AMCO CP6 Year 3

C 302/122 B Culvert Renewal

Form 001

Doc. No.: 2383-MHB-REP-001

REMIT NO:	-	**STRUCTURE NO:**	C 302/122 B
ELR:	WCK	**MILEAGE:**	53 miles 1040 yards
O.S. REF:	NH 65434 86809	**MHB PROJECT REF:**	2383

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Project title	AMCO Year 3 Culverts C 302/122 B Culvert		
Project Number			
Location	Between Ardgay & Tain Stations		
ELR	WCK	**Mileage**	53 miles 1040 yards
Asset Number	C 302/122 B	**OS grid reference**	NH 65434 86809
RRD Reference Nr.			
DRRD Reference Nr.			
CR-T Reference Nr.			
Other AiP Documents Associated with this submission			

PART 1: DETAILS

1.1 Existing Layout

General Description

Culvert, C302/122 B is a drystone, masonry culvert that passes below the WCK line at 53 miles 1040 yards. The railway line is a single, bidirectional, non-electrified line, with the up traffic going toward Tain, and the down traffic toward Ardgay. The track comprises jointed bullhead rail on timber sleepers set in cast iron chairs. The railway at the site follows the mean high water springs of the Dornoch Firth on shallow embankment. The structure takes run off from the Cnoc an t-Sabhail on the South, to the Dornoch Firth on the North. The line speed is restricted to 65mph. An extract from Ordinance Survey below shows the site at a 1:50,000 scale.

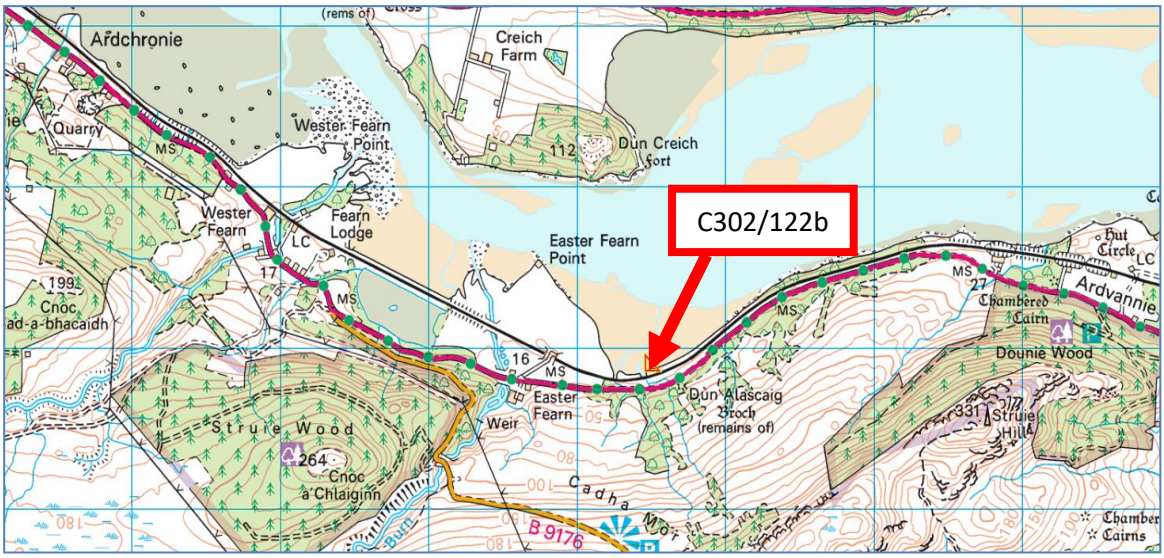

Figure 1 – Site Location (Extract from 1:50,000 Ordnance Survey Map)

The structure is around 16m long and measures approximately 0.85m x 0.85m although given the nature

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of the construction this varies over its length. (0.85m x 0.7m at the inlet and 0.88m x 0.9m at the outlet).

The inlet is on the down line side, with the outlet on the up-line side. The incoming stream enters the Network Rail boundary approximately 30m from the culvert inlet and runs parallel to the railway at the toe of the embankment slope. The ditch has meandered over time and lost its shape.

Figure 2 Inlet

Figure 3 Outlet

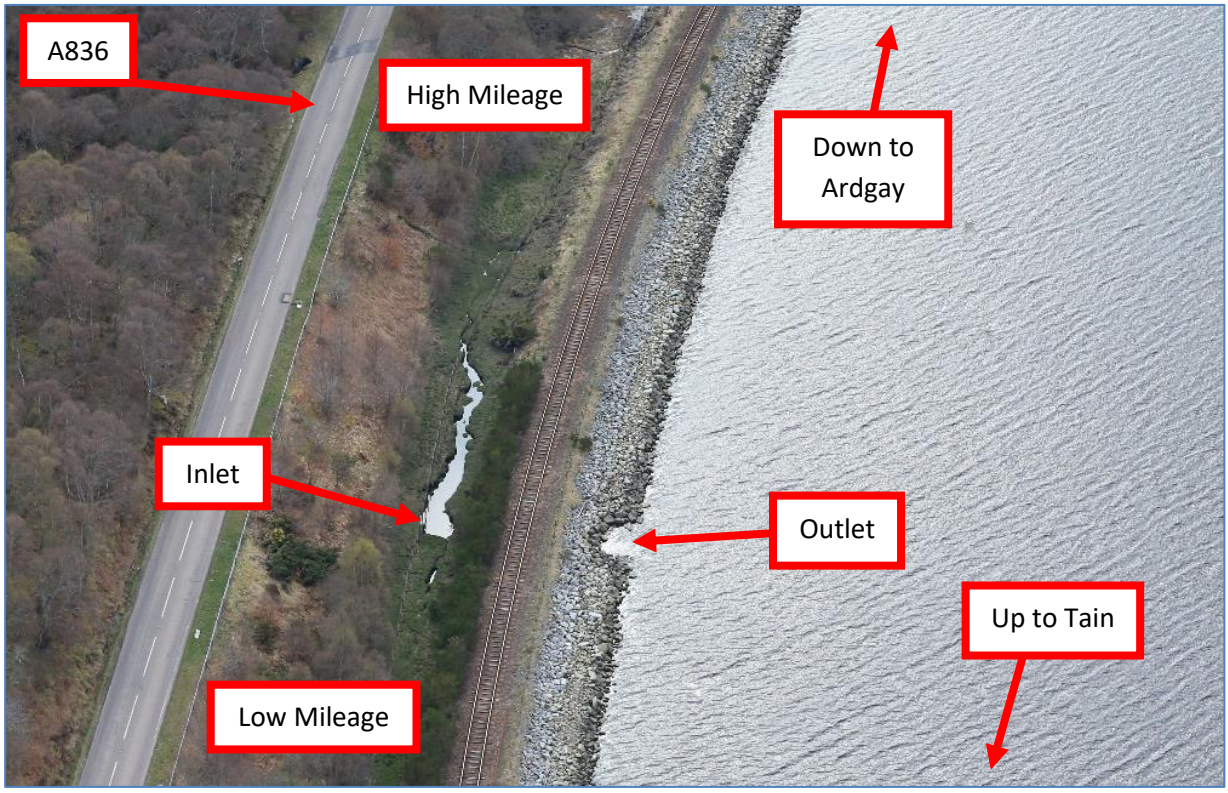

Figure 4 Layout of Site

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1.2 Existing Condition

Upon reviewing previous reports of the structure, it is understood to have fallen into a state of disrepair. Defects at the site include –

- Built up silt within the Culvert.
- Inlet Headwall missing.
- Scoured Outlet
- Detached 'Hidden Structure' plate in the four foot.

These defects have been highlighted in previous reports and will continue to deteriorate if action is not taken to remediate them and restore the structure to its full capacity.

Figure 5 Silt buildup in and around Culvert outlet

Figure 6 Missing Inlet Headwall

Figure 7 Scoured Outlet

Figure 8 Detached Plate at Track Level

These defects have the potential to severely disrupt flow through the structure.

1.3 Proposed Works

Given the depth below track (approx. 3m from track to soffit) it is considered that excavation and replacement would represent a significant operation in terms of excavated volume and disruption to the railway. It is proposed to introduce a pipe through the existing masonry culvert along with headwalls at the inlet and outlet.

Given the improved roughness coefficient of an HDPE pipe the required diameter of the pipe is 600mm. Although this is geometrically compatible with the aperture of the existing culvert it is recommended that the proposed pipe be pulled into position using pipe bursting equipment or similar. This is to overcome any dropped stones or local narrowing of the existing culvert.

The pipe will be grouted into position making the existing culvert structurally redundant.

Precast headwalls are proposed at the inlet and outlet compete with handrails to protect against falls from height. Handrails will be GRP and all bolts will be provided in Stainless steel given their location adjacent to the estuary.

Rock armour stone will be placed around each headwall to provide local embankment stability. This will protect the embankment from any localised scour at the inlet and any tidal or wave action from the Dornoch Firth on the outlet side. On the outlet side some of the existing rock armour stone will be replaced but it is considered at this stage that additional stone will be required to complete.

The inlet ditch will be formalised and reshaped over its length within the NR boundary and lined with geotextile. Where the boundary fence is removed it shall be replaced on a like for like basis. The fence shall also be reinstated to provide a barrier against livestock over the ditch profile.

On completion culvert ID plates will be installed at track level and hidden structure plate glued to the sleeper in the four foot.

It should be noted that while the outlet is located on the same level as the mean high water springs of the Dornoch Firth over the year tide levels and storm levels will rise higher than this causing water to back up at the inlet. We have indicated that rock armour stone will be used to protect the embankment but this is local to the culvert. Unless directed otherwise we have not shown or made any attempt to limit this phenomenon. If there is a larger issue at the site due to this it would need to be considered as part of a separate study.

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PART 2: DESIGNER'S SUBMISSION

I confirm that the criteria specified in NR/L2/CIV/003 have been considered and that the Design is submitted for Approval in Principle on behalf of:

MHB Consultants Ltd.

52 St Enoch Square

3rd Floor

Glasgow

G1 4AA

Signed: [redacted]	Title: Director
Name: A Gray	Date: 01.04.20
To be signed by the Contractor's Responsible Engineer.	

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PART 3: CONSTRUCTION ORGANISATION'S ACKNOWLEDGEMENT OF SUBMISSION BY A SUB-CONTRACT DESIGNER

The Design organisation named in **PART 1** is engaged as a sub-contractor to the organisation stated below. I formally acknowledge the submission of this Certificate to Network Rail in support of our sub-contract obligation for provision of the Design on behalf of:

AMCOGRIFFEN

5 Carradale Crescent

Broadwood Business Park

Cumbernauld

G68 9LE

Signed:	Title:
Name:	Date:
To be signed by the Contractor's Responsible Engineer appointed for the Construction Phase.	

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PART 4: SUPPLEMENTARY NETWORK RAIL REVIEWS AND ENDORSEMENT

Security, Emergency and Contingency Review

My comments on the submission are given below. Provided that these comments are addressed, I hereby endorse the Approval in Principle of the above proposals regarding the physical security, emergency and contingency arrangements of railway infrastructure.

Signed	Title
Name (print)	Date
To be signed by the Security and contingency planning specialist.	

Station Pedestrian Capacity and Evacuation Review

My comments on the submission are given below. Provided that these comments are addressed, I hereby endorse Approval in Principle of the above proposals regarding Station capacity and evacuation.

Signed	Title
Name (print)	Date
To be signed by the Network Rail Capacity Engineer.	

Fire Safety Review

My comments on the submission are given below. Provided that these comments are addressed, I hereby endorse Approval in Principle of the above proposals regarding Fire Safety.

Signed	Title
Name (print)	Date
To be signed by the Network Rail Fire Engineer.	

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PART 5: PROJECT ENGINEER'S COMMENTS

I have considered this submission for Approval in Principle and I am satisfied that this has adequately addressed the criteria specified in **NR/L2/CIV/003** and confirm that the Design of the Permanent Works is to be checked in accordance with the Design Check Categories listed in 12.2 of **NR/L2/CIV/003**.

My comments on the submission are given below. Provided that these comments are addressed, I hereby give Approval in Principle to the proposals.

Signed	Title
Name (print)	Date
To be signed by the Project Engineer (Building and Civil Engineering).	

Signed	Title
Name (print)	Date
To be signed by other responsible person (if applicable - Project Engineer (Building Services) for example)	

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PART 6: ASSET MANAGER'S APPROVAL

I have considered the submission and confirm that this is approved subject to the comments given below being addressed within the Detailed Design.

Signed	Title
Name (print)	Date
To be signed by the Asset Manager (Structures).	

Signed	Title
Name (print)	Date
To be signed by the Asset Manager (Geotechnical).	

Signed	Title
Name (print)	Date
To be signed by the Asset Manager (Drainage).	

Signed	Title
Name (print)	Date
To be signed by the Asset Manager (Buildings).	

APPENDIX A

A1 List of Buildings and Civil Engineering assets affected by the proposal

Asset No 1

Description	C 302/122 B		
Location	Between Ardgay & Tain Stations		
ELR	WCK	**Mileage**	53 miles 1040 yards
Asset Number	C 302/122 B	**OS Grid Reference**	NH 65434 86809

A1.1 Drawings and Models of Proposals

2383-MHB-DRG-001 Notes

2383-MHB-DRG-002 Existing Layout Prior To Works

2383-MHB-DRG-003 Existing Sections Prior To Works Sheet 1 of 2

2383-MHB-DRG-004 Existing Sections Prior To Works Sheet 2 of 2

2383-MHB-DRG-101 General Arrangement of Culvert Renewal Works Sheet 1 of 2

2383-MHB-DRG-102 General Arrangement of Culvert Renewal Works Sheet 2 of 2

2383-MHB-DRG-103 Proposed Sections Sheet 1 of 2

2383-MHB-DRG-104 Proposed Sections Sheet 2 of 2

2383-MHB-DRG-105 Details Sheet 1 of 2

2383-MHB-DRG-106 Details Sheet 2 of 2

A1.2 DESIGN CRITERIA

Route Class

The WCK line is classed as a Secondary Route and the proposed culvert design will be designed to accommodate a 50-year return period, whilst also allowing for climate change in accordance with NR/L3/CIV/005. The capacity of the proposed structure is calculated in accordance with NR/L3/CIV/005.

Hydraulic Capacity

The existing culvert capacity has been assessed with the smallest cross-sectional area available resulting in a discharge of 0.56m^3/s.

Based on a Wallingford Procedure, and by applying an additional 20% for climate change, a 50-year return is calculated to be 0.4m^3/s, while a 200-year return is 0.55m^3/s.

The proposed culvert design would have the capacity to allow for 0.47m^3/s, this is based on the proposed pipe diameter being 600mm diameter on a 1:60 gradient.

Design Life

Proposed culvert and headwalls 120 years

A1.3 ANTICIPATED DEVIATIONS FROM STANDARDS (with justification)

None

A1.4 GEOTECHNICAL CONSIDERATIONS

The proposed headwalls will be checked for sliding, bearing and overturning in line with Eurocode 7 using simple statics. Although the site is known to be underlain by soft soils the increase in vertical effective stress from the installation of the pipe and grout over the length of the culvert is considered to be sufficiently small that by inspection there any settlement over the longer term as a result of the works will be negligible. The rock armour stone will be designed and using the guidance laid out in the rock manual – CIRIA 683.

A1.5 ACCOMPANYING DRAWINGS AND OTHER DOCUMENTS

Reference Reports

Detailed Examination September 2016

Visual Examination October 2017

A1.6 OTHER RELEVANT INFORMATION

A borehole was undertaken at track level by SKF on the first of March which is summarised below.

The embankment comprises loose to medium dense granular material. The medium dense material is found within bottom 1.5m of the embankment. The embankment is underlain by around 3m of very soft cohesive deposits before terminating on rock.

The British Geological Society (BGS) online map was consulted to review the geological conditions. The Bedrock at the Site is made up of the Ben Wyvis Pelite Formation comprising metamorphosized clay sediment constituting relatively soft rock.

The superficial deposits are shown to comprise gravels, sands and silts.

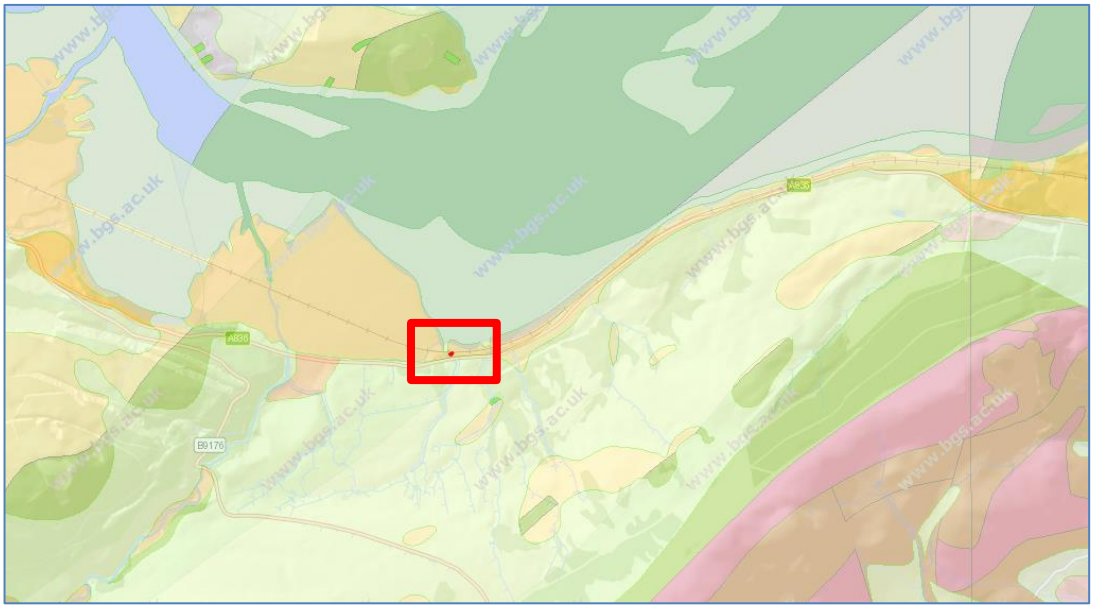

Figure 10 Superficial deposits and Bedrock map from British Geological Society

The nearest historical borehole is located at NH 64490 86840, which is approximately 950m to the West of the structure.

The borehole found loose sand and gravel to around 1m below ground level. Dense sand with traces of gravel continued from 1m to 1.85m. Compacted sand, with coarse gravels, cobbles and occasional boulders was shown down to 7.3m. Finally, there were large cobbles and boulders below this to a depth of 9.3m where the borehole was terminated.

A1.7 SPECIAL ACCESS ARRANGEMENTS/REQUIREMENTS FOR EXAMINATION, INSPECTION, REPAIR, RENEWAL OR REMOVAL

None.

A1.8 CHECKING CATEGORY

The Design of the Permanent Works is proposed to be checked in accordance with the following Categories in NR/L2/CIV/003.

Description of asset	Permanent or Temporary Works	Design Check Category
Culvert	Permanent	ii