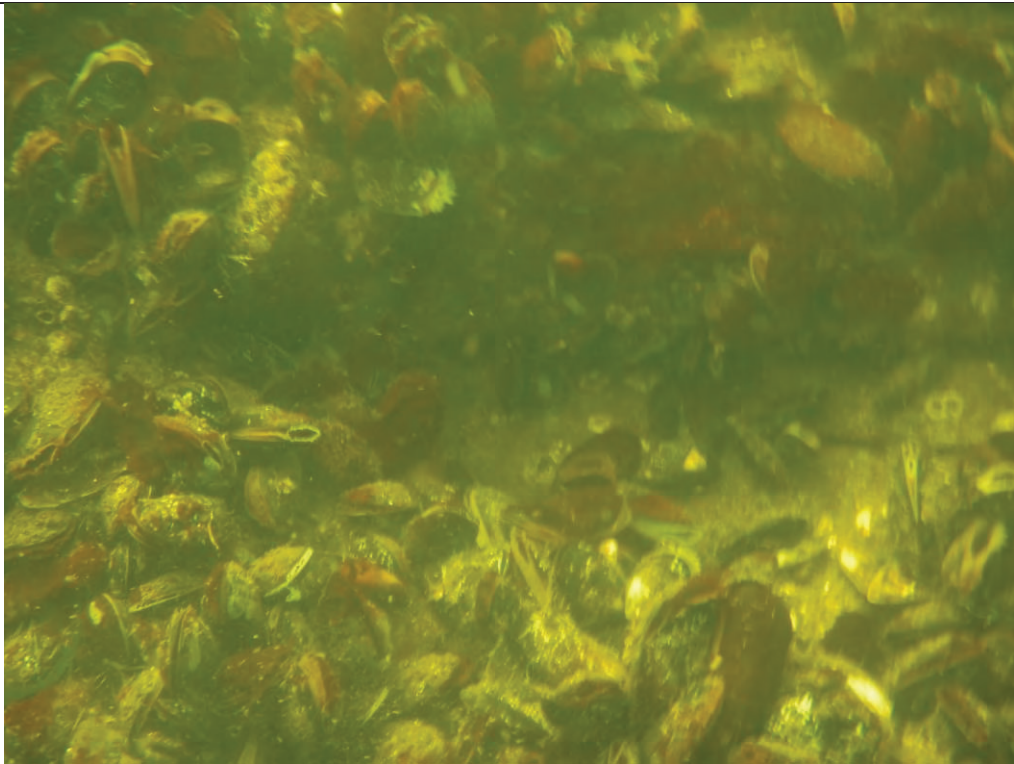




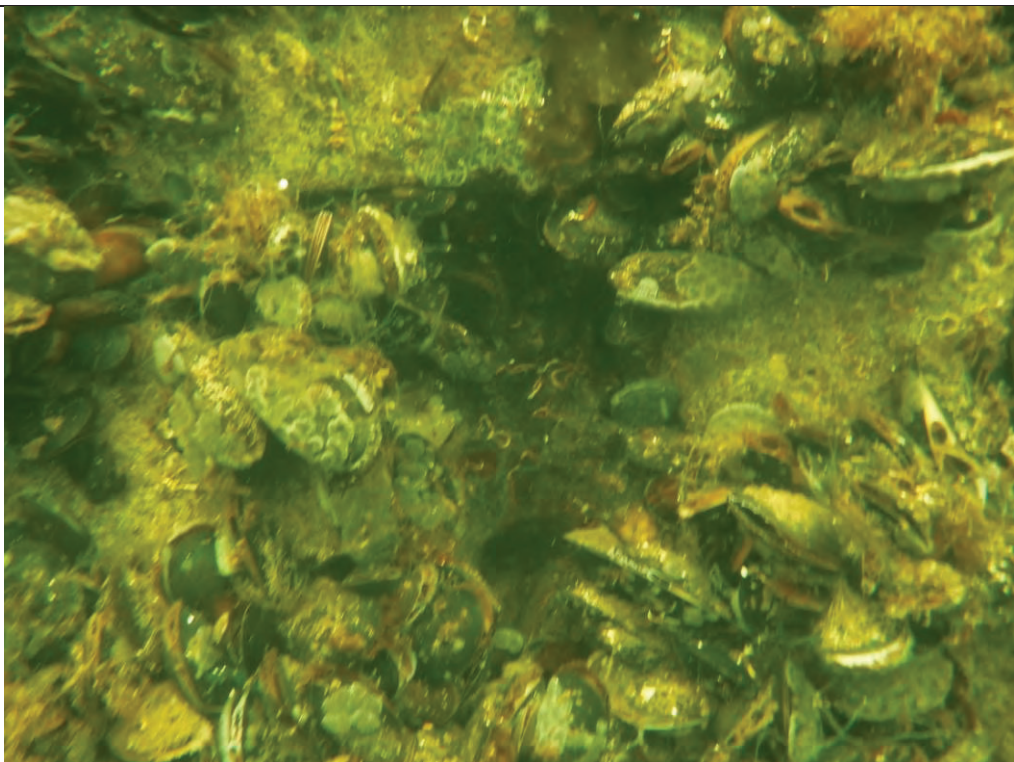
**Photograph 9.** Close up of open jointing



**Photograph 10.** Close up of open jointing

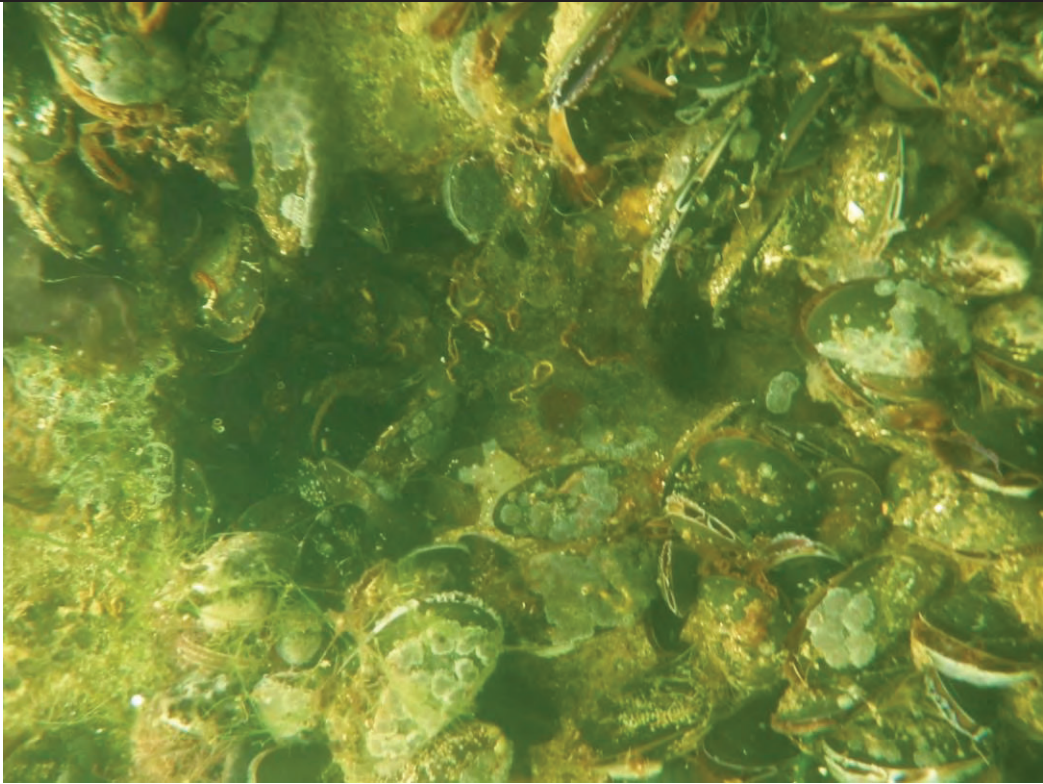


**Photograph 11.** Void found in the wall

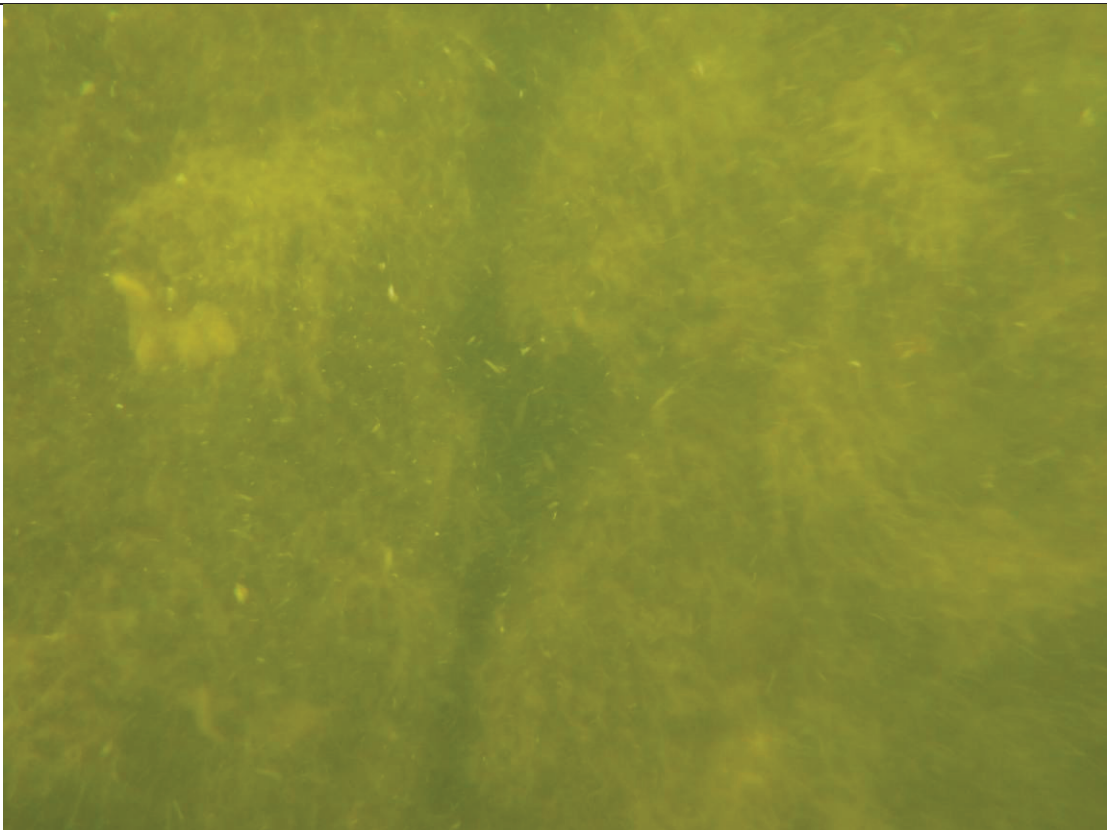


**Photograph 12.** Void found in the wall





**Photograph 13.** Void found in the wall



**Photograph 14.** 773m Vertical crack



**Photograph 15. 773m Vertical crack**



**Photograph 16. 773m Vertical crack**



		Project number:		170701		
		Sheet no.		01	/ 200 / 5	Rev. C
				<i>Phase</i>	<i>Set</i>	<i>Sheet</i>
Client:	BuroHappold	Source drawings nos.				
Project Name:	Bramley-Moore Dock Survey	Prepared by:	D. Ollier	Date:	16/08/17	
		Checked by:	R. Williams	Date:	16/08/17	
Structure:	Dock Wall	Reviewed by:	H. Howell	Date:	16/08/17	
		<i>dd / Mon / yy</i>				

## Appendix B Soundings

## Bramley-Moore Dock

Chainage	From coping to Dock bottom in M
0	10.4
10	10.2
20	10.3
30	9.5
40	7.7
50	7.6
60	7.4
70	7.9
80	8.1
90	7.9
100	8.5
110	8.0
120	7.5
130	7.8
140	7.7
150	8.1
160	7.6
170	7.7
180	7.6
190	7.4
200	7.3
210	7.8
220	7.7
230	7.7
240	7.7
250	7.4
260	7.6
270	7.4
280	7.6
290	7.9
300	7.9
310	8.5
320	8.6
330	8
340	8.5
350	8
360	7.2
370	7.4
380	7.2

390	8
400	8.7
410	9.2
420	9.9
430	10.2
440	10.2
450	91
460	9.4
470	9.5
480	9.4
490	10.3
500	10.3
510	10.5
520	10.3
530	10.2
540	10.9
550	9.9
560	9.4
570	10.5
580	10.4
590	10.4
600	10.4
610	10.3
620	10.3
630	9.6
640	9.6
650	9.4
660	8.7
670	8.3
680	7.4
690	7.3
700	8.3
710	8.6
*720	5.8
730	7.1
*740	7.4
750	7.7
760	8
770	8.1
780	8.6
790	5.3
800	6.4
810	7.3
820	8.2
830	8.8
840	8.8
850	9.1
860	9.2
870	8.8
880	8.9



890	8.2
900	7.2
910	6.4
920	8.9
930	10
940	10.1
950	10.5
960	10.9
970	10.7

250	7.6
260	8.8
270	8.9
280	9.1
290	9

### South Facing wall of Nelson Dock

Chainage	From coping to Dock bottom in M
-3	7.9
0	8.3
10	9.6
17	9.3
30	6.8
*40	8.4
50	6
63	8.8
70	9.1
80	9.3
90	8.5
100	8
110	8.2
120	7.2
130	7.9
140	7.8
150	7
160	7.2
170	7.9
180	8.5
190	8.5
200	8.6
210	8
220	7.7
230	7.3
240	7.3

## A photograph showing a stone wall, likely a retaining wall or part of a fortification. The wall is constructed from large, irregular, light-colored stone blocks. A metal fence with vertical bars runs along the top of the wall. In the background, there is a rocky hill or cliff face. The sky is overcast and grey. Two yellow vertical lines are drawn on the image, one on the left and one on the right, possibly indicating measurement points or specific features of the wall.

Inspection Date & Time	12th -13th July 2017
Weather Conditions	Warm & Sunny
Water Conditions	Impounded Water
Wall Height (m) [Crest Level / Water Level mOD]	2.1m [+6.9mOD / +4.8mOD]

Overall Condition Rating		
Overall Assessment	2	Good

Chainage (m)	Feature	Level (m from top)	Dimensions (m)	Description
-27 to -19	Coping	0 to 1	-	Good - Minor cracks created by minor movement. Surface defects in coping or limited mortar loss from joints
-27 to -19	Brickwork / Masonry	0 to 2.1	-	Good - Minor cracks created by minor movement. Surface defects in bricks or limited mortar loss from joints
-27 to -19	Marine Growth	1.8 to 2.1	-	Minor growth. Features partially obscured
-21 to -19.5	Recess	0.5 to 2.1	-	Good - Surface defects in blocks/bricks, minor cracks and/or limited mortar loss from joints
-27 to -19	Vegetation	0 (coping)	-	Minor growth. Features partially obscured. Vegetation does not affect structural integrity
-27 to -19	Hand railing / Fence	0 (coping)	H = 1.1m	Very Good - No visible defects. Well maintained with no signs of corrosion

[illegible]

**A2 Chainage -19 to -13m**



**Figure A2 - Bramley Moore: Chainage -19 to -13m**

<b>Inspection Date &amp; Time</b>	12th -13th July 2017
<b>Weather Conditions</b>	Warm & Sunny
<b>Water Conditions</b>	Impounded Water
<b>Wall Height (m)</b>	2.3m (+7.1mOD / +4.8mOD)

Features				
Features	Present	Features	Present	Present
Anchor		Lock Gate		x
Boat		Manhole		Repair
Brickwork / Masonry	x	Marine Growth	x	Sheet Piling
Chain Post / Fencing		Metalwork		Steps
Cobbles		Miscellaneous		Timber
Concrete		Mooring BOLLARD		Vegetation
Coping	x	Mooring Chain		Weephole / Outfall
Fender		Mooring Ring		
Hand railing / Fence	x	Obstruction		-
Ladder		Opening / Vault		-

**Overall Condition Rating**

Overall Assessment	2	Good
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**Features / Condition**

Chainage (m)	Feature	Level (m from top)	Dimensions (m)	Description
-19 to -13	Coping	0 to 0.5	-	Good - Minor cracks created by minor movement. Surface defects in coping or limited mortar loss from joints
-19 to -13	Brickwork / Masonry	0.5 to 2.3	-	Good - Minor cracks created by minor movement. Surface defects in bricks or limited mortar loss from joints
-19 to -13	Marine Growth	1.6 to 2.3	-	Minor growth. Features partially obscured
-18.5 to -18	Recess	1.1 to 2.3	-	Fair - Slight brick/block displacement. Mortar loss from joints and joint/brick/block cracking. Rounding of recess edges
-16 to -15.5	Recess	1.2 to 2.3	-	Good - Surface defects in blocks/bricks, minor cracks and/or limited mortar loss from joints
-19 to -13	Vegetation	0 (coping)	-	Minor growth. Features partially obscured. Onset of structural degradation by root growth
-19 to -13	Hand railing / Fence	0 (coping)	H = 1.1m	Very Good - No visible defects. Well maintained with no signs of corrosion

## Defects

[illegible]

**A3 Chainage -13 to -8m**



**Figure A3 - Bramley Moore: Chainage -13 to -8m**

<b>Inspection Date &amp; Time</b>	12th -13th July 2017
<b>Weather Conditions</b>	Warm & Sunny
<b>Water Conditions</b>	Impounded Water
<b>Wall Height (m)</b>	2.4m (+7.2mOD / +4.8mOD)

Features		Present	Features	Present	Features	Present
	Anchor		Lock Gate		Recess	
	Boat		Manhole		Repair	
	Brickwork / Masonry	x	Marine Growth	x	Sheet Piling	
	Chain Post / Fencing		Metalwork	x	Steps	
	Cobbles		Miscellaneous		Timber	
	Concrete		Mooring Bollard		Vegetation	
	Coping	x	Mooring Chain		Weephole / Outfall	
	Fender		Mooring Ring		-	
	Hand railing / Fence	x	Obstruction		-	
	Ladder		Opening / Vault		-	

**Overall Condition Rating**

Overall Assessment	2	Good
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Features / Condition	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	

[illegible]

## Defects

[illegible]



## A photograph of a large, dark, textured rock face or wall, possibly a dam or bridge structure. A yellow measuring tape is visible on the left side, indicating the scale of the structure. The rock surface is rough and layered, with some lighter-colored material visible in the crevices. The background shows a body of water and some buildings in the distance.

<b>Inspection Date &amp; Time</b>	12th -13th July 2017
<b>Weather Conditions</b>	Warm & Sunny
<b>Water Conditions</b>	Impounded Water
<b>Wall Height (m) [Crest Level / Water Level mOD]</b>	2.4m (+7.2mOD) / +4.8mOD]

Overall Condition Rating		
Overall Assessment	2	Good

Chainage (m)	Feature	Level (m from top)	Dimensions (m)	Description
-3 to 0	Vegetation	0 (coping)	-	Minor growth. Features partially obscured. Vegetation does not affect structural integrity
-1	Mooring Bollard	0 (coping)	-	Short pillar bollard. Good condition, localised surface corrosion
-8 to 0	Concrete	0 (coping)	-	Good - Structurally sound but with minor cracks and localised honeycombing/flaking with no significant defects
-8 to 0	Concrete	0 to 2.4	-	Good - Structurally sound but with minor cracks and localised honeycombing/flaking with no significant defects
-8 to 0	Marine Growth	1.9 to 2.4	-	Minor growth. Features partially obscured
-3	Chain Post / Fencing	0 (coping)	-	Temporary Heras fence restricting access

[illegible]

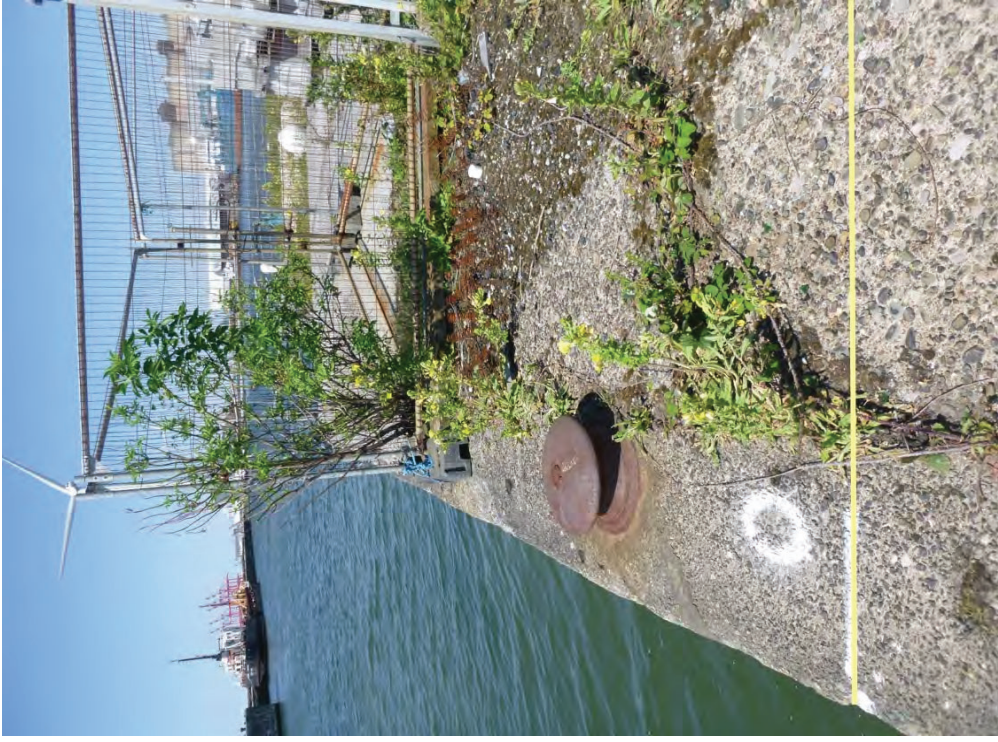


Figure A4a - Bramley Moore: Coping Chainage - 8 to 0m

**A5 Chainage 0 to 5m**



**Figure A5 - Bramley Moore: Chainage 0 to 5m**

<b>Inspection Date &amp; Time</b>	12th -13th July 2017
<b>Weather Conditions</b>	Warm & Sunny
<b>Water Conditions</b>	Impounded Water
<b>Wall Height (m)</b>	2.4m (+7.2mOD / +4.8mOD)

Features				
Features	Present	Features	Present	Features
Anchor		Lock Gate		Recess
Boat		Manhole		Repair
Brickwork / Masonry		Marine Growth	x	Sheet Piling
Chain Post / Fencing		Metalwork		Steps
Cobbles		Miscellaneous		Timber
Concrete	x	Mooring BOLLARD		Vegetation
Coping		Mooring Chain		Weephole / Outfall
Fender		Mooring Ring		-
Hand railing / Fence		Obstruction		-
Ladder		Opening / Vault		-

**Overall Condition Rating**

Overall Assessment	3	Fair
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Features / Condition	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	

[illegible]

## Defects

[illegible]





Figure A5a - Bramley Moore: Coping Chainage 0 to 5m



A6 Chainage 5 to 10m



Figure A6 - Bramley Moore: Chainage 5 to 10m

Inspection Date & Time	12th -13th July 2017
Weather Conditions	Warm & Sunny
Water Conditions	Impounded Water
Wall Height (m) [Crest Level / Water Level mOD]	1.8 to 2.2m [+6.6 to +7.0mOD / +4.8mOD]

Features		Present	Features	Present	Features	Present
Anchor			Lock Gate	x	Recess	
Boat			Manhole		Repair	
Brickwork / Masonry	x		Marine Growth	x	Sheet Piling	
Chain Post / Fencing			Metalwork	x	Steps	
Cobbles			Miscellaneous		Timber	
Concrete	x		Mooring Bollard		Vegetation	x
Coping	x		Mooring Chain		Weephole / Outfall	
Fender			Mooring Ring		-	
Hand railing / Fence Ladder			Obstruction	x	-	
			Opening / Vault		-	

Overall Condition Rating

Overall Assessment	4	Poor
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Features / Condition

Chainage (m)	Feature	Level (m from top)	Dimensions (m)	Description
5 to 10	Concrete	0 to 1	-	Poor - Extensive spalling and severe cracking, exposed rebar, extensive movement or damage likely to affect structural integrity
5 to 10	Brickwork / Masonry	0.7 to 2.2	-	Good - Minor cracks created by minor movement. Surface defects in coping or limited mortar loss from joints
5 to 10	Marine Growth	1.9 to 2.2	-	Minimal growth. Features remain visible
7 to 10	Lock Gate	1 to 2.2	-	Gate within recess. Fair condition, split timbers and established decay, corrosion to fixings and gaps at timber joints. Some movement in gates
7 to 10	Obstruction	1 to 2.2	-	Significant obstruction. Features obscured. Condition cannot be assessed
7	Vegetation	0.5 to 1	-	Significant growth. Features partially obscured. Significant structural degradation by root growth
8	Metalwork	0.2	L = 0.5m	I-beam. Fair condition, extensive corrosion with minor thickness loss and/or partially bent and deformed
8 to 10	Coping	0.5 to 0.7	-	Fair - Slight brick displacement created by movement. Mortar loss from joints and joint/brick cracking
5 to 10	Concrete	0 (coping)	-	Good - Structurally sound but with minor cracks and localised honeycombing/flaking with no significant defects
5 to 10	Vegetation	0 (coping)	-	Minor growth. Features partially obscured. Onset of structural degradation by root growth

Defects

Chainage (m)	Feature	Defect	Level (m from top)	Description
5 to 5.5	Concrete	Impact Damage	0 to 1	Localised impact damage resulting in chipping/fragmentation of wall materials
5 to 8	Concrete	Cracking	0 to 1	Significant horizontal cracking of mortar joints and/or bricks/blocks. Indicates wall movement/settlement
5 to 10	Brickwork / Masonry	Loss of Mortar	0.7 to 2.2	Mortar loss to bricks/blocks extends below surface and has the potential to weaken/loosen surrounding bricks/blocks
7 to 10	Lock Gate	Decay	1 to 2.2	Decay is throughout intertidal zone leading to weakening of timber elements and localised section loss
7 to 10	Lock Gate	Corrosion	1 to 2.2	Progressive corrosion has lead to deep pitting and loss of thickness weakening the metal



Figure A6a - Bramley Moore: Coping Chainage 5 to 10m

## A photograph of a bridge deck. On the left is a concrete curb with some yellow flowers. The deck is made of wooden planks. On the right is a stone wall. A yellow line is drawn across the image, indicating a measurement or boundary.

Inspection Date & Time	12th -13th July 2017
Weather Conditions	Warm & Sunny
Water Conditions	Impounded Water
Wall Height (m) [Crust Level / Water Level mOD]	1.8m [+6.6mOD / +4.8mOD]

Overall Condition Rating		
Overall Assessment	3	Fair

Chainage (m)	Feature	Level (m from top)	Dimensions (m)	Description
10 to 15	Coping	0.3 to 0.5	-	Good - Minor cracks created by minor movement. Surface defects in coping or limited mortar loss from joints
10 to 15	Brickwork / Masonry	0.5 to 0.7	-	Good - Minor cracks created by minor movement. Surface defects in bricks or limited mortar loss from joints
10 to 15	Lock Gate	0.7 to 1.8	-	Gate within recess. Fair condition, split timbers and established decay, corrosion to fixings and gaps at timber joints. Some movement in gates
10 to 15	Obstruction	0.7 to 1.8	-	Significant obstruction. Features obscured. Condition cannot be assessed
10 to 15	Marine Growth	1.5 to 1.8	-	Minimal growth. Features remain visible
10 to 15	Concrete	0 to 0.3		Good - Structurally sound but with minor cracks and localised honeycombing/flaking with no significant defects

[illegible]



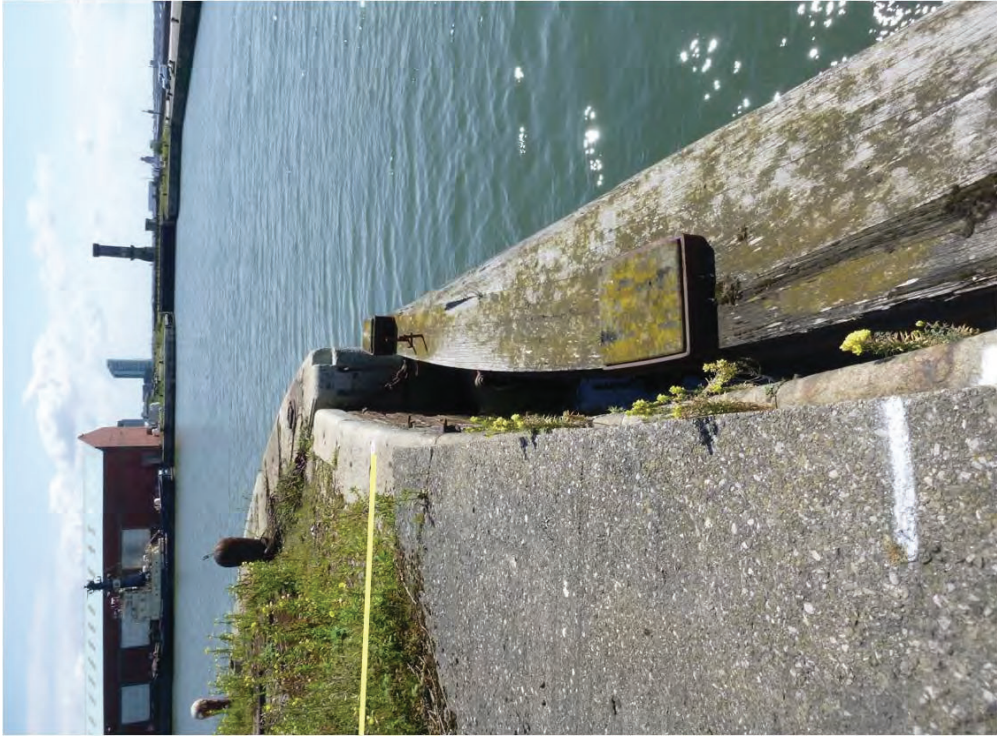


Figure A7a - Bramley Moore: Coping Chainage 10 to 15m



**A8 Chainage 15 to 20m**



**Figure A8 - Bramley Moore: Chainage 15 to 20m**

<b>Inspection Date &amp; Time</b>	12th -13th July 2017
<b>Weather Conditions</b>	Warm & Sunny
<b>Water Conditions</b>	Impounded Water
<b>Wall Height (m)</b> [Crest Level / Water Level mOD]	1.8m [+6.6mOD / +4.8mOD]

Features					
Features	Present	Features	Present	Features	Present
Anchor		Lock Gate	x	Recess	
Boat		Manhole		Repair	
Brickwork / Masonry	x	Marine Growth	x	Sheet Piling	
Chain Post / Fencing		Metalwork	x	Steps	
Cobbles	x	Miscellaneous	x	Timber	
Concrete		Mooring Bolland		Vegetation	x
Coping	x	Mooring Chain		Weephole / Outfall	
Fender		Mooring Ring		-	
Hand railing / Fence		Obstruction	x	-	
Ladder		Opening / Vault		-	

**Overall Condition Rating**

Overall Assessment	3	Fair
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Features / Condition

Chainage (m)	Feature	Level (m from top)	Dimensions (m)	Description
15 to 20	Coping	0 to 1	-	Good - Minor cracks created by minor movement. Surface defects in coping or limited mortar loss from joints
15 to 20	Brickwork / Masonry	0.2 to 1.8	-	Good - Minor cracks created by minor movement. Surface defects in bricks or limited mortar loss from joints
15 to 20	Marine Growth	1.5 to 1.8	-	Minimal growth. Features remain visible
15 to 17.5	Lock Gate	0.4 to 1.8	-	Gate within recess. Fair condition, split timbers and established decay, corrosion to fixings and gaps at timber joints. Some movement in gates
15 to 17.5	Obstruction	0.4 to 1.8	-	Significant obstruction. Features obscured. Condition cannot be assessed
15 to 20	Vegetation	0 (coping)	-	Minor growth. Features partially obscured. Onset of structural degradation by root growth
16 to 20	Cobbles	0 (coping)	-	Good - Minor cracks created by settlement/heave. Surface defects in cobbles or limited mortar loss from joints
19 to 20	Miscellaneous	0 (coping)	-	Steel cable to secure the gates in the open position. Minor corrosion.
19.5	Metalwork	0 (coping)	D = 0.2m	Metal fixing. Good condition, localised surface corrosion

### Defects

[illegible]



Figure A8a - Bramley Moore: Coping Chainage 15 to 20m