

## Appendix A11.8: Watercourse Crossings Report

### 1 Introduction

- 1.1.1 This appendix provides additional information relating to watercourse crossings to be constructed or modified as part of the proposed scheme.
- **Section 2** provides a general description of the design approach being adopted.
  - **Section 3** considers each watercourse crossing in turn identifying the preferred approach that could be applied at this stage in the proposed scheme development.
  - **Section 4** provides photographs of the existing watercourse crossings.
  - **Section 5** provides a schematic plan and long section for each proposed watercourse crossing.
- 1.1.2 This appendix is to be read in conjunction with the relevant sections of the Environmental Statement (ES) and in particular Chapter 11 (Road Drainage and the Water Environment).

### 2 Design Approach

- 2.1.1 At each proposed watercourse crossing, consideration has been given to the nature and size of the crossing, fluvial scour and environmental requirements.
- 2.1.2 There is a range of different types of watercourse crossings of differing size to be constructed as part of the proposed scheme, including simply supported beam bridges, arch bridges and rectangular/circular culverts.
- 2.1.3 At each watercourse crossing, consideration has been given to the 'opening size' of the bridge/culvert required to pass the design fluvial event<sup>1</sup> incorporating appropriate freeboard. This also includes consideration of the impact of the proposed watercourse crossing on flood risk, associated with the design flood event<sup>2</sup>, which is reported in Appendix A11.3 (Flood Risk Assessment) of the ES.
- 2.1.4 The design approach adopted for each of the watercourse crossings is provided below.

#### **Culvert Watercourse Crossings**

- 2.1.5 The majority of watercourses crossed by the existing A9 are conveyed by means of a culvert. The proposed scheme retains the same general approach to these watercourse crossings by following the design process defined below.
- 2.1.6 The decision making hierarchy adopted with regards to the design of culverted watercourse crossings is presented below in order of preference:
- Retain the existing watercourse crossing infrastructure unchanged.
  - Retain the existing watercourse crossing infrastructure, but extended to accommodate the proposed scheme.
  - Replace the existing watercourse crossing infrastructure with new infrastructure.

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<sup>1</sup> The 'design fluvial event' is used to define the fluvial event used in the design of watercourse crossings and the magnitude of the event will be stated as appropriate.

<sup>2</sup> The 'design flood event' is the estimated peak flow associated with the 0.5% Annual Exceedance Probability (AEP) (200-year) plus an allowance for climate change flood event.

- 2.1.7 The design process adopted for each watercourse crossing is complex, taking account of a range of design criteria and constraints to develop the most appropriate crossing for each watercourse. The primary technical standards driving the design of culverts are DMRB HA107/04 Design of Outfall and Culvert Details (2004) and the CIRIA Culvert design and operation guide (C689) (2010). However, in addition to these technical standards, there are other site-specific drivers that influence the culvert design which include flood risk; maintenance requirements; ecological considerations; geomorphological considerations; and other aspects of the proposed scheme design such as highway drainage design.
- 2.1.8 The design process for each watercourse crossing is iterative, such that the final design meets the fundamental design standard; which is that the proposed scheme remains free from flooding during the design flood event whilst maintaining adequate freeboard (typically 600mm) and flood risk is not compromised elsewhere (as reported in Appendix A11.3: Flood Risk Assessment). In this context freeboard is defined as the difference between the proposed scheme road level and the peak water level during the 0.5% AEP (200-year)<sup>3</sup> plus climate change design flood event. Section 3 (Watercourse Crossing Information) outlines the site-specific design considerations which have shaped the development of each watercourse crossing proposed to be constructed as part of the scheme.
- 2.1.9 There are no new proposed watercourse crossings.

### **Cascades**

- 2.1.10 There are a number of locations where the proposed scheme will result in an earthworks 'cut' into the adjacent hillside or the invert of the new watercourse crossing will be lowered to pass beneath the proposed road drainage system. In both cases this will result in a steepened watercourse requiring a 'cascade' to safely convey the design flood event without compromising the integrity of the hillside and/or operation of the proposed scheme.
- 2.1.11 From a hydraulic perspective, the flow of water within a cascade is complex and characterised by two different flow types – 'nappe flow' and 'skimming flow'. 'Nappe flow' is characterised by a succession of free falling drops at each step with water depth recovering before the next step. 'Skimming flow' occurs when each step is submerged, typically occurring during larger magnitude discharges and/or longer cascades and requiring a stilling basin at the toe of the cascade to dissipate energy and allow water depth recovery. Both flow types are acceptable, as long as the proposed cascade geometry safely contains the flow of water.
- 2.1.12 The design approach taken has been to design a hydraulic cascade to typically follow the proposed hillside topography without significant additional excavation to form the cascade steps which have been limited to a maximum height of 0.5m where possible.
- 2.1.13 Where a cascade is considered necessary, at each watercourse this is identified in Section 3 and also shown on the associated drawing. The nature of the cascade could take one of the following forms:
- bedrock channel cascade;
  - natural cascade with natural gravel, cobbles and rock forming individual steps; and
  - concrete cascade with stone pitching.

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<sup>3</sup> AEP refers to the chance that a flood of a particular size is experienced or exceeded during any year. In this report we use a probability value expressed as a percentage to quantify this. For example, a 50% AEP equates to a 1 in 2 chance of the flood being experienced or exceeded in a year. Similarly, the 0.5% AEP equates to a 1 in 200 chance of the flood being experienced or exceeded in a year. It is important to recognise that a low probability doesn't preclude the event happening in the following year.

Return period – this form of referring to event rarity has and continues to be commonly used within extreme event studies. The 2-year event is the same as the 50% AEP event, and the 200-year event is the same as the 0.5%. It refers to an on average spacing between floods of that size. A problem with this usage is that some wrongly interpret this as: once the event has occurred then it will not happen again for the period of the return period. For example, if a 200-year event was experienced it is a wrong interpretation to say that that event will not reoccur for 200 years. Every year there is a chance that a 200-year flood may happen, albeit a very small chance, and it is possible therefore for a really rare event to re-occur in quick succession, equally there could be a much larger gap between the recurrences of the event than return period might suggest.

- 2.1.14 The nature of the cascade will be determined at detailed design stage taking into account hydraulic requirements, topography, fluvial morphology and nature of the underlying strata and its susceptibility to fluvial erosion. Similarly, the geometry of the proposed cascades provided in this report and associated drawings is indicative and could be subject to further development at detail design stage.

### **Scour Protection Measures**

- 2.1.15 Fluvial scour of highway structure foundations is a major cause of failure. Consequently, it is critical that attention is given to the design of new watercourse crossings to prevent failure due to fluvial scour.
- 2.1.16 For each proposed watercourse crossing, an assessment has been made regarding the need to offer scour protection measures, in particular at bridge abutments, bridge piers, culvert exit and/or any other river training works required as part of the proposed scheme.
- 2.1.17 Where highway structures are founded directly onto sound bedrock and/or the watercourse local to the structure is formed by a bedrock channel with little or no alluvium mantling the risk of scour is considered to be low and hence no further scour protection measure is considered necessary at this stage.
- 2.1.18 Where highway structures are not founded directly onto sound bedrock and/or the channel local to the structure is not formed of bedrock, consideration has been given to estimating the maximum depth of scour such that structure foundations are set below this level and/or scour protection measures are provided to offer protection against scour and undermining of the structure foundations.
- 2.1.19 The extent of required scour protection measures for each watercourse is provided in Section 3 and also shown on the drawings. The nature of any scour protection measure will be determined at detailed design stage taking into account hydraulic requirements, channel morphology and nature of the underlying strata, however it could include stone (rip-rap) aprons and revetments forming the river bed and banks to limit the extent to which scour can occur.
- 2.1.20 The design of any scour protection measure will be in accordance with the relevant provision of the DMRB BD97/12 (Highways Agency *et al.* 2012).

### **Environmental Design**

- 2.1.21 Consideration has been given to both the provision of mammal passage and culvert embedment.

#### Mammal Passage

- 2.1.22 The provision of mammal passage within watercourse crossings has been considered alongside geometric constraints, hydraulic performance requirements and other aspects of scheme design in developing the watercourse crossing proposals outlined in this report.
- 2.1.23 Where existing watercourse crossing culverts are being replaced with a new culvert, consideration has been given to provide integral mammal passage where an ecological need has been identified. Mammal ledges have been designed in accordance with DMRB HA81/99 (Highways Agency *et al.* 2001) and as shown in Figure 5.4 of the ES.
- 2.1.24 The alternative provision of mammal passage by means of dry mammal underpass rather than provision of mammal ledges within an enlarged watercourse culvert has been selected at several locations to avoid the need to significantly enlarge the culvert cross-section in order to accommodate the DMRB HA81/99 mammal ledge geometry.
- 2.1.25 Consequently, the use of dry mammal underpasses in such a situation reduces the need to increase clearance between the proposed scheme road level and the watercourse bed level. Raising proposed scheme road levels can have potentially significant impacts in terms of increasing the footprint of the road, drainage design, visual impact and increased capital cost; whereas the alternative option of lowering the watercourse potentially requires significant engineering intervention in the channel, with possible further ecological and geomorphological impacts. Avoiding, or minimising an increase in culvert size also has the benefit of reducing changes to flow conveyance capacity through the culvert, with

consequent reduction in changes to both the hydraulic regime and flood risk associated with the watercourse.

- 2.1.26 Where an existing watercourse crossing culvert has been confirmed to provide a mammal corridor but is being retained and extended to accommodate the proposed scheme, it is proposed to provide an adjacent dry mammal underpass to maintain and/or improve habitat connectivity.
- 2.1.27 Where required details relating to the provision of mammal passage within culvert structures are provided in Section 3 (Water Crossing Information) and are also shown on the drawings. Dry mammal underpasses are not detailed within this report, but their presence is noted in Section 3 (Watercourse Crossing Information) where the dry mammal underpass is associated with an adjacent watercourse.
- 2.1.28 No provision is made for mammal passage through culverts proposed as part of the proposed scheme to accommodate access tracks, non-motorised user tracks and other minor crossings. Due to the (infrequent, low speed and/or non-motorised user) nature of the traffic using such minor crossings the risk to mammals crossing overland in times of high river flow within the culvert barrel is not considered to be significant.

#### Fish Passage

- 2.1.29 The current accessibility of each watercourse for migratory fish is provided in Appendix A11.1 (Baseline Conditions), where data has been available.
- 2.1.30 In line with good practice (SEPA, 2010), measures to provide fish passage will be developed for each watercourse crossing, as determined where necessary through consultation with SEPA and the Tay District Salmon Fisheries Board, at the detailed design stage for applications made under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended).

#### Culvert Embedment

- 2.1.31 Where possible consideration has been given to burying the culvert invert below the natural bed level to allow for a naturalised culvert bed. This approach has been taken where a new culvert is proposed of moderate gradient and generally where the natural river bed level and bed slope is maintained through the culvert.
- 2.1.32 Where this is not the case, in particular where the channel upstream is relatively steep, where the design incorporates a hydraulic feature such as a cascade and/or where the existing culvert is being retained and extended, culvert embedment has not been provided.
- 2.1.33 The amount of embedment will vary depending on the size of culvert and hydraulic requirements. Typically, the depth of embedment will meet the following criteria, as suggested in 'River Crossings (Engineering in the water environment: a good practice guide)', published by Scottish Environment Protection Agency (SEPA) and Natural Scotland:
- for culverts less than 1.2m diameter, the invert should be buried at least 150mm below natural bed level;
  - for culverts between 1.2 and 1.8m diameter, the invert should be buried at least 200mm below natural bed level; and
  - for culverts greater than 1.8m diameter, the invert should be buried at least 300mm below natural bed level.
- 2.1.34 In addition, and where possible all new proposed scheme culverts should maintain the existing natural channel width.
- 2.1.35 The depth of embedment at each watercourse crossing is provided in Section 3 and also shown on the drawings.

### **3 Watercourse Crossing Information**

- 3.1.1 Table 1 provides information for each watercourse crossing which could be affected by the proposed scheme. This includes identification of the waterbody affected (together with predicted flood flows at the point of interest), details of the proposed works and broad justification for the engineering solution.
- 3.1.2 Cross-reference should be made between Table 1 and Sections 4 (Photographs) and 5 (Drawings), which provide photographs of the existing watercourse crossing and outline drawing of the proposed scheme watercourse crossing respectively.

Table 1: Watercourse Crossings additional information

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
<p><b>WF59</b></p> <p>Approximate channel bed width at mainline culvert inlet: 0.8m</p> <p>Flow data: 50% AEP: 0.63m<sup>3</sup>/s 1% AEP: 0.8m<sup>3</sup>/s 0.5% AEP + CC: 1.10m<sup>3</sup>/s</p>	<p>59/A9</p> <p>Grid Reference: (295629,756435)</p>	<p>Existing culverts of WF59, WF60 and WF61 to be extended downstream.</p> <p>Revisions to downstream watercourses (combined solution with WF 60 &amp; 61) to improve conveyance of flows between culvert outlets and River Tummel (WF70)</p> <p>WF59 Existing diameter = 2No 0.59m</p>	<p>The three watercourses WF59, WF60 and WF61 are culverted beneath both the existing A9 and the Highland Main Line (HML) railway. The proposed scheme will result in the A9 footprint at this location being widened to accommodate the dualling of the A9 mainline and revisions to the layout of Pitlochry South Junction.</p> <p>There is an existing complex hydraulic interaction between the three minor watercourses (WF59, WF60 and WF61) and their confluence with the River Tummel immediately downstream. As a result, flooding of the areas immediately upstream of the existing A9 culverts is predicted during the 0.5% AEP (200-year) plus allowance for climate change design flood event. Further assessment and evaluation is provided in Appendix A11.3 (Flood Risk Assessment).</p> <p>In summary, the approach adopted at this location is to achieve a neutral flood risk impact upstream of the A9 for the design flood event, with consideration given to the following options;</p> <ul style="list-style-type: none"> <li>Retain the existing culverts unchanged: The existing culverts are not long enough to accommodate the proposed scheme footprint; therefore this option has been discounted.</li> <li>Extension of the existing culverts: As the existing culvert alignment and level does not conflict with the proposed scheme infrastructure, this is considered to be the preferred option.</li> <li>Replace the existing culverts: The existing culverts could be replaced, however this has been considered unnecessary in view of the suitability of the extension option. In the case of WF60 which passes through the substructure of the Dalshian Underbridge, carrying the A9 over the Highland Main Line (HML) railway, replacement would probably require temporary disruption to the operation of the HML railway which is considered undesirable.</li> </ul> <p><b>Proposed Scheme</b></p> <p>The preferred solution for these three watercourse crossings taking account of engineering and environmental design criteria is to extend the existing culverts in a downstream direction to accommodate the proposed scheme.</p> <p>Downstream of the HML railway, the existing culverts terminate in small depressions along the field boundary. Onward conveyance towards the River Tummel is provided to WF59 and WF60 by small diameter pipes which are likely to restrict the pass forward flow of water. The A9 culvert on WF61 discharges to a short reach of open channel before it is also piped to its confluence with the River Tummel.</p> <p>To provide effective onward conveyance of flows downstream of the A9 to the River Tummel, it is proposed that a new network of pipes will direct flows to a new open channel aligned close to and parallel with the existing field boundary. Access manhole chambers will be provided at the outlet of the extended A9 culvert, at changes of direction and where WF59 and WF60 combine. The open channel will be sized to convey the design flood event flows from WF59, WF60 and WF61 to the River Tummel.</p> <p>An additional culvert is proposed to be installed adjacent to the existing WF61 structure to act as a flood relief culvert. Another new culvert is proposed where the proposed open channel intersects the existing river side flood</p>
<p><b>WF60</b></p> <p>Approximate channel bed width at mainline culvert inlet: 2.0m</p> <p>Flow data: 50% AEP: 0.54m<sup>3</sup>/s 1% AEP: 0.69m<sup>3</sup>/s 0.5% AEP + CC: 0.95m<sup>3</sup>/s</p>	<p>60/A9</p> <p>Grid Reference: (295515,756524)</p>	<p>Existing length = 72.6m</p> <p>Proposed diameter = 2No 0.59m</p> <p>Proposed length = 85.8m (excluding downstream connection to Tummel)</p> <p>WF60 Existing diameter = 0.44m Existing length = 63m</p>	<p>The preferred solution for these three watercourse crossings taking account of engineering and environmental design criteria is to extend the existing culverts in a downstream direction to accommodate the proposed scheme.</p> <p>Downstream of the HML railway, the existing culverts terminate in small depressions along the field boundary. Onward conveyance towards the River Tummel is provided to WF59 and WF60 by small diameter pipes which are likely to restrict the pass forward flow of water. The A9 culvert on WF61 discharges to a short reach of open channel before it is also piped to its confluence with the River Tummel.</p> <p>To provide effective onward conveyance of flows downstream of the A9 to the River Tummel, it is proposed that a new network of pipes will direct flows to a new open channel aligned close to and parallel with the existing field boundary. Access manhole chambers will be provided at the outlet of the extended A9 culvert, at changes of direction and where WF59 and WF60 combine. The open channel will be sized to convey the design flood event flows from WF59, WF60 and WF61 to the River Tummel.</p> <p>An additional culvert is proposed to be installed adjacent to the existing WF61 structure to act as a flood relief culvert. Another new culvert is proposed where the proposed open channel intersects the existing river side flood</p>
<p><b>WF61</b></p> <p>Approximate channel bed width at mainline culvert inlet: 0.6m</p> <p>Flow data: 50% AEP: 0.45m<sup>3</sup>/s 1% AEP: 0.57m<sup>3</sup>/s 0.5% AEP + CC: 0.79m<sup>3</sup>/s</p>	<p>61/A9</p> <p>Grid Reference: (295450,756561)</p>	<p>Proposed diameter = 0.44m</p> <p>Proposed length = 92.6m (excluding downstream connection to Tummel)</p> <p>WF61 Existing diameter = 0.67m Existing length = 67m Proposed diameter = 0.67m Proposed length = 113.4m</p>	<p>The preferred solution for these three watercourse crossings taking account of engineering and environmental design criteria is to extend the existing culverts in a downstream direction to accommodate the proposed scheme.</p> <p>Downstream of the HML railway, the existing culverts terminate in small depressions along the field boundary. Onward conveyance towards the River Tummel is provided to WF59 and WF60 by small diameter pipes which are likely to restrict the pass forward flow of water. The A9 culvert on WF61 discharges to a short reach of open channel before it is also piped to its confluence with the River Tummel.</p> <p>To provide effective onward conveyance of flows downstream of the A9 to the River Tummel, it is proposed that a new network of pipes will direct flows to a new open channel aligned close to and parallel with the existing field boundary. Access manhole chambers will be provided at the outlet of the extended A9 culvert, at changes of direction and where WF59 and WF60 combine. The open channel will be sized to convey the design flood event flows from WF59, WF60 and WF61 to the River Tummel.</p> <p>An additional culvert is proposed to be installed adjacent to the existing WF61 structure to act as a flood relief culvert. Another new culvert is proposed where the proposed open channel intersects the existing river side flood</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
			<p>bank. The latter culvert will be fitted with a flap valve on the outlet to maintain the functionality of existing flood embankments to prevent flows from the River Tummel entering the floodplain until the embankments overtop.</p> <p><b>Environmental</b></p> <p>There is no provision for mammal passage in the existing culverts. Ecological assessment has identified these watercourses as existing mammal corridors; however, the introduction of a new section of open channel downstream of the A9 to the River Tummel may encourage otters and other mammals to spread from the River Tummel towards the A9. The existing culverts are too small to permit the retro-fitment of mammal ledges, and there is insufficient space between watercourse levels and the existing Highland Main Line railway for any new culvert to incorporate mammal ledges. Fencing is incorporated within the proposed scheme to deter mammals attracted by the new channel from crossing over the Railway and A9 and encourage them towards the River Tummel Underbridge.</p> <p>No fish species of conservation interest are expected to be present in these watercourses.</p> <p>The provision to accommodate natural river bed deposits to form the culvert invert by oversizing the proposed culvert is not possible within the extended culverts, given the need to match the geometry of the existing culvert.</p> <p><b>Flood Risk</b></p> <p>Due to the complex hydraulic interaction between the three minor watercourses (WF59, WF60 and WF61) and the River Tummel (WF70) floodplain, this area has been subjected to numerical modelling, as reported in Appendix A11.3 (Flood Risk Assessment).</p> <p>In summary, the proposed scheme as described above, including further mitigation measures discussed for WF70 below, will result in neutral and beneficial impacts with regards to flood risk upstream of the A9 culverts during the design flood event in comparison to the baseline scenario.</p> <p>Downstream of the A9 there are no sensitive receptors; flood risk impacts during the design flood event in this area are mainly negligible with localised minor adverse impacts adjacent to the new embankment.</p> <p>For further details of flood risk associated with WF59, WF60 and WF61 refer to Appendix A11.3 (Flood Risk Assessment).</p>
<p>WF70 River Tummel</p> <p>Approximate channel bed width at bridge: 67.8m</p> <p>Flow data: 50% AEP: 559m<sup>3</sup>/s 1% AEP: 1201m<sup>3</sup>/s 0.5% AEP + CC: 1609m<sup>3</sup>/s</p>	<p>Tummel Underbridge</p> <p>Grid Reference: (295122,756670)</p>	<p>Existing bridge to be retained.</p> <p>New bridge to be constructed, parallel to existing structure and immediately downstream for northbound carriageway.</p> <p>Existing structure span: 40m, 70m, 40m (multi-span)</p> <p>Existing structure piers: 3No.</p> <p>Existing structure deck height: Approx. 19m above water level.</p>	<p>The Tummel Underbridge, located north of the A924 Pitlochry South Junction, carries the existing A9 carriageway over the northbound slip road from the A9 to the A924 local road, an access track and the River Tummel. It is a three span structure with the superstructure comprising of multiple steel plate girders composite with a reinforced concrete deck slab.</p> <p>The intermediate supports are reinforced concrete leaf piers on either spread footings or piled foundations and the end supports comprise of reinforced concrete bank seat abutments on spread footings. The intermediate supports are located within the watercourse under typical flow conditions and a gabion mattress scour protection system surrounds the existing bridge piers.</p> <p>Upstream of the existing bridge on the left bank (looking downstream); existing gabion baskets and gabion mattresses protect the riverbank and support the A924 and an access track. These bank protection measures are showing signs of deterioration.</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
		<p>Proposed new structure span: 150m (single span)</p> <p>Proposed new structure piers: None</p> <p>Proposed new structure deck height: Approx. 19m above water level.</p>	<p><b>Proposed Scheme</b></p> <p>The existing bridge dimensions can only accommodate a single carriageway. It is proposed to construct a new bridge structure on the south, downstream side of the existing bridge to accommodate a new northbound carriageway. The existing embankments will also be widened on the south, downstream side to accommodate the new carriageway and a revised Pitlochry South Junction which leads to loss of floodplain storage.</p> <p>The proposed new bridge is a single span steel bowstring arch structure of equal overall span to the existing structure. There will be no intermediate supports in the watercourse, and its abutments will be set back from the watercourse on either bank. The new and existing bridge decks will be at similar elevations above river level.</p> <p><b>Environmental</b></p> <p>Based on information from Tay District Salmon Fisheries Board (TDSFB) and findings of aquatic walkover surveys, fish species of conservation interest expected to be present are: Atlantic salmon, European eel, brown/sea trout, brook lamprey, river lamprey and sea lamprey.</p> <p>There are no in-channel works associated with the proposed structure, and the proposed bridge forms no impediment to river bank mammal or fish habitat connectivity.</p> <p><b>Flood Risk</b></p> <p>Due to the complex hydraulic interaction between the three minor watercourses (WF59, WF60 and WF61) and the River Tummel (WF70) floodplain in the vicinity of the Tummel Underbridge, this structure and the surrounding area has been subjected to numerical modelling, as reported in Appendix A11.3 (Flood Risk Assessment).</p> <p>In summary, the proposed scheme will result in loss of floodplain storage due to the widening of the existing earthworks to accommodate the new carriageway. Flood risk impacts during the design event without mitigation measures are principally minor adverse, upstream of the A9 on the left hand bank of the River Tummel (looking downstream) and downstream of the A9 on the right hand bank of the River Tummel.</p> <p>Mitigation measures including an area of compensatory storage and a new, additional culvert adjacent to WF61 to link areas of floodplain across the A9 have been included to counteract the adverse flood risk impacts variously from the River Tummel and from the minor watercourse flows.</p> <p>Inclusive of mitigation measures, the proposed scheme will result in neutral and beneficial impacts with regards to flood risk upstream of the A9 culverts during the design flood event in comparison to the baseline scenario.</p> <p>Downstream of the A9 there are no sensitive receptors; flood risk impacts during the design flood event in this area are mainly negligible with localised minor adverse impacts adjacent to the new embankment.</p> <p>For further details of flood risk associated with the River Tummel at this location refer to Appendix A11.3 (Flood Risk Assessment).</p>
<p>WF63</p> <p>Approximate channel bed width at culvert inlet: 0.7m</p> <p>Flow data:</p>	<p>63/SR</p>	<p>Replacement of existing culvert to new alignment.</p> <p>Existing diameter = 0.3m</p> <p>Existing length = 512m</p>	<p>Watercourse WF63 does not cross the existing A9. The watercourse is culverted adjacent to the northbound carriageway of the existing A9 from a point upstream of the C452 Foss – Logierait road near Dunfallandy to its confluence with the River Tummel adjacent to the A9 Tummel Underbridge. The proposed scheme will result in the A9 footprint being widened on the northbound carriageway.</p> <p>To accommodate the proposed scheme, a number of alternative options have been considered, as follows:</p> <ul style="list-style-type: none"> <li>Retain the existing culvert unchanged:</li> </ul>



Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
50% AEP: 0.51m <sup>3</sup> /s 1% AEP: 0.65m <sup>3</sup> /s 0.5% AEP + CC: 0.89m <sup>3</sup> /s		Proposed diameter = 1.05m Proposed embedment = 0.15m Proposed length = 495m	<p>The existing culvert conflicts with the proposed Scheme including the Tummel Underbridge, earthworks and a drainage attenuation pond.</p> <ul style="list-style-type: none"> <li>Revise scheme design to switch widening to the southbound side of the existing A9: Revising the scheme design to position the additional carriageway on the southbound side of the existing A9 and hence clear of the existing WF63 culvert has been discounted due to unacceptable flood risk changes due to loss of floodplain upstream of the Tummel Underbridge and other engineering and environmental constraints.</li> <li>Replace the existing WF63 culvert to a new alignment: This is the preferred option, to accommodate the northbound widening of the A9 and associated works by replacing and realigning the WF63 culvert.</li> </ul> <p><b>Proposed Scheme</b></p> <p>The preferred solution for this crossing taking account of engineering and environmental design criteria is to replace the existing culvert to accommodate the proposed scheme.</p> <p>The existing culvert will be removed and replaced by a new 1.05m diameter concrete culvert. This culvert will retain the existing inlet position upstream of the C452 Foss Road, but diverge from the existing alignment downstream of the C452 Foss Road. From a new manhole, the culvert will follow the C452 Foss Road in a south-westerly direction to a new outlet into WF191.</p> <p>The increased pipe size will be accommodated by lowering the culvert inlet level to maintain the existing soffit level and hence headroom to the C452 Foss Road. To achieve this, the upstream watercourse will require to be lowered locally to tie in to the proposed culvert bed level.</p> <p><b>Environmental</b></p> <p>It is proposed to discharge road drainage via an attenuation basin into the culvert. This has the effect of removing one existing direct road drainage outfall from the River Tummel and providing additional dilution prior to discharge into the River Tummel.</p> <p>Mammal passage is not incorporated within the proposed culvert, as it does not provide habitat connectivity across the A9, and the C452 Foss Road is considered to pose low risk to mammals due to the relatively light traffic and low speeds of vehicles.</p> <p>No fish species of conservation interest are expected to be present in this watercourse.</p> <p>The culvert invert is specified to be embedded through the proposed culvert to maintain continuity of natural bed material.</p> <p><b>Flood Risk</b></p> <p>The existing culvert surcharges and overtops during the design flood event i.e.0.5% AEP (200-year) plus an allowance for climate change, leading to overtopping of the C452 Foss Road. However, this watercourse poses no flood risk to the A9 in the design flood event.</p> <p>The proposed replacement culvert has been sized to freely pass the design flood event; therefore, the upstream headwater level is reduced. This reduced headwater level combined with a lowered inlet results in headwaters</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
			<p>being contained within the upstream channel. As the proposed culvert is no longer a constraint to the design flood event, flood risk to the C452 Foss Road will be reduced.</p> <p>The proposed scheme will increase the flows in WF191 for any given storm; however, there are no sensitive receptors close to this watercourse. The C452 Foss Road is elevated above the watercourse by approximately 4m where WF63 is proposed to discharge into it, so that any flooding from the watercourse will spill into the River Tummel floodplain and into the River Tummel before it floods along the C452 Foss Road.</p>
<p>WF64</p> <p>Approximate channel bed width at mainline culvert inlet: 1.5m</p> <p>Flow data:  50% AEP: 2.60m<sup>3</sup>/s  1% AEP: 3.39m<sup>3</sup>/s  0.5% AEP + CC: 4.77m<sup>3</sup>/s</p>	<p>64/A9</p> <p>Grid Reference:  (294343,756986)</p>	<p>Realignment of upstream channel for approximately 22.5m</p> <p>Extension to both upstream and downstream ends of the existing A9 culvert.</p> <p>Existing diameter = 1.75m  Existing length = 41m</p> <p>Proposed diameter = 1.75m  Proposed length = 65m</p>	<p>Watercourse WF64 is culverted beneath the existing A9 via a 1.75m diameter circular concrete culvert. The proposed scheme will result in the A9 footprint at this location being widened on both sides to accommodate the dualling of the A9 mainline.</p> <p>To accommodate the proposed scheme, a number of alternative watercourse crossing options have been considered, as follows:</p> <ul style="list-style-type: none"> <li>Retain the existing culvert unchanged:  The existing culvert is not long enough to accommodate the proposed scheme; therefore, this option has been discounted.</li> <li>Extension of the existing culvert:  As the existing culvert alignment and level does not conflict with the proposed scheme infrastructure, this is considered to be the preferred option.</li> <li>Replace the existing culvert:  The existing culvert could be replaced, however this has been considered unnecessary in view of the suitability of the extension option.</li> </ul> <p><b>Proposed Scheme</b></p> <p>The preferred solution for this crossing taking account of engineering and environmental design criteria is to extend the existing culvert to accommodate the proposed scheme.</p> <p>The existing culvert will be extended in both the upstream and downstream directions to accommodate the proposed scheme foot print. This will result in a new culvert inlet and outlet arrangement, together with the need to realign the upstream channel. The nature of the new channel will be designed at detail design stage, but will typically be trapezoidal in shape and where possible be geomorphologically similar to the existing channel immediately downstream.</p> <p>The new culvert section will have the same internal diameter, alignment and gradient as the existing culvert.</p> <p><b>Environmental</b></p> <p>No fish species of conservation interest are expected to be present.</p> <p>There is no provision for mammal passage in the existing culvert, however ecological assessment has identified this watercourse as a potential mammal corridor. Accommodating mammal ledges compliant with DMRB HA81/99 within the geometry of the existing culvert is not possible, hence alternative habitat connectivity across the proposed scheme, is proposed via a new adjacent dry mammal underpass structure provided local to the existing culvert.</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
			<p>The provision to accommodate natural river bed deposits to form the culvert invert by oversizing the proposed culvert is not possible at this location, given the need to match the geometry of the existing culvert.</p> <p><b>Flood Risk</b></p> <p>The existing culvert is considered to have sufficient capacity to freely convey the design flood event i.e. 0.5% AEP (200-year) plus an allowance for climate change. The proposed extension of this culvert has been assessed to similarly pass the design flood event in free flow with no increase in headwater level.</p> <p>As the A9 is proposed to be raised by 1.3m, freeboard between headwater level and the A9 road level is predicted to increase, reducing the risk of flooding to the road.</p> <p>No sensitive receptors are at risk upstream of the proposed scheme, and there is no predicted increase in downstream flood risk.</p>
<p>WF65</p> <p>Approximate channel bed width at mainline culvert inlet: 2.0m</p> <p>Flow data:                      50% AEP: 0.93 m<sup>3</sup>/s                      1% AEP: 1.18 m<sup>3</sup>/s                      0.5% AEP + CC: 1.65 m<sup>3</sup>/s</p>	<p>65/A9</p> <p>Grid Reference: (293962,757406)</p>	<p>New upstream cascade feature to replace existing concrete and gabion basket cascade.</p> <p>Replacement of existing A9 culvert.</p> <p>Reprofiling of downstream channel for approximately 36m</p> <p>Existing diameter = 1.15m                      Existing length = 149m</p> <p>Proposed diameter = 1.15m                      Proposed length = 157m</p>	<p>Watercourse WF65 is culverted beneath the existing A9 via a 1.15m diameter circular concrete culvert. The proposed scheme will result in the A9 footprint at this location being widened on the upstream (northbound) side to accommodate the dualling of the A9 mainline.</p> <p>To accommodate the proposed scheme, a number of alternative watercourse crossing options have been considered, as follows:</p> <ul style="list-style-type: none"> <li>Retain the existing culvert unchanged:                      The existing culvert is not long enough to accommodate the proposed scheme, and also conflicts with the vertical alignment of the proposed scheme; hence this option has been discounted.</li> <li>Extension of the existing culvert:                      The existing culvert could be extended to accommodate the footprint of the proposed scheme; however the existing culvert conflicts with the proposed scheme vertical alignment. Raising the proposed road level at this location has been considered but discounted, as road levels are constrained by the nearby Foss Road Junction. Raising the proposed scheme would lead to unacceptable carriageway gradients on Foss Road on its approach to the A9 Junction.</li> <li>Replace the existing culvert:                      Due to the conflict between the existing culvert and proposed scheme, replacing the existing culvert is considered to be the preferred option.</li> </ul> <p><b>Proposed Scheme</b></p> <p>The preferred solution for this crossing taking account of engineering and environmental design criteria is to replace the existing crossing to a revised alignment and gradient to accommodate the proposed scheme.</p> <p>Due to the proximity of downstream residential properties and so not to compromise existing downstream flood risk, the new culvert has been designed so far as is practical to provide a 'like-for-like' hydraulic response, when compared to the existing culvert performance.</p> <p>In addition and to accommodate the proposed scheme drainage system, the culvert invert level at its entrance will be set at a lower level than the present channel bed level, however to limit the depth, the upstream section of</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
			<p>new culvert will be set at a slightly steeper gradient. Due to the new steep channel immediately upstream of the culvert entrance, a new cascade feature will be required to train the flow of water to the culvert entrance.</p> <p>The proposed geometry of the cascade is shown on the drawing (Section 5) and the nature of the cascade will be further developed at detail design stage, but will likely be either a bedrock cascade, natural cascade or concrete (stone pitched) cascade.</p> <p>A scour protection system will be required for a short distance downstream of the culvert exit. This will be developed further at detail design stage, but will likely consist of a rock armour (rip-rap) revetment system.</p> <p>To accommodate the proposed culvert invert levels, it is proposed to regrade the downstream watercourse over approximately 36m from the culvert outlet to tie-in with the existing downstream channel bed level.</p> <p><b>Environmental</b></p> <p>There is no provision for mammal passage in the existing culvert. Flood risk impact considerations prevent the replacement of the existing culvert with a larger culvert accommodating mammal passage (see below); hence it is proposed to provide appropriate fencing to direct mammals to the adjacent Rob Roy Way Non-Motorised User underpass to cross the proposed scheme.</p> <p>No fish species of conservation interest are expected to be present in this watercourse</p> <p>Given the presence of the new upstream cascade feature no provision has been made to accommodate a natural river bed invert within the new culvert section.</p> <p><b>Flood Risk</b></p> <p>The existing culvert full bore capacity is 1.19m<sup>3</sup>/s; whereas the proposed replacement culvert (with steeper gradient and increased length) has been assessed to have a capacity of 1.14m<sup>3</sup>/s; hence there is no predicted increase in pass forward flow and consequent increase in downstream flood risk.</p> <p>The existing culvert surcharges during the design flood event but the headwater level at the culvert entrance is 0.7m below the existing road level, hence the existing A9 road is not considered to be at flood risk during the design flood event.</p> <p>The new culvert design has similar hydraulic response to the existing structure; hence the new culvert arrangement will also surcharge during the design flood event; however due to the lowering of the inlet, the available freeboard between headwater level and the proposed A9 road level increases to 1.7m, hence the proposed scheme is not considered to be at flood risk during design flood event. As the headwater level is contained within the upstream channel, no further mitigation measures are considered necessary.</p>
<p>WF66</p> <p>Approximate channel bed width at mainline culvert inlet: 2.0m</p> <p>Flow data:</p>	<p>66/A9</p> <p>Grid Reference: (293567,757500)</p>	<p>New upstream cascade feature to replace existing concrete /gabion basket cascade feature.</p> <p>Partial replacement of existing A9 culvert to a lower profile.</p>	<p>Watercourse WF66 is culverted beneath the existing A9 via a 1.8m diameter circular concrete culvert. The proposed scheme will result in the A9 footprint at this location being widened on the both sides to accommodate the proposed scheme.</p> <p>To accommodate the proposed scheme, a number of alternative watercourse crossing options have been considered, as follows:</p> <ul style="list-style-type: none"> <li>Retain the existing culvert unchanged:</li> </ul>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
<p>50% AEP: 0.96m<sup>3</sup>/s  1% AEP: 1.22m<sup>3</sup>/s  0.5% AEP + CC: 1.71m<sup>3</sup>/s</p>		<p>Existing diameter = 1.8m  Existing length = 127m</p> <p>Proposed diameter = 1.8m  Proposed length = 122m</p>	<p>The existing culvert could be retained to accommodate the footprint of the proposed scheme; however the existing culvert levels conflict with the proposed scheme vertical alignment. Raising the proposed road level at this location has been considered but discounted, as road levels are constrained by the nearby Foss Road Junction. Raising the proposed scheme would lead to unacceptable carriageway gradients on Foss Road on its approach to the A9 Junction.</p> <ul style="list-style-type: none"> <li>Extension of the existing culvert:  The existing culvert has sufficient length to accommodate the proposed scheme, however the existing culvert levels conflict with the proposed scheme, as highlighted above.</li> <li>Replace the existing culvert:  Due to the conflict between the existing culvert and proposed scheme, replacing the existing culvert with a new vertical alignment is considered to be the preferred option.</li> </ul> <p><b>Proposed Scheme</b></p> <p>The preferred solution for this crossing taking account of engineering and environmental design criteria is to replace the existing crossing to a revised alignment and gradient to accommodate the proposed scheme.</p> <p>The new culvert will be set at a shallower gradient to provide increased depth between the proposed road level and culvert soffit level to accommodate the proposed scheme whilst maintaining the existing culvert outlet invert level. The new culvert has been designed to freely pass the 0.5% AEP (200-year) design fluvial event with appropriate freeboard. The new culvert will tie-in to a short section of retained culvert at its downstream end including the existing culvert outlet. This section of existing culvert is being retained to limit works within the 'Explorers Gardens' grounds, a local ornamental garden and tourist attraction, which is considered undesirable. At its upstream end an appropriately designed concrete inlet structure including headwall, wingwalls and apron will be required.</p> <p>Due to the revised culvert gradient, the culvert inlet invert level will be set at a lower level relative to the exiting culvert. This will require the existing concrete/gabion cascade feature to be removed and replaced with a new cascade feature to train the flow of water to the culvert entrance. The proposed geometry of the cascade is shown on the drawing (Section 5: Drawings) and the nature of the cascade will be further developed at detail design stage, but will likely be either a bedrock cascade, natural cascade or concrete (stone pitched) cascade.</p> <p><b>Environmental</b></p> <p>There is no provision for mammal passage in the existing culvert. The geometry of the new culvert will match the geometry of the short section of culvert being retained within the grounds of the 'Explorers Garden', which cannot accommodate mammal passage compliant with DMRB HA81/99. Instead it is proposed that fencing is provided to encourage use of alternative crossings provided by a dry mammal underpass to the west and a Non-motorised User (NMU) underbridge to the east of this location.</p> <p>No fish species of conservation interest are expected to be present in this watercourse.</p> <p>Given the presence of the new upstream cascade feature no provision has been made to accommodate a natural river bed invert with the new culvert section.</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
			<p><b>Flood Risk</b></p> <p>The existing A9 culvert freely passes the design flood event i.e. 0.5% AEP (200-year) plus an allowance for climate change.</p> <p>Similarly, the new culvert arrangement will freely pass the design flood event. The head water level at the culvert entrance is predicted to reduce by 1.14m due to lowering of the culvert entrance invert. The available freeboard between headwater level at the culvert entrance and the proposed A9 road level is 1.2m, hence the proposed scheme is not considered to be at flood risk during design flood event. As the increase in water level is contained within the upstream channel, no further mitigation measures are considered necessary.</p> <p>Downstream flood risk is not impacted by the proposed scheme.</p>
<p>WF67</p> <p>Approximate channel bed width at mainline culvert inlet: 1.3m</p> <p>Flow data:  50% AEP: 0.07m<sup>3</sup>/s  1% AEP: 0.09m<sup>3</sup>/s  0.5% AEP + CC: 0.13m<sup>3</sup>/s</p>	<p>67/A9</p> <p>Grid Reference: (293260,757567)</p>	<p>Downstream extension of existing A9 culvert.</p> <p>Existing diameter = 0.8m  Existing length = 36m</p> <p>Proposed diameter = 0.8m  Proposed length = 64m</p>	<p>Watercourse WF67 is culverted beneath the existing A9 via a 0.8m diameter concrete culvert. The proposed scheme will result in the A9 footprint at this location being widened on the downstream (southbound) side to accommodate the dualling of the A9 mainline.</p> <p>To accommodate the proposed scheme, a number of alternative watercourse crossing options have been considered, as follows:</p> <ul style="list-style-type: none"> <li>Retain the existing culvert unchanged:  The existing culvert is not long enough to accommodate the proposed scheme and hence this option has been discounted.</li> <li>Extension of the existing culvert:  As the existing culvert alignment and level do not conflict with the proposed scheme infrastructure, this is considered to be the preferred option</li> <li>Replace the existing culvert:  The existing culvert could be replaced, however this has been considered unnecessary in view of the suitability of the extension option.</li> </ul> <p><b>Proposed Scheme</b></p> <p>The preferred solution for this crossing taking account of engineering and environmental design criteria is to extend the existing culvert in a downstream direction to accommodate the proposed scheme. The proposed new culvert extension has been arranged to tie in to the existing downstream channel which requires a bend in the culvert plan alignment. Access for maintenance and inspection purposes will be provided at the bend via a manhole located in the central reservation.</p> <p>The new culvert section will have the same internal diameter, alignment and gradient as the existing culvert.</p> <p><b>Environmental</b></p> <p>There is no provision for mammal passage in the existing culvert and it is not possible to provide mammal passage compliant with DMRB HA81/99 within the geometry of the existing culvert. Hence to improve mammal habitat connectivity at this location, a new adjacent dry mammal underpass structure is proposed together with appropriate guide fencing.</p> <p>No fish species of conservation interest are expected to be present in this watercourse.</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
			<p>The provision to accommodate natural river bed deposits to form the culvert invert by oversizing the proposed culvert is not possible at this location, given the need to match the geometry of the existing culvert.</p> <p><b>Flood Risk</b></p> <p>The existing culvert is considered to have sufficient capacity to freely convey the design flood event i.e. 0.5%AEP (200-year) plus an allowance for climate change. The proposed extension of this culvert has been assessed to similarly pass the design flood event in free flow; however headwater levels are predicted to increase by 60mm. The existing inlet chamber inlet is set back from the carriageway close to existing and proposed A9 road levels, however to pose risk to the A9, headwater levels require to overtop the chamber spill level. Under baseline conditions with the existing culvert there is 2.08m freeboard from the headwater level to the spill level, reducing to 2.02m as a result of the proposed culvert extension.</p> <p>No sensitive receptors are at risk upstream of the proposed scheme for the design flood event, and there is no predicted increase in downstream flood risk.</p>
<p>WF68</p> <p>Approximate channel bed width at mainline culvert inlet: 4.0m</p> <p>Flow data:  50% AEP: 1.14m<sup>3</sup>/s  1% AEP: 1.46m<sup>3</sup>/s  0.5% AEP + CC: 2.03m<sup>3</sup>/s</p>	<p>68/A9</p> <p>Grid Reference: (293189,757603)</p>	<p>Downstream extension of existing A9 culvert.</p> <p>Existing diameter = 1.75m  Existing length = 52m</p> <p>Proposed diameter = 1.75m  Proposed length = 55m</p>	<p>Watercourse WF68 is culverted beneath the existing A9 via a 1.75m diameter reinforced concrete pipe culvert. The proposed scheme will result in the A9 footprint at this location being widened on the downstream (southbound) side to accommodate the proposed scheme.</p> <p>To accommodate the proposed scheme, a number of alternative watercourse crossing options have been considered, as follows:</p> <ul style="list-style-type: none"> <li>Retain the existing culvert unchanged:  The existing culvert is not long enough to accommodate the proposed scheme and hence option has been discounted.</li> <li>Extension of the existing culvert:  As the existing culvert alignment and level does not conflict with the proposed scheme infrastructure, this is considered to be the preferred option.</li> <li>Replace the existing culvert:  The existing culvert could be replaced, however this has been considered unnecessary in view of the suitability of the extension option.</li> </ul> <p><b>Proposed Scheme</b></p> <p>The preferred solution for this crossing taking account of engineering and environmental design criteria is to extend the existing culvert in a downstream direction to accommodate the proposed scheme, albeit the extension will be short at 3m, and likely be formed as part of the proposed scheme retaining wall supporting widening of the southbound carriageway.</p> <p>The new culvert section will have the same internal diameter, alignment and gradient as the existing culvert.</p> <p>A scour protection system will be required for a short distance downstream of the culvert exit. This will be developed further at detail design stage, but will likely consist of a rock armour (rip-rap) revetment system.</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
			<p><b>Environmental</b></p> <p>There is no provision for mammal passage in the existing culvert. Ecological assessment has identified this watercourse as a potential mammal corridor linking potential habitat zones across the A9; however the existing culvert geometry is not suited to the provision of mammal ledges compliant with DMRB HA81/99. To provide mammal habitat connectivity, fencing is proposed to guide mammals to use an adjacent new dry mammal underpass.</p> <p>No fish species of conservation interest are expected to be present in this watercourse.</p> <p>The provision to accommodate natural river bed deposits to form the culvert invert by oversizing the proposed culvert is not possible at this location, given the need to match the geometry of the existing culvert.</p> <p><b>Flood Risk</b></p> <p>The existing culvert is considered to have sufficient capacity to freely convey the design flood event i.e. 0.5% AEP (200-year) plus an allowance for climate change. The proposed extension of this culvert has been assessed to similarly pass the design flood event in free flow; however headwater levels are predicted to increase by 6mm. Flows upstream of the culvert are estimated to be at bank level and there is 5.0m freeboard between headwater level and the proposed A9.</p> <p>No sensitive receptors are at risk upstream of the proposed scheme, and there is no predicted increase in downstream flood risk.</p>
<p>WF69</p> <p>Approximate channel bed width at mainline culvert inlet: 2.8m</p> <p>Flow data:  50% AEP: 1.45m<sup>3</sup>/s  1% AEP: 1.84m<sup>3</sup>/s  0.5% AEP + CC: 2.60m<sup>3</sup>/s</p>	<p>69/A9</p> <p>Grid Reference: (292906,757994)</p>	<p>New cascade feature to lower upstream watercourse to new culvert invert level.</p> <p>Downstream extension of existing A9 culvert.</p> <p>Existing diameter = 1.75m  Existing length = 73m</p> <p>Proposed diameter = 1.75m  Proposed length = 75m</p>	<p>Watercourse WF69 is culverted beneath the existing A9 via a 1.75m diameter circular concrete culvert. The proposed scheme will result in the A9 footprint at this location being widened on the downstream (southbound) side to accommodate the proposed scheme and widening of the southbound carriageway. The existing bridge structure on the adjacent side road (C452 Clunie-Foss Road) will be replaced.</p> <p>To accommodate the proposed scheme, a number of alternative watercourse crossing options have been considered, as follows:</p> <ul style="list-style-type: none"> <li>Retain the existing culvert unchanged:  The existing culvert is not long enough to accommodate the proposed scheme hence this option has been discounted.</li> <li>Extension of the existing culvert:  This is the preferred option: that the existing culvert will be extended to accommodate the footprint of the proposed scheme.</li> <li>Replace the existing culvert:  The existing culvert could be replaced, however this has been considered unnecessary in view of the suitability of the extension option.</li> </ul> <p><b>Proposed Scheme</b></p> <p>The preferred solution for this crossing taking account of engineering and environmental design criteria is to extend the existing culvert at its downstream end to a new outlet in the verge of the widened A9.</p>



Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
			<p>The extended culvert has been assessed to freely pass the 0.5% AEP (200-year) design fluvial event with appropriate freeboard. The culvert extension will also incorporate an appropriately designed new concrete outlet structure including headwall, wingwalls and apron.</p> <p>Downstream of the culvert; regrading and scour protection works are proposed within the reach of watercourse which lies under the C452 side road bridge. A scour protection system will be required for a short distance downstream of the culvert exit. This will be developed further at detail design stage, but will likely consist of a rock armour (rip-rap) revetment system.</p> <p>To accommodate the proposed culvert invert levels, it is proposed to regrade the downstream watercourse from the culvert outlet to tie-in with the existing downstream channel bed levels.</p> <p>The existing C452 Clunie-Foss Underbridge will be replaced by a new reinforced concrete structure.</p> <p><b>Environmental</b></p> <p>There is no provision for mammal passage within the existing culvert, however ecological assessment has identified this watercourse as an existing and/or potential mammal corridor providing connectivity between habitats on either side of the A9.</p> <p>As the existing structure cannot accommodate the retro-fitting of mammal ledges compliant with DMRB HA81/99, no provision is proposed within the new culvert extension which adopts the same geometry as the existing culvert. To improve mammal habitat connectivity at this location, a new adjacent dry mammal underpass structure is proposed together with appropriate guide fencing.</p> <p>No fish species of conservation interest are expected to be present in this watercourse.</p> <p>The proposed culvert cross-section shall match the existing culvert and hence does not include natural river bed deposits.</p> <p><b>Flood Risk</b></p> <p>The existing A9 culvert freely passes the design flood event i.e. 0.5% AEP (200-year) plus an allowance for climate change.</p> <p>The proposed extension of this culvert has been assessed to have minor impact on hydraulic performance at the design flood event. The culvert continues to pass the design flood event in free flow with approximately 10mm increase in headwater level. The existing inlet is set back from the carriageway and at an elevation close to existing and proposed A9 road levels; however to pose risk to the A9, headwater levels require to overtop the inlet spill level. Under baseline conditions with the existing culvert there is 1.66m freeboard from the headwater level to the spill level, reducing to 1.65m as a result of the proposed culvert extension.</p> <p>There is no increase in pass forward flow during the design flood event; hence downstream flood risk is not impacted by the proposed scheme.</p>
<p>WF70 Loch Faskally</p> <p>Approximate channel bed width at bridge: 70.5m</p>	<p>Clunie Underbridge</p> <p>Grid Reference: (292801,758578)</p>	<p>Existing underbridge retained, with a new underbridge of similar construction and arrangement constructed immediately adjacent.</p>	<p>Clunie Underbridge, located approximately 450m south of the A924 Pitlochry North Junction, carries the existing A9 carriageway over the C452 Clunie-Foss Road, Loch Faskally and a Core Path. It was constructed circa 1981 and is a three span structure with the superstructure comprising twin steel box girders with splayed legs. The deck girders are composite with a reinforced concrete deck slab. The intermediate supports are footed on reinforced concrete thrust blocks and the end supports comprise reinforced concrete bank seat abutments on spread footings. There are no piers or other bridge footings within Loch Faskally.</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
<p>Flow data:  50% AEP: 571m<sup>3</sup>/s  1% AEP: 1228m<sup>3</sup>/s  0.5% AEP + CC: 1646m<sup>3</sup>/s</p>		<p>Existing structure span: 149.5m  Existing structure piers: None within watercourse.  Existing structure deck height: Approximately 18m over water level.    Proposed new structure span: 149.5m  Proposed new structure piers: None within watercourse.  Proposed new structure deck height: Approximately 18m over water level.</p>	<p><b>Proposed Scheme</b>  The existing bridge can only accommodate a single carriageway. It is proposed to construct a new structure of similar form and outline arrangement on the east, downstream side of the existing bridge to accommodate a new southbound carriageway. As per the existing structure, the new bridge will also have no piers within Loch Faskally.</p> <p><b>Environmental</b>  Based on information from the Tay District Salmon Fisheries Board (TDSFB) and findings of aquatic walkover surveys, fish species of conservation interest expected to be present are Atlantic salmon, brown trout and brook lamprey.</p> <p>There are no in-channel works associated with the proposed structure, and the proposed bridge forms no impediment to river bank mammal habitat connectivity.</p> <p><b>Flood Risk</b>  The proposed bridge is to be constructed out with the design flood event envelope, therefore there is no change to flood risk due to this structure.</p>
<p>WF71</p> <p>Approximate channel bed width at mainline culvert inlet: 0.8m</p> <p>Flow data:  50% AEP: 0.51m<sup>3</sup>/s  1% AEP: 0.66m<sup>3</sup>/s  0.5% AEP + CC: 0.90m<sup>3</sup>/s</p>	<p>71/A9</p> <p>Grid Reference:  (292721,758840)</p>	<p>New upstream diversion and new replacement A9 culvert. Downstream A924 culvert retained unchanged.</p> <p>Existing diameter = 0.59m  Existing length = 70m</p> <p>Proposed diameter = 1.05m  Proposed length = 116m</p>	<p>Watercourse WF71 is culverted beneath the existing A9 via a 0.59m diameter circular concrete culvert. The proposed scheme will result in the A9 footprint at this location being widened on both sides to accommodate the proposed scheme.</p> <p>To accommodate the proposed scheme, a number of alternative watercourse crossing options have been considered, as follows:</p> <ul style="list-style-type: none"> <li>Retain the existing culvert unchanged:  The existing culvert is not long enough to accommodate the proposed scheme; hence this option has been discounted.</li> <li>Extension of the existing culvert:  The existing culvert could be extended to accommodate the proposed scheme, however maintaining the existing culvert gradient will result in the invert level of the new inlet being considerably higher than the upstream channel.</li> <li>Replace the existing culvert:  This is the preferred option. The existing A9 culvert will be replaced to a new alignment.</li> </ul> <p><b>Proposed Scheme</b>  The preferred solution for this crossing taking account of engineering and environmental design criteria is to replace the existing culvert to accommodate the proposed scheme.</p> <p>In addition, as the proposed A9 earthworks will encroach on the existing upstream channel, the existing channel will be diverted to tie-in with the location of the new A9 culvert entrance. The length of channel diversion is approximately 88m.</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
			<p>Downstream, the proposed new culvert will connect with an existing chamber (being retained) which also receives water from an adjacent watercourse. Downstream of the chamber, water will be conveyed via a steeply inclined 2.2m diameter culvert beneath the A924 until its confluence with Loch Faskally.</p> <p>The proposed replacement culvert has been designed to freely pass the 0.5% AEP (200-year) design flow with appropriate freeboard.</p> <p><b>Environmental</b></p> <p>There is no provision for mammal passage within the existing culvert. Ecological assessment has not identified this watercourse as an existing and/or potential mammal corridor; hence the provision for mammal ledges etc. with the existing and extended culvert section is not considered necessary and will have little or no benefit. Also, given the close proximity of the Loch Faskally bridge (Clunie Underbridge), it is considered that mammal passage and habitat connectivity on either side of the A9 at this locale is adequately provided for.</p> <p>No fish species of conservation interest are expected to be present in this watercourse.</p> <p>The provision to accommodate natural river bed deposits to form the culvert invert is not possible at this location, due to the nature of the culvert network and its steepness.</p> <p><b>Flood Risk</b></p> <p>The existing A9 culvert surcharges during the design flood event i.e. 0.5% AEP (200-year) plus an allowance for climate change.</p> <p>The new culvert arrangement will freely pass the design flood event. The head water level at the culvert entrance is predicted to decrease by 2.08m as a result of enlargement of the culvert barrel. The available freeboard between headwater level and the proposed A9 road level is 12.3m, hence the proposed scheme is not considered to be at flood risk during design flood event. As the head water level is contained within the upstream channel, no further mitigation measures are considered necessary.</p> <p>Downstream flood risk is not impacted by the proposed scheme.</p>
<p>WF72</p> <p>Approximate channel bed width at mainline culvert inlet: 0.34m</p> <p>Flow data:  50% AEP: 0.22m<sup>3</sup>/s  1% AEP: 0.28m<sup>3</sup>/s  0.5% AEP + CC: 0.38m<sup>3</sup>/s</p>	<p>72/A9</p> <p>Grid Reference: (292407,759077)</p>	<p>Upstream extension to existing culvert.</p> <p>Existing culvert (to be retained):  Diameter = 1.2m  Length = 139m</p> <p>Extension:  Diameter = 0.75m  Length = 117.8m</p>	<p>Watercourse WF72 is culverted beneath the existing A9 via a 1.2m diameter circular concrete culvert. The proposed scheme will result in the A9 footprint at this location being located offline to the existing A9 alignment and upstream of the existing A9 watercourse crossing location. The existing A9 at this location will be retained and will form part of the new Pitlochry North junction.</p> <p>To accommodate the proposed scheme, a number of alternative watercourse crossing options have been considered, as follows:</p> <ul style="list-style-type: none"> <li>Retain the existing culvert unchanged:  The existing culvert is not long enough to accommodate the proposed scheme.</li> <li>Extension of the existing culvert:  This is the preferred option. The existing culvert is proposed to be extended upstream to accommodate the proposed scheme.</li> <li>Replace the existing culvert:</li> </ul>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
			<p>The existing culvert could be replaced, however this has been considered unnecessary in view of the suitability of the extension option.</p> <p><b>Proposed Scheme</b></p> <p>The preferred solution for this crossing taking account of engineering and environmental design criteria is to extend the existing culvert in an upstream direction to accommodate the proposed scheme.</p> <p>A formal channel feature does not exist upstream of the proposed new A9 footprint, however surface water runoff from the small upstream catchment will be captured at the toe of the proposed scheme earthworks via pre-earthworks drainage ditches and catchpit forming the entrance to the extended culvert. A new section of culvert will cross the A9 and tie in with a new chamber located at the inlet to the existing culvert.</p> <p>The existing downstream culvert will be retained to convey water beneath the Highland Main Line railway and revised Pitlochry North Junction.</p> <p><b>Environmental</b></p> <p>There is no provision for mammal passage in the existing culvert. Ecological assessment in the context of the wider landscape and proximity to the Loch Faskally bridge (Clunie Underbridge) has not identified this watercourse as an existing and/or potential mammal corridor, hence the provision of mammal ledges etc. with the existing and extended culvert section is not considered necessary.</p> <p>No fish species of conservation interest are expected to be present in this watercourse.</p> <p>The provision to accommodate natural river bed deposits to form the culvert invert is not possible at this location, due to the nature of the culvert network and its steepness.</p> <p><b>Flood Risk</b></p> <p>The existing culvert freely passes the design flood event i.e. 0.5% AEP (200-year) plus an allowance for climate change, and the existing A9 is not at risk of overtopping.</p> <p>Similarly, the new culvert arrangement will freely pass the design flood event. The head water level is predicted to remain 3.4m below the proposed road level; hence the proposed scheme is not considered to be at flood risk during the design flood event.</p> <p>Upstream headwater levels will be contained within the pre-earthworks drainage channel hence there is no upstream mitigation necessary.</p> <p>Downstream flood risk is not impacted by the proposed scheme.</p>
<p>WF74</p> <p>Approximate channel bed width at mainline culvert inlet: 0.8m</p> <p>Flow data: 50% AEP: 0.25m<sup>3</sup>/s</p>	<p>74/A9</p> <p>Grid Reference (existing A9 crossing): (292165,759426)</p>	<p>New cascade on WF76.</p> <p>New culvert network upstream of existing A9 culvert.</p> <p>Retention of the existing A9 culvert.</p>	<p>Watercourses WF74 and 76 (of which the latter comprises two tributaries) form a network of channels upstream of the existing A9. It appears that both tributaries of WF76 have been previously diverted, most likely during construction of the existing A9, to be parallel to the road prior to combining with WF74 and then a single culvert beneath the existing A9 Tigh na Beithe Rail Underbridge. The alignment of the downstream culvert is not clear however it appears to be a 1.75m diameter circular concrete culvert. The proposed scheme will result in the A9 footprint at this location being located offline, with the Tigh na Beithe Rail Underbridge retained and carrying part of the revised Pitlochry North Junction. The proposed new A9 will be located in an earthwork cut formed in the adjacent hillside, and the footprint of the proposed scheme and junction will cross the existing channels of WF74 and WF76.</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
1% AEP: 0.31m <sup>3</sup> /s 0.5% AEP + CC: 0.44m <sup>3</sup> /s		Existing section of culvert (to be retained): Diameter = 1.75m Length = 121m	To accommodate the proposed scheme, a number of alternative watercourse crossing options have been considered, as follows:
WF76  Approximate channel bed width at mainline culvert inlet: 1.0m  Flow data: 50% AEP: 1.71m <sup>3</sup> /s 1% AEP: 2.17m <sup>3</sup> /s 0.5% AEP + CC: 3.02m <sup>3</sup> /s	76/A9  Grid Reference (existing A9 crossing): (292165,759426)	New sections of culvert: Diameters: 0.75m (Culvert 74/A9) 1.5m (Culvert 76/A9) 1.0m (Culvert 76A/A9)	<ul style="list-style-type: none"> <li>Retain the existing culvert unchanged: The existing culvert system is not long enough to accommodate the proposed scheme.</li> <li>Extension of the existing culvert: This is the preferred option. The existing culvert system will be extended upstream to accommodate the proposed scheme.</li> <li>Replace the existing culvert: The existing culvert could be replaced, however, this has been considered unnecessary in view of the suitability of the extension option.</li> </ul>
Tributary of WF76  Approximate channel bed width at mainline culvert inlet: 1.0m  Flow data: 50% AEP: 0.49m <sup>3</sup> /s 1% AEP: 0.63m <sup>3</sup> /s 0.5% AEP + CC: 0.87m <sup>3</sup> /s	76A/A9  Grid Reference (existing A9 crossing): (292165,759426)	Proposed lengths (excluding retained section): 113m (Culvert 74/A9) 91m (Culvert 76/A9) 74m (Culvert 76A/A9)	<p><b>Proposed Scheme</b></p> <p>The preferred solution for this crossing taking account of engineering and environmental design criteria is to extend the existing culvert system upstream by means of a new upstream culverts network to transfer flows across the footprint of the proposed scheme. The existing layout and connectivity of watercourses will be maintained.</p> <p>Watercourses WF74 and a tributary of watercourse WF76 only extend as far upstream as the proposed A9 footprint. Upstream of this it is proposed that surface water runoff is collected by means of pre-earthworks drainage ditches located at the boundary of the proposed scheme earthworks and conveyed to the culvert entrance. Watercourse WF76 is channelised upstream of the proposed scheme, and a new cascade will be required to lower the watercourse down the cut slope upstream of the proposed A9.</p> <p>New sections of culvert will cross beneath the A9 and will combine flows at a new chamber formed at the inlet to the existing culvert. The existing 1.75m diameter culvert will be retained and serve to pass flows beneath the Highland Main Line railway and revised Pitlochry North Junction. A short (approximately 6m) upstream extension of the existing 1.75m diameter culvert is proposed in order to move the inlet chamber clear of the carriageway of the Pitlochry North Junction to a location in the verge.</p> <p><b>Environmental</b></p> <p>There is no provision for mammal passage in the existing culvert.</p> <p>The scheme design has considered the provision of a new mammal crossing at this location; however due to the constraints posed by the Highland Main Line and associated A9 Tigh Na Beithe Underbridge immediately downstream of the proposed A9 carriageway, a suitably sized culvert with sufficient dimensions to allow mammal passage compliant with DMRB HA81/99 is not possible. Consideration has also been given to the provision of a dry mammal underpass in this locality; however, it was not possible to align such a structure under the footprint of the proposed scheme due to junction slip road levels. An associated proposal whereby the underpass crossed only the mainline carriageways was discounted due to the potential risk to both road users and mammals in the event of collision.</p> <p>Given that the ecological assessment has not identified this watercourse as an existing and/or potential mammal corridor and there is a generally low record of road kills in this area; no further provision is considered necessary or beneficial.</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
			<p>No fish species of conservation concern are expected to be present in this watercourse.</p> <p>The provision to accommodate natural river bed deposits to form the culvert invert is not possible at this location, due to the nature of the culvert network and its steepness.</p> <p><b>Flood Risk</b></p> <p>Due to the hydraulic complexity, the culverted system at this location has been subjected to numerical modelling. Further detail is provided in Appendix A11.3 (Flood Risk Assessment), however in summary the existing culvert system carrying the combined flows from all three watercourses/tributaries across the A9 freely passes the design flood event i.e. 0.5%AEP (200-year) plus an allowance for climate change. Consequently, the existing A9 is not considered to be flood risk during the design flood event.</p> <p>The new culvert arrangement will also freely pass the design flood event. The head water levels upstream of the proposed scheme are predicted to remain below the proposed A9 slip road levels (by 2.31m in the case of watercourse WF74; 4.59m in the case of WF76 and 2.73m in the case of the northern tributary of WF76); hence the proposed A9 will not be at risk of overtopping during the design flood event.</p> <p>Upstream headwater levels will be contained within the upstream channels hence there is no upstream mitigation necessary.</p> <p>Downstream flood risk is not impacted by the proposed scheme.</p>
<p>WF77</p> <p>Approximate channel bed width at mainline culvert inlet: 2.8m</p> <p>Flow data:  50% AEP: 1.34 m<sup>3</sup>/s  1% AEP: 1.70 m<sup>3</sup>/s  0.5% AEP + CC: 2.33 m<sup>3</sup>/s</p>	<p>77/A9</p> <p>Grid Reference: (291680,760585)</p>	<p>Upstream extension to existing A9 culvert</p> <p>Existing diameter = 1.75m  Existing length = 160m</p> <p>Proposed diameter = 1.75m  Proposed length = 184m</p>	<p>Watercourse WF77 is culverted beneath the existing A9 via a 1.75m diameter concrete culvert. The proposed scheme will result in the A9 footprint at this location being widened on the upstream side to accommodate a new access track.</p> <p>To accommodate the proposed scheme, a number of alternative watercourse crossing options have been considered, as follows:</p> <ul style="list-style-type: none"> <li>Retain the existing culvert unchanged:  The existing culvert is not long enough to accommodate the proposed scheme; hence this option has been discounted.</li> <li>Extension of the existing culvert:  This is the preferred option. The existing culvert is proposed to be extended upstream to accommodate the proposed Scheme.</li> <li>Replace the existing culvert:  The existing culvert could be replaced, however, this has been considered unnecessary in view of the suitability of the extension option.</li> </ul> <p><b>Proposed Scheme</b></p> <p>The preferred solution for this crossing taking account of engineering and environmental design criteria is to extend the existing culvert in an upstream direction to accommodate the proposed scheme.</p> <p>A new cascade feature will be required to lower the watercourse to a new culvert inlet upstream of the proposed new access track. However, to minimise the extent of the cascade, it is proposed to introduce a change of</p>

Waterbody	Culvert number & Location	Construction detail	Justifications for engineering solution
			<p>gradient within the culvert between the track and the A9 mainline. This will serve to reduce the depth of the culvert at its inlet, and hence reduce the extent of the engineered cascade.</p> <p><b>Environmental</b></p> <p>There is no provision for mammal passage in the existing culvert. Ecological assessment has not identified this watercourse as an existing mammal corridor; hence the provision of mammal passage at this location is not considered a priority.</p> <p>No fish species of conservation interest are expected to present in this watercourse.</p> <p>The provision to accommodate natural river bed deposits to form the culvert invert by oversizing the proposed culvert is not possible at this location, given the need to match the geometry of the existing culvert.</p> <p><b>Flood Risk</b></p> <p>The existing culvert freely passes the design flood event i.e. 0.5% AEP (200-year) plus an allowance for climate change, and consequently the existing A9 is not considered to be at flood risk during the design flood event.</p> <p>Similarly, the proposed extended culvert will also freely pass the design flood event with upstream water level contain in channel, hence the proposed scheme is not considered to be at flood risk during the design flood event. Downstream flood risk is not impacted by the proposed scheme.</p>

## 4 Photographs

4.1.1 Photographs of each of the culverts and watercourses are provided in Table 2. Typically where available, both upstream and downstream photographs are provided to illustrate smaller structures. Larger structures e.g. bridges typically are provided with a single representative view.

**Table 2: Watercourse photographs**

	
<p><b>Photograph 1</b></p> <p>WF59 Existing A9 culvert outlet and downstream channel</p>	<p><b>Photograph 2</b></p> <p>WF59 Existing A9 culvert inlet and upstream channel</p>





**Photograph 3**

WF60 Existing A9 culvert outlet and downstream channel



**Photograph 4**

WF60 Existing A9 culvert inlet and upstream channel



**Photograph 5**

WF61 Existing A9 culvert outlet and downstream channel



**Photograph 6**

WF61 Existing A9 culvert inlet



**Photograph 7**

WF70 Existing A9 River Tummel Underbridge



**Photograph 8**

WF63 Existing culvert outlet



**Photograph 9**

WF63 Existing culvert inlet and upstream channel



**Photograph 10**

WF64 Existing A9 culvert outlet and downstream channel



**Photograph 11**

WF64 Existing A9 culvert inlet and upstream channel



**Photograph 12**

WF65 Existing A9 culvert outlet



**Photograph 13**

WF65 Existing A9 culvert inlet and upstream cascade



**Photograph 14**

WF66 Existing A9 culvert outlet and downstream channel



**Photograph 15**

WF66 Existing A9 culvert inlet and upstream cascade



**Photograph 16**

WF67 Existing A9 culvert outlet



**Photograph 17**

WF67 Existing A9 culvert inlet





**Photograph 18**

WF68 Existing A9 culvert outlet and downstream channel



**Photograph 19**

WF68 Existing A9 culvert inlet



**Photograph 20**

WF69 Existing A9 culvert outlet and downstream channel



**Photograph 21**

WF69 Existing A9 culvert inlet and upstream cascade



**Photograph 22**

WF75 Existing A9 Clunie Underbridge (Loch Faskally)

(no image available)



**Photograph 23**

WF71 Existing A9 culvert outlet

**Photograph 24**

WF71 Existing A9 culvert inlet and upstream channel



**Photograph 25**

WF72 Existing A9 culvert outlet and downstream channel



**Photograph 26**

WF72 Existing A9 culvert inlet and upstream channel



**Photograph 27**

WF74 Existing A9 culvert outlet



**Photograph 28**

WF74 Existing A9 culvert inlet and upstream channel



**Photograph 29**

WF77 Existing A9 culvert outlet



**Photograph 30**

WF77 Existing A9 culvert inlet and upstream channel

## **5 Drawings**

- 5.1.1 Engineering sketches (and where available, drawings) are provided for each watercourse crossing. Sketches outlining the proposed arrangements are provided for the numerous smaller watercourse crossings which are proposed to be replaced or extended to accommodate the widened A9 footprint. General Arrangement drawings of the larger structures are provided, which present a greater level of detail for these structures.

## **6 References**

CIRIA (2010). Culvert Design and Operation Guide; Publication C689.

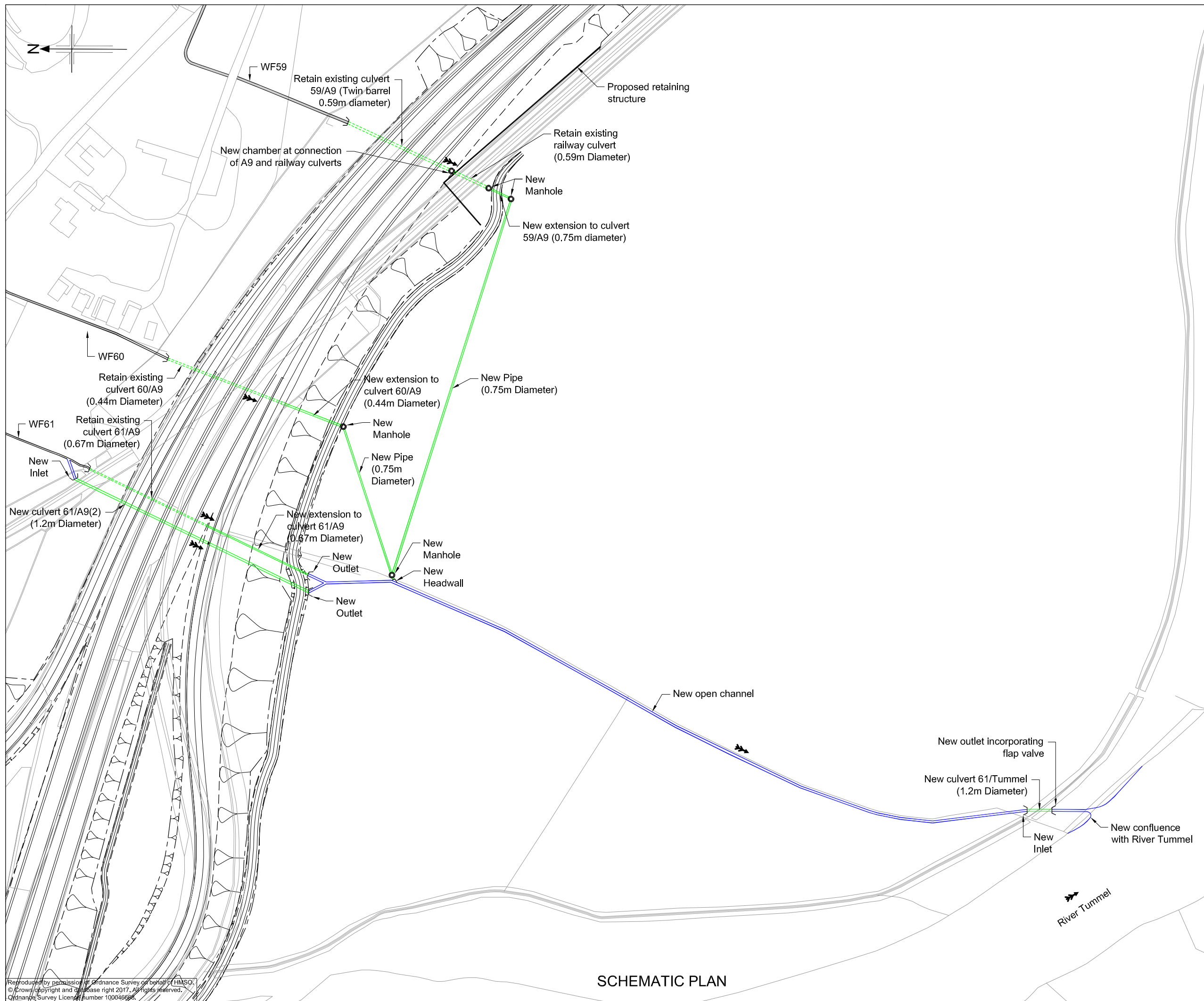
SEPA (2010). Engineering in the Water Environment: Good Practice Guide. River Crossings.

Highways Agency et al. (2001). Design Manual for Roads and Bridges; Volume 4, Section 2, Part 7, HA81/99.

Highways Agency et al. (2004). Design Manual for Roads and Bridges (DMRB); Volume 4, Section 2, Part 7, HA107/04.

Highways Agency et al. (2012). Design Manual for Roads and Bridges; Volume 3, Section 4, Part 21, BD97/12.





- Legend:**
- New culvert/extension
  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - Inlet/outlet headwall (retained)
  - Pre-earthworks drain and outfall
  - Access chamber
  - Flow direction
  - IL

- Notes:**
1. All dimensions are in meters unless noted otherwise.
  2. All levels are in meters above ordnance datum.
  3. All details shown on this drawing are indicative only and subject to development at detailed design.
  4. This drawing shall be read in conjunction with the 'Watercourse Crossing report' only and not in isolation.
  5. All 'new' and 'extended' culverts have been designed in accordance with the relevant provisions of DMRB.
  6. Where required 'scour protection measures' shall be provided within the zone indicated on the drawing. The nature and the extent of the scour protection measure will be further developed at detailed design stage in accordance with the relevant provisions of DMRB, taking into account flow hydraulics, channel geometry and channel morphology.
  7. Where shown culverts shall be 'embedded' with natural river deposits to the depth shown.
  8. Where shown 'cascades' are required to safely convey the design flood event (0.5% AEP (200-year) plus allowance for climate change). The cascade geometry shown on the drawing is indicative only and will be subject to further development at detailed design stage. The nature of the cascade will take one of the following forms,
    - Bedrock channel cascade.
    - Natural cascade with natural gravels, cobbles and rock forming individual steps.
    - Concrete cascade with stone pitching.
 The nature of the cascade will be determined at the detailed design stage taking into account hydraulic requirements, topography and nature of the underlying strata and its susceptibility to fluvial erosion.
  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	29/03/17	FOR INFORMATION	CON	JW	LMS	

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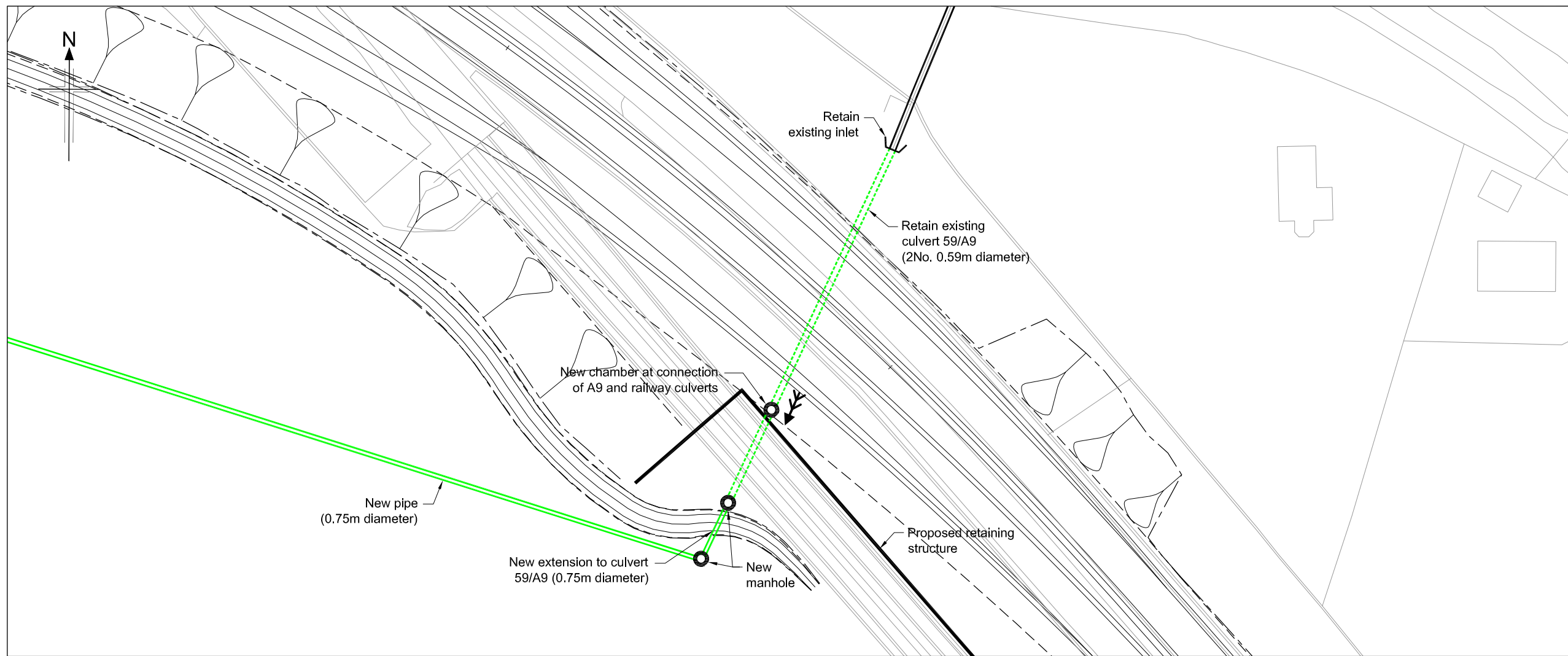
**PITLOCHRY TO KILLIECRANKIE  
 PROPOSED MODIFICATIONS  
 TO WATERCOURSES  
 WF59, WF60 & WF61**

Drawing status: **FOR INFORMATION**  
 Scale: **NTS @ A1** **DO NOT SCALE**  
 Jacobs No. **B2140004**

Drawing number: **Figure A.11.8.1** Rev **0**

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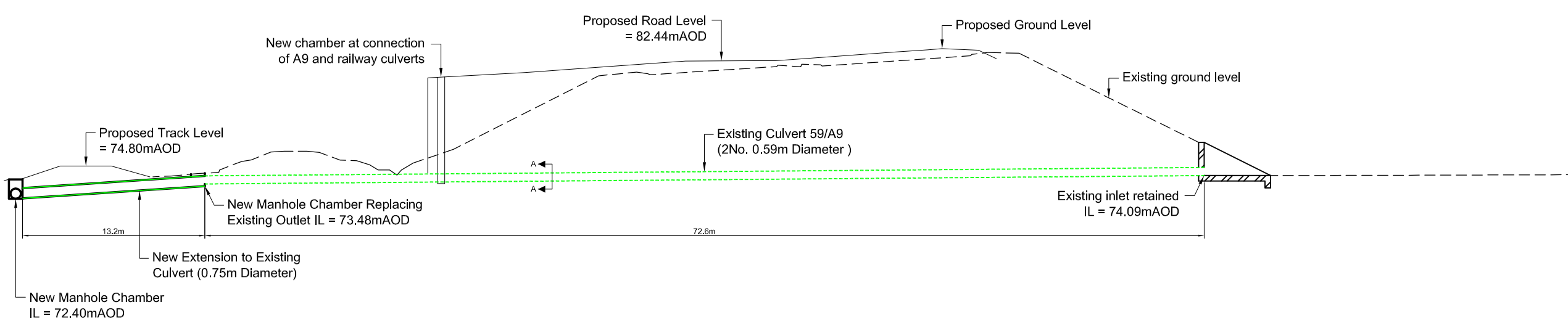
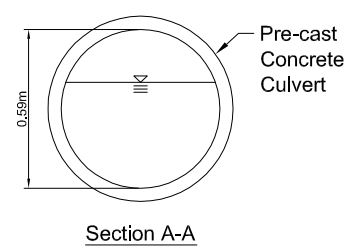
**SCHEMATIC PLAN**



- Legend:**
- New culvert/extension
  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - - - Inlet/outlet headwall (retained)
  - Pre-earthworks drain and outfall
  - Access chamber
  - Flow direction
  - IL Invert Level

- Notes:**
1. All dimensions are in meters unless noted otherwise.
  2. All levels are in meters above ordnance datum.
  3. All details shown on this drawing are indicative only and subject to development at detailed design.
  4. This drawing shall be read in conjunction with the 'Watercourse Crossing report' only and not in isolation.
  5. All 'new' and 'extended' culverts have been designed in accordance with the relevant provisions of DMRB.
  6. Where required 'scour protection measures' shall be provided within the zone indicated on the drawing. The nature and the extent of the scour protection measure will be further developed at detailed design stage in accordance with the relevant provisions of DMRB, taking into account flow hydraulics, channel geometry and channel morphology.
  7. Where shown culverts shall be 'embedded' with natural river deposits to the depth shown.
  8. Where shown 'cascades' are required to safely convey the design flood event (0.5% AEP (200-year) plus allowance for climate change). The cascade geometry shown on the drawing is indicative only and will be subject to further development at detailed design stage. The nature of the cascade will take one of the following forms,
    - Bedrock channel cascade.
    - Natural cascade with natural gravels, cobbles and rock forming individual steps.
    - Concrete cascade with stone pitching.
 The nature of the cascade will be determined at the detailed design stage taking into account hydraulic requirements, topography and nature of the underlying strata and its susceptibility to fluvial erosion.
  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.

**SCHEMATIC PLAN**



**WATERCOURSE 59 LONGSECTION THROUGH A9 AND RAIL CULVERTS**

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Project: **A9 DUALING**  
 PERTH TO INVERNESS  
 Pìobachry ce Kìlliecrankie

Drawing title:  
**PITLOCHRY TO KILLIECRANKIE PROPOSED MODIFICATIONS TO CULVERT ON WATERCOURSE WF59**

Drawing status:  
**FOR INFORMATION**

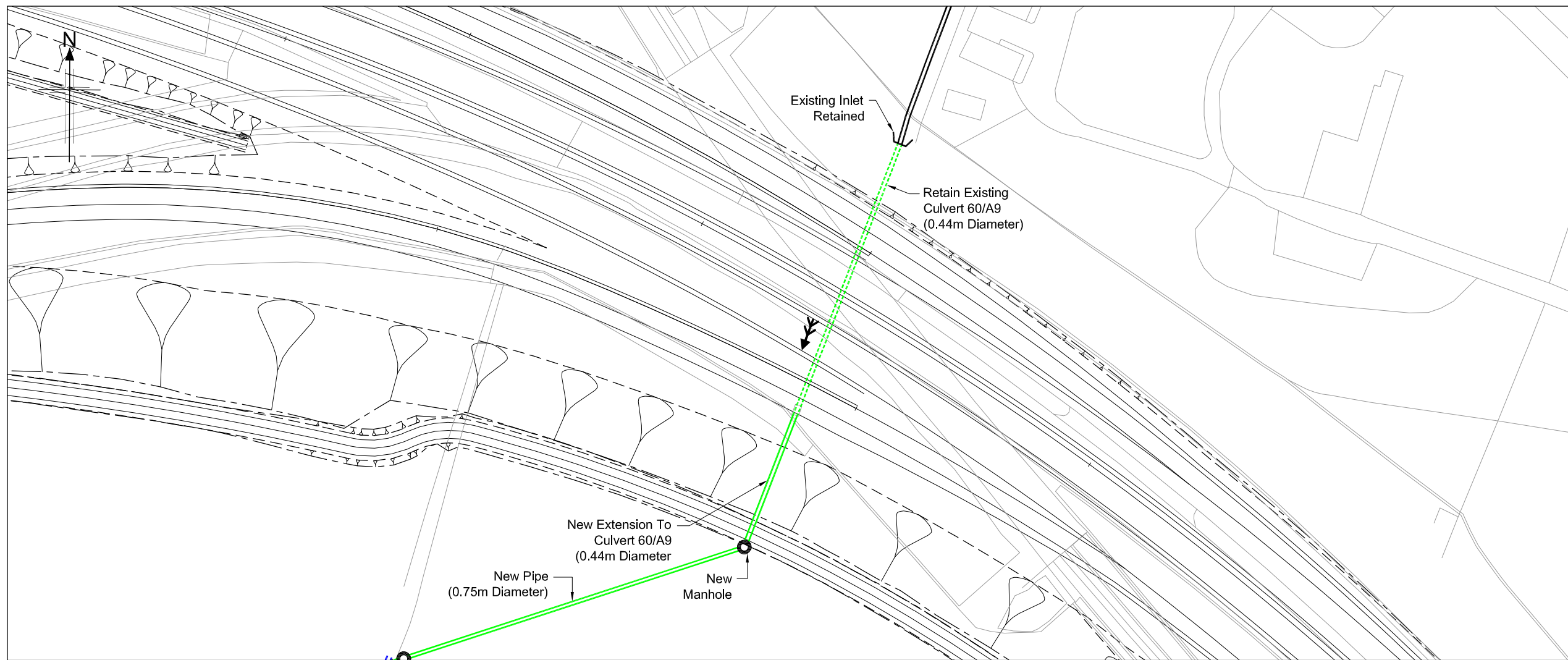
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Jacobs No.: **B2140004**

Drawing number:  
**Figure A.11.8.2**

Rev: **0**

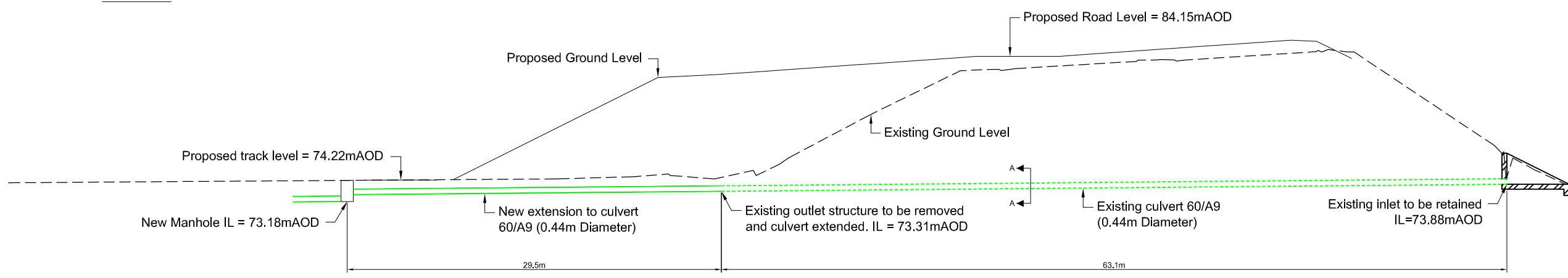
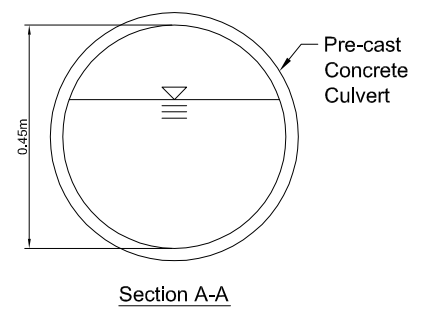
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- Legend:**
- New culvert/extension
  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - - - Inlet/outlet headwall (retained)
  - Pre-earthworks drain and outfall
  - Access chamber
  - Flow direction
  - IL Invert Level

- Notes:**
1. All dimensions are in meters unless noted otherwise.
  2. All levels are in meters above ordnance datum.
  3. All details shown on this drawing are indicative only and subject to development at detailed design.
  4. This drawing shall be read in conjunction with the 'Watercourse Crossing report' only and not in isolation.
  5. All 'new' and 'extended' culverts have been designed in accordance with the relevant provisions of DMRB.
  6. Where required 'scour protection measures' shall be provided within the zone indicated on the drawing. The nature and the extent of the scour protection measure will be further developed at detailed design stage in accordance with the relevant provisions of DMRB, taking into account flow hydraulics, channel geometry and channel morphology.
  7. Where shown culverts shall be 'embedded' with natural river deposits to the depth shown.
  8. Where shown 'cascades' are required to safely convey the design flood event (0.5% AEP (200-year) plus allowance for climate change). The cascade geometry shown on the drawing is indicative only and will be subject to further development at detailed design stage. The nature of the cascade will take one of the following forms,
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    - Concrete cascade with stone pitching.
 The nature of the cascade will be determined at the detailed design stage taking into account hydraulic requirements, topography and nature of the underlying strata and its susceptibility to fluvial erosion.
  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.

**SCHEMATIC PLAN**



**WATERCOURSE 60 LONGSECTION THROUGH A9 AND RAIL CULVERTS**

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	25/01/17	FOR INFORMATION	COR	JW	LMG	



**PITLOCHRY TO KILLIECRANKIE PROPOSED MODIFICATIONS TO CULVERT ON WATERCOURSE WF60**

Drawing status: **FOR INFORMATION**

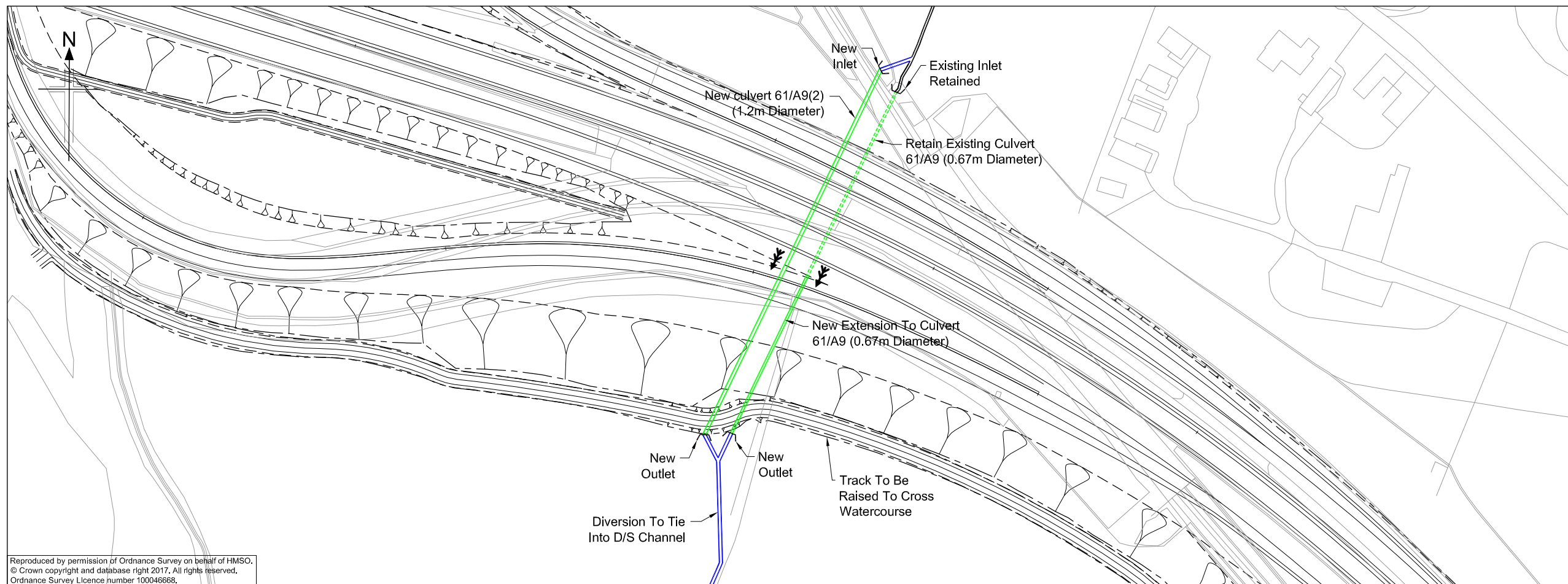
Scale: **NTS @ A1**      **DO NOT SCALE**

Jacobs No. **B2140004**

Drawing number **Figure A.11.8.3**      Rev **0**

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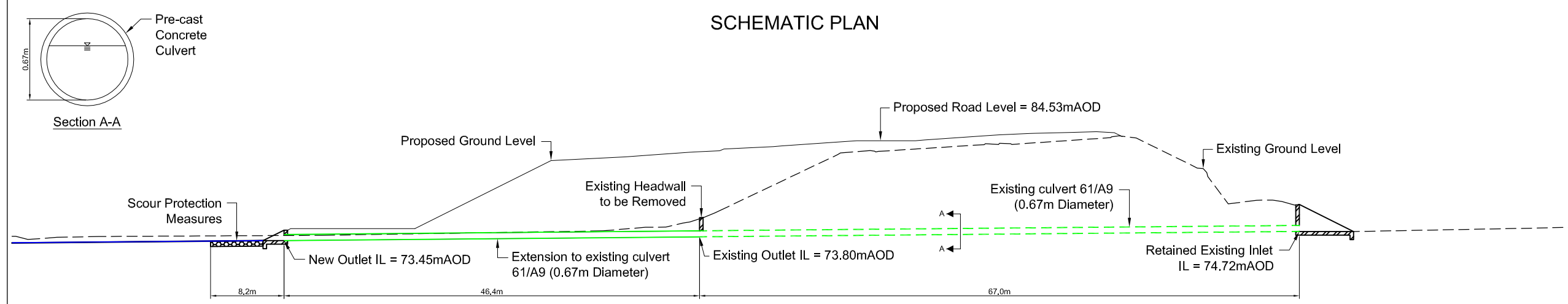


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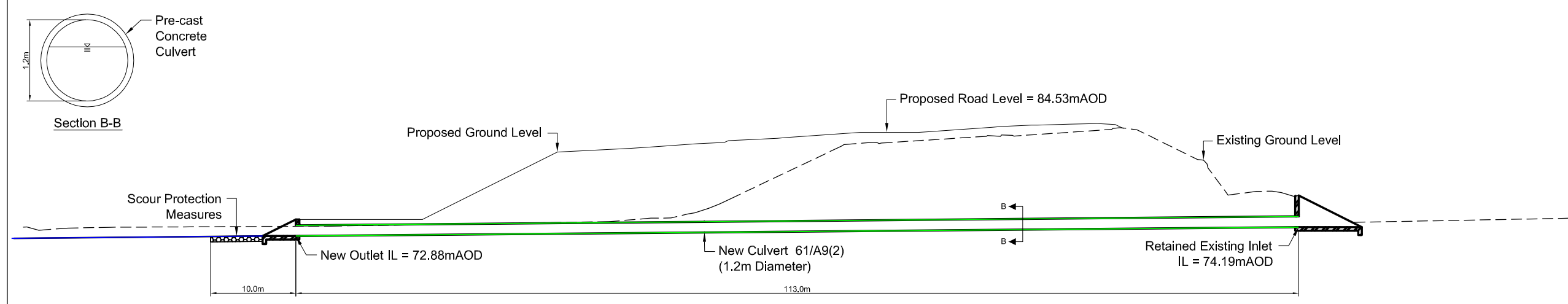
- Legend:**
- New culvert/extension
  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - - - Inlet/outlet headwall (retained)
  - Pre-earthworks drain and outfall
  - Access chamber
  - Flow direction
  - IL Invert Level

- Notes:**
1. All dimensions are in meters unless noted otherwise.
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  4. This drawing shall be read in conjunction with the 'Watercourse Crossing report' only and not in isolation.
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  6. Where required 'scour protection measures' shall be provided within the zone indicated on the drawing. The nature and the extent of the scour protection measure will be further developed at detailed design stage in accordance with the relevant provisions of DMRB, taking into account flow hydraulics, channel geometry and channel morphology.
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  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.

**SCHEMATIC PLAN**



**WATERCOURSE 61 LONGSECTION THROUGH EXTENDED EXISTING A9 AND RAIL CULVERT**



**WATERCOURSE 61 LONGSECTION THROUGH NEW SUPPLEMENTARY CULVERT**

Rev	Rev. Date	FOR INFORMATION	CON	JW	LMG
0	23/01/17	FOR INFORMATION			

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Client  
**TRANSPORT SCOTLAND**  
COMHAIL ALBA

Project  
**A9 DUALING**  
PERTH TO INVERNESS  
Pìobachry ce Kìlliecrankie

Drawing title  
**PITLOCHRY TO KILLIECRANKIE PROPOSED MODIFICATIONS TO CULVERT ON WATERCOURSE WF61**

Drawing status  
**FOR INFORMATION**

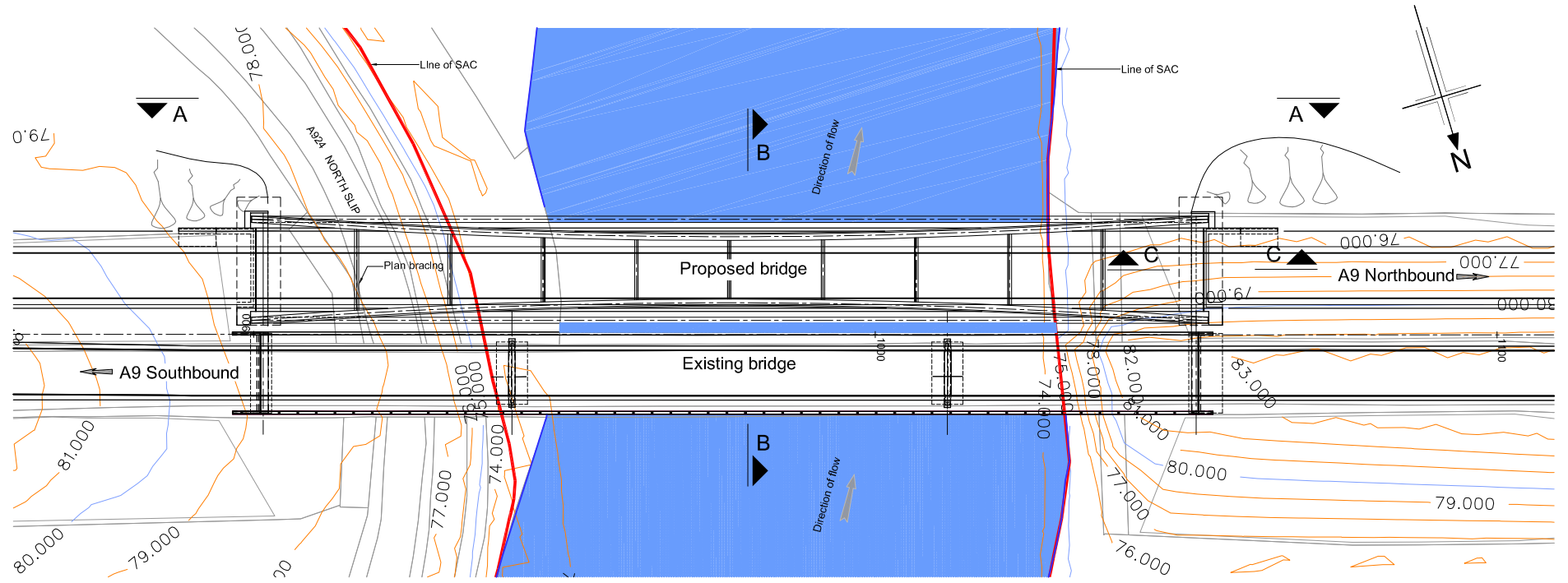
Scale  
NTS @ A1 DO NOT SCALE

Jacobs No.  
B2140004

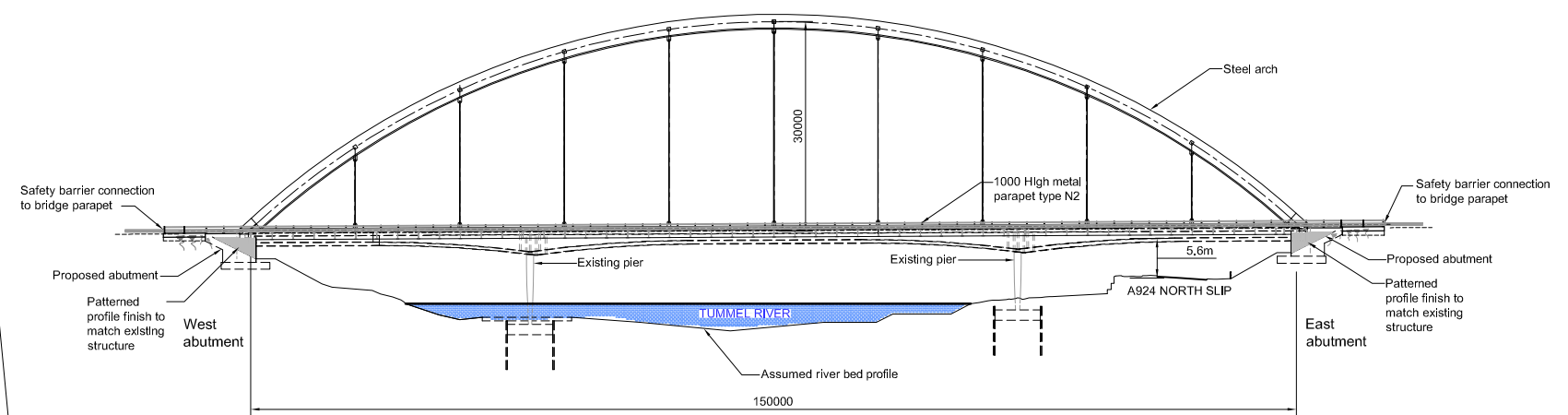
Drawing number  
**Figure A.11.8.4**

Rev  
**0**

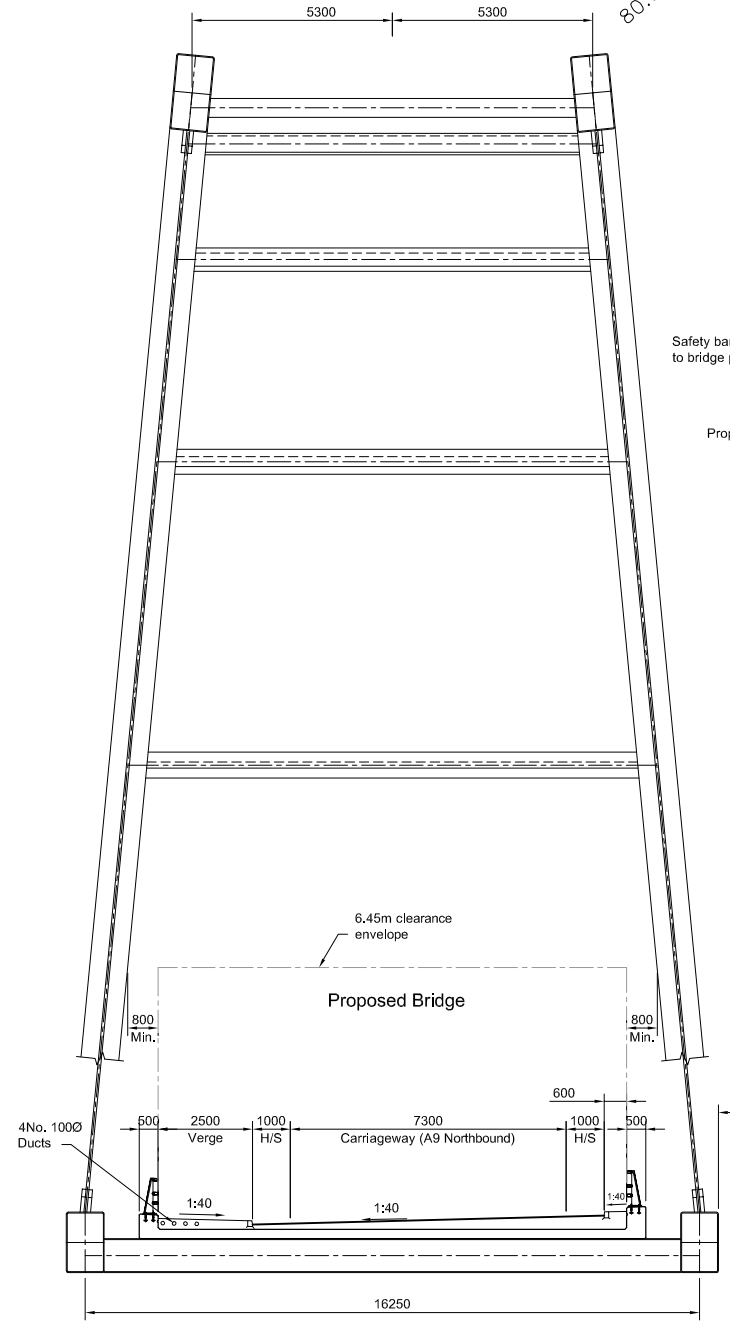
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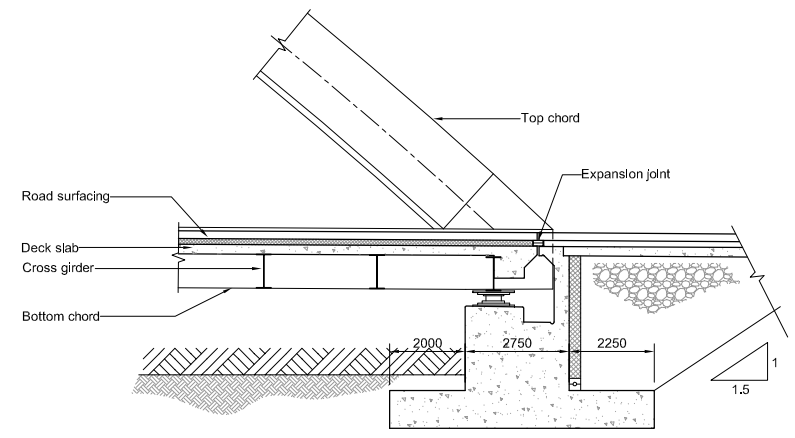
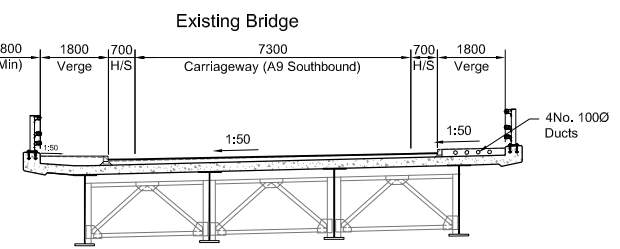
**PLAN**  
SCALE 1 : 500



**ELEVATION A - A**  
SCALE 1 : 500



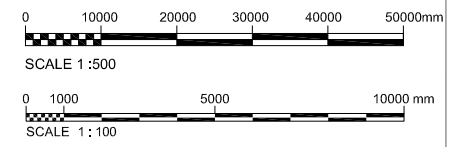
**SECTION B - B**  
SCALE 1 : 100



**SECTION C - C**  
SCALE 1 : 100

- Notes**
- All dimensions are in millimetres unless noted otherwise.
  - All levels in metres Above Ordnance Datum.
  - All chalmages are in metres.
  - All exposed arrises to have 25x25 chamfers unless noted otherwise.
  - All details shown on this drawing are indicative only and subject to development.
  - Do not scale from this drawing.
  - Concrete finishes :
    - (F) - Formed surfaces.
    - (U) - Unformed surfaces.
  - Concrete protection :
    - (B) - Buried surfaces.
    - (W) - Spray applied waterproofing.
    - (S) - Surface impregnation

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :	
<b>CONSTRUCTION</b>	- None
<b>MAINTENANCE / CLEANING</b>	- None
<b>DECOMMISSIONING / DEMOLITION</b>	- None
It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement	



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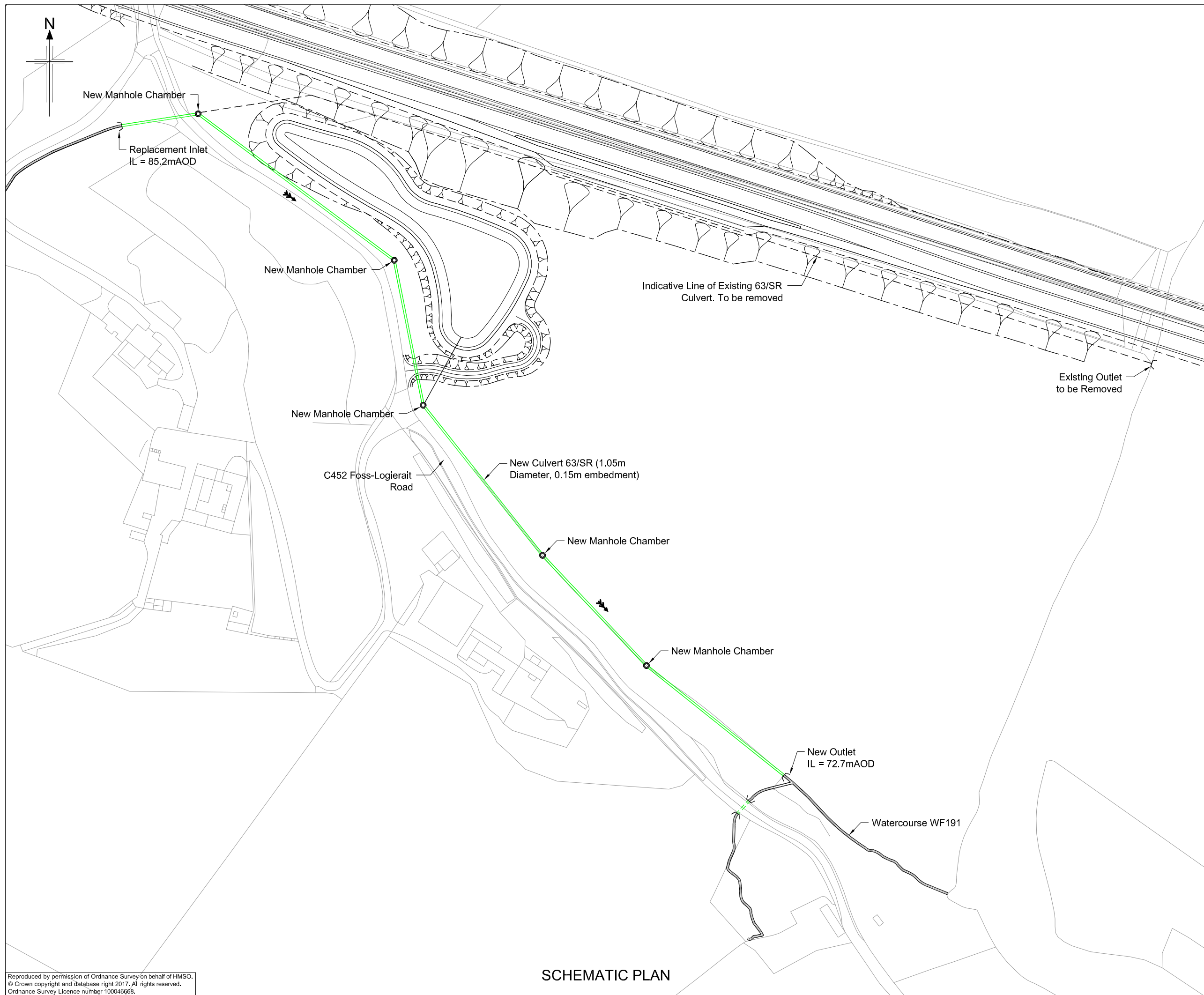
P2	27 Apr 2017	DESIGN FIX 3a - ISSUED FOR REVIEW	GPA	PG	MM	
P1	19 Jan 2017	DESIGN FIX 3 - ISSUED FOR REVIEW	GPA	PG	MM	
Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Appr'd



**DMRB STAGE 3  
PITLOCHRY TO KILLIECRANKIE  
TUMMEL UNDERBRIDGE  
GENERAL ARRANGEMENT**

Drawing status	PRELIMINARY	
Scale	AS SHOWN @ A1	DO NOT SCALE
JACOBS No.	B2140004	
Drawing number	Figure A.11.8.5	Rev P2

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- Legend:**
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  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - - - Inlet/outlet headwall (retained)
  - Pre-earthworks drain and outfall
  - Access chamber
  - ← Flow direction
  - IL Invert Level

- Notes:**
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Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	30/01/17	FOR INFORMATION	CON	JW	LMG	

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Client



TRANSPORT SCOTLAND  
 CON-DHAL ALBA

Project



A9  
 DUALLING  
 PERTH TO INVERNESS  
 Pìobachry ce Kìlliecrankie

Drawing title

**PITLOCHRY TO KILLIECRANKIE  
 PROPOSED MODIFICATIONS  
 TO CULVERT ON  
 WATERCOURSE WF63**

Drawing status

**FOR INFORMATION**

Scale

NTS @ A1      DO NOT SCALE

Jacobs No.

B2140004

Drawing number

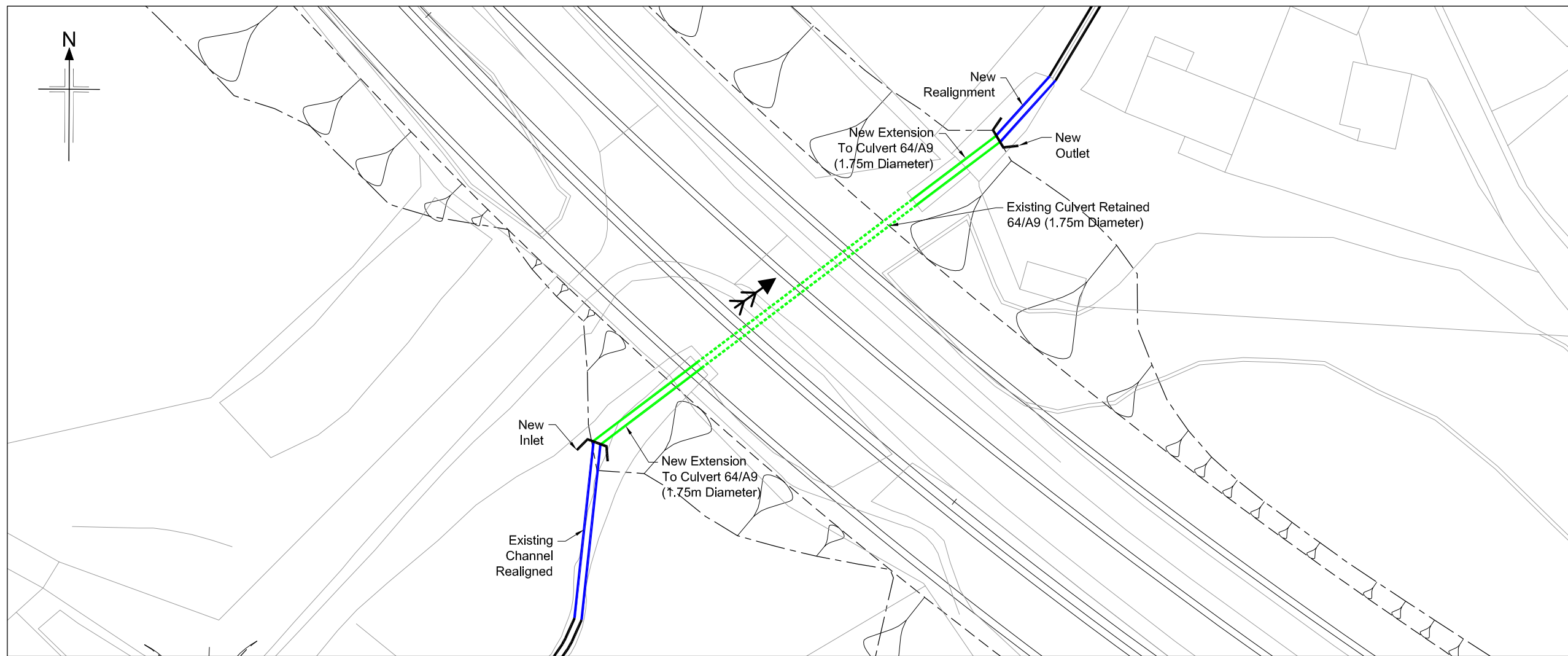
**Figure A.11.8.6**

Rev

0

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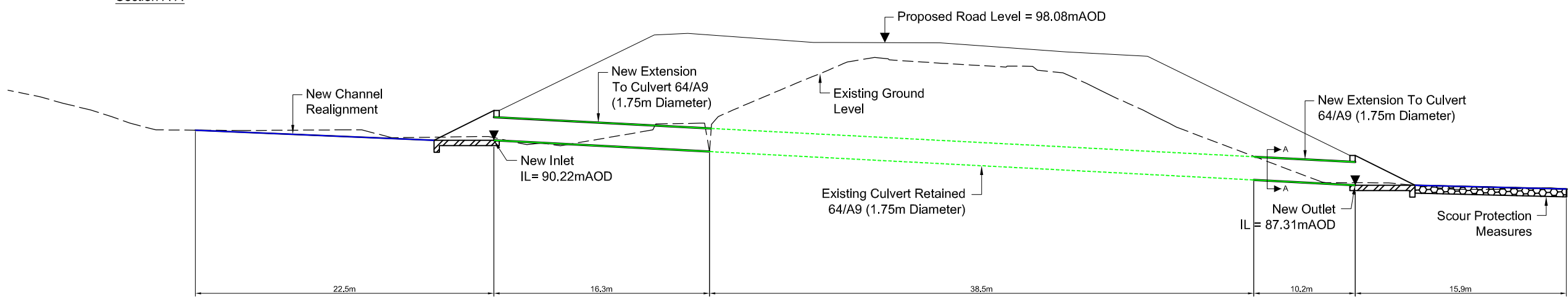
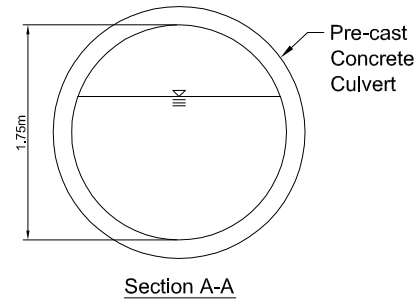
**SCHEMATIC PLAN**



- Legend:**
- New culvert/extension
  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - Inlet/outlet headwall (retained)
  - Pre-earthworks drain and outfall
  - Access chamber
  - Flow direction
  - IL

- Notes:**
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  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.

**SCHEMATIC PLAN**



**WATERCOURSE 64 LONGSECTION**

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	25/01/17	FOR INFORMATION	COR	JW	LMG	

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**PITLOCHRY TO KILLIECRANKIE  
 PROPOSED MODIFICATIONS  
 TO CULVERT ON  
 WATERCOURSE WF64**

Drawing status: **FOR INFORMATION**

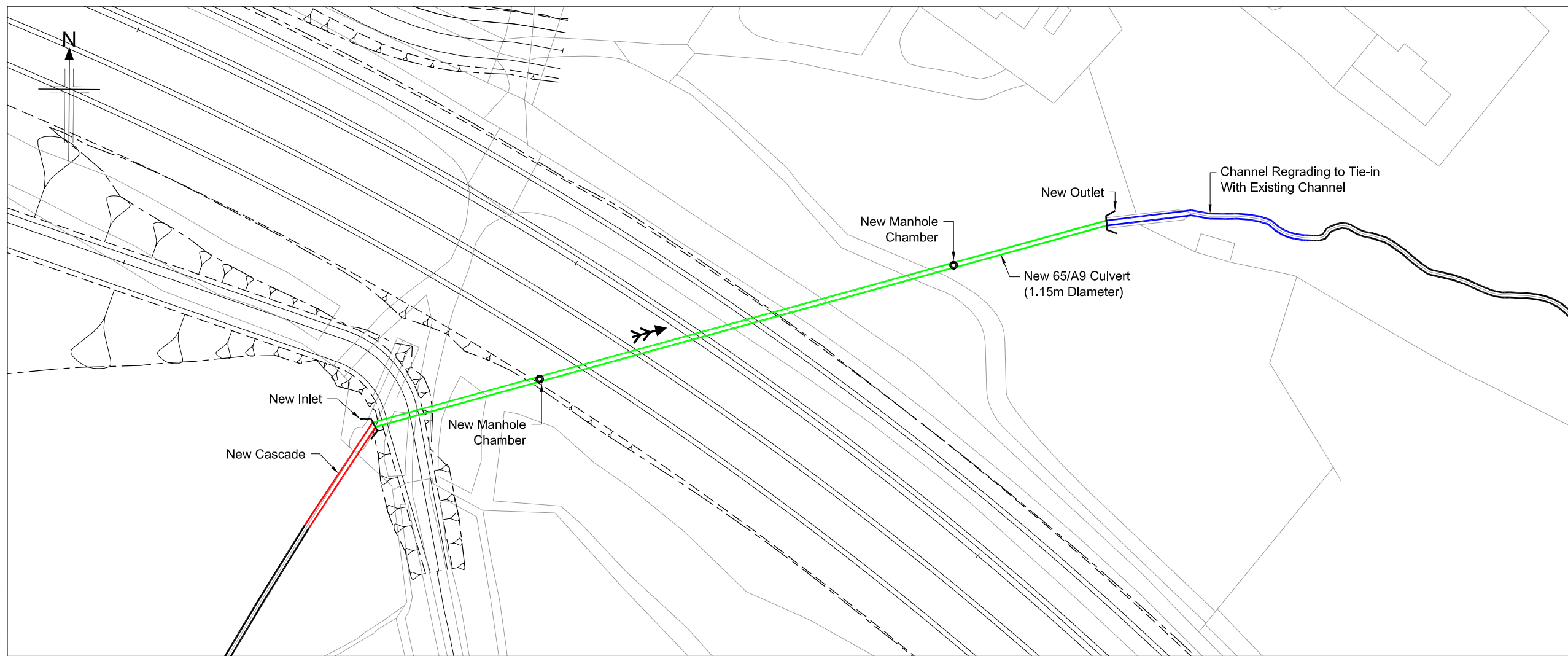
Scale: **NTS @ A1** **DO NOT SCALE**

Jacobs No. **B2140004**

Drawing number: **Figure A.11.8.7** Rev **0**

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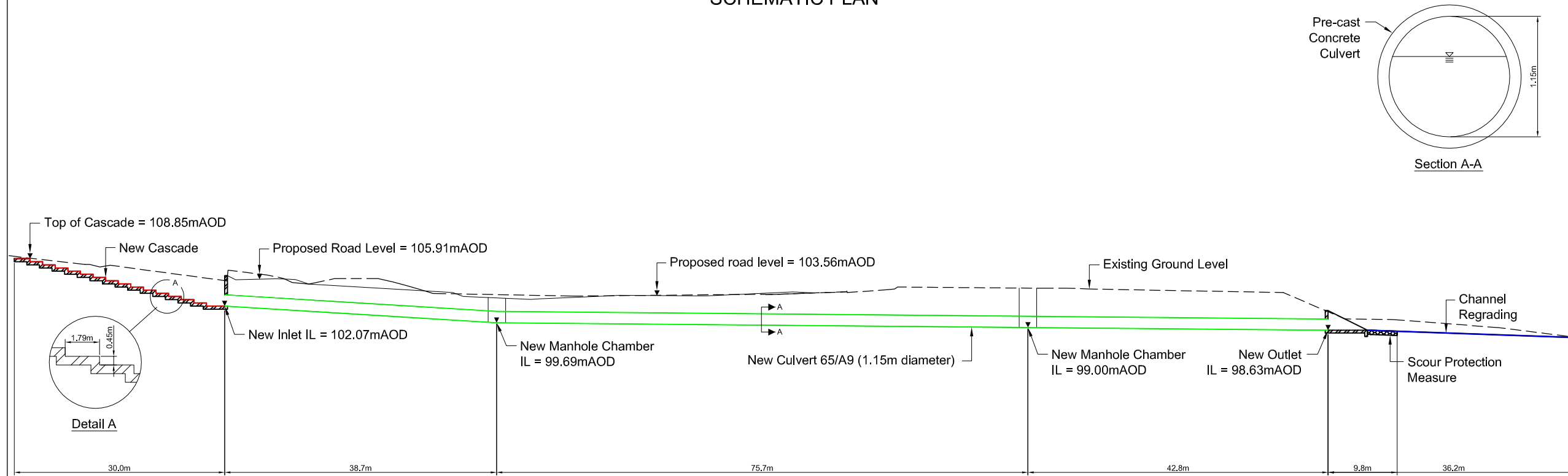
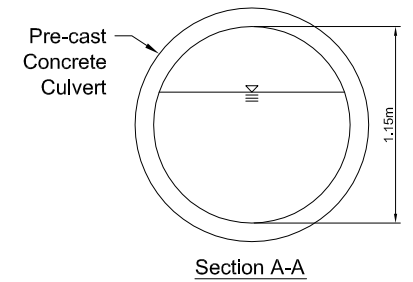
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- Legend:**
- New culvert/extension
  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - - - Inlet/outlet headwall (retained)
  - Pre-earthworks drain and outfall
  - Access chamber
  - Flow direction
  - IL Invert Level

- Notes:**
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  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.

**SCHEMATIC PLAN**



**WATERCOURSE 65 LONGSECTION**

Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd
0	23/01/17	FOR INFORMATION	CON	JW	LMS	

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**PITLOCHRY TO KILLIECRANKIE  
 PROPOSED MODIFICATIONS  
 TO CULVERT ON  
 WATERCOURSE WF65**

Drawing status: **FOR INFORMATION**

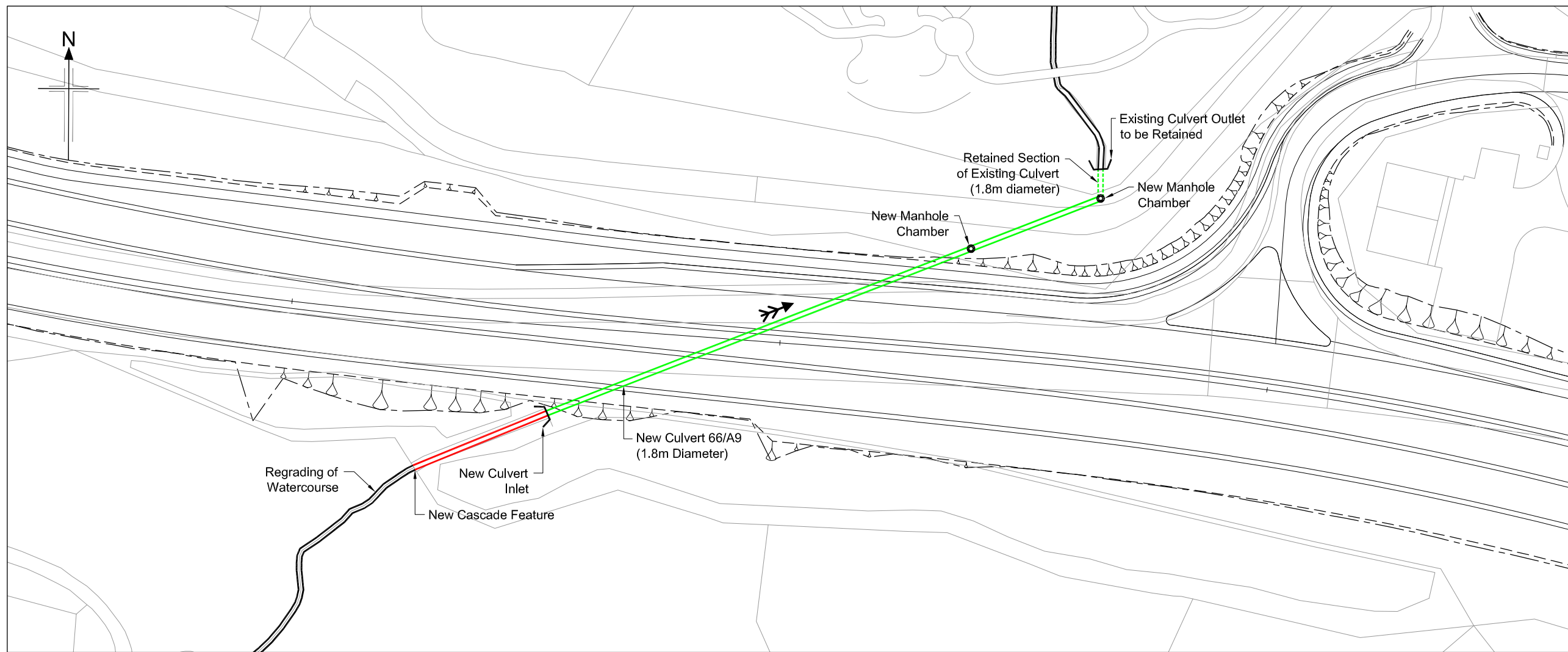
Scale: **NTS @ A1**      **DO NOT SCALE**  
 Jacobs No. **B2140004**

Drawing number: **Figure A.11.8.8**      Rev **0**

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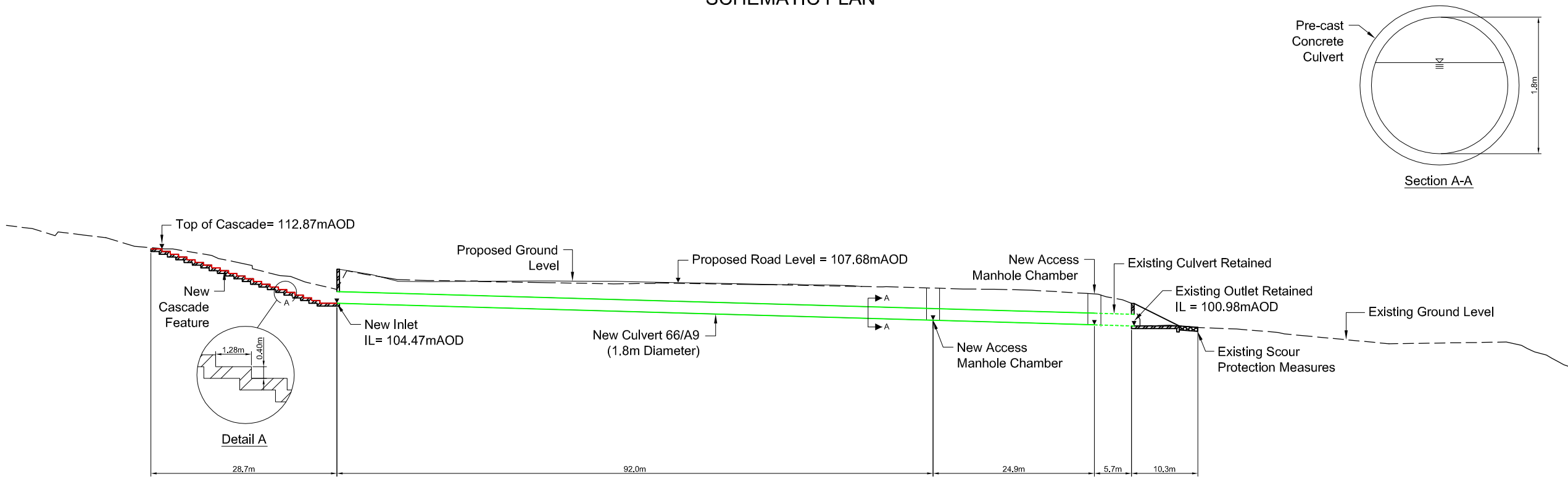
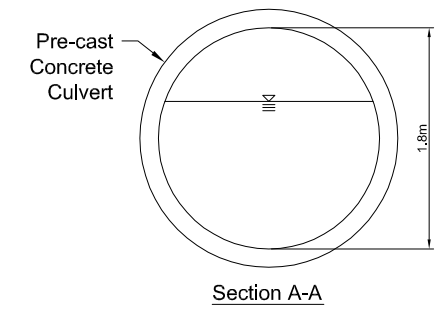




- Legend:**
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  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - Inlet/outlet headwall (retained)
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**SCHEMATIC PLAN**



**WATERCOURSE 66 LONGSECTION**

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	23/01/17	FOR INFORMATION	COR	JW	LMS	

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**PITLOCHRY TO KILLIECRANKIE  
 PROPOSED MODIFICATIONS  
 TO CULVERT ON  
 WATERCOURSE WF66**

Drawing status: **FOR INFORMATION**

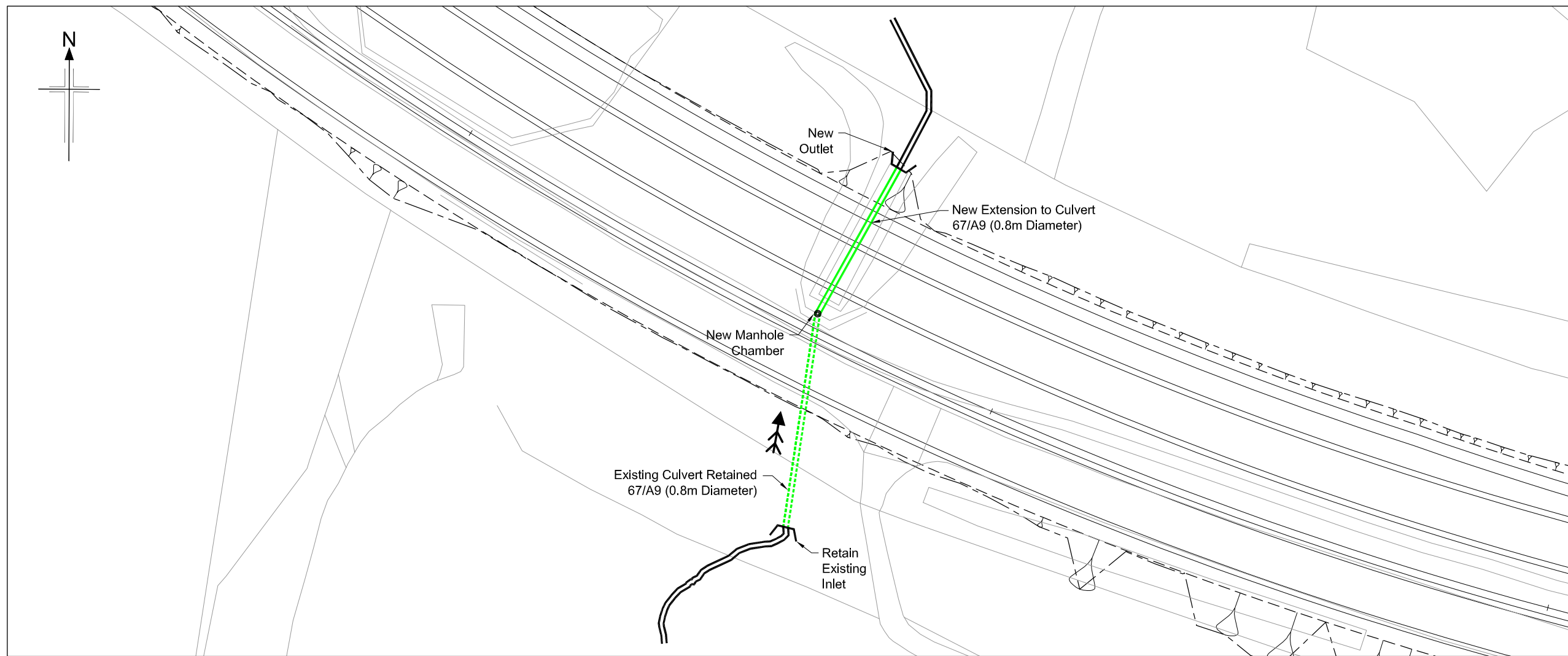
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Jacobs No. **B2140004**

Drawing number **Figure A.11.8.9** Rev **0**

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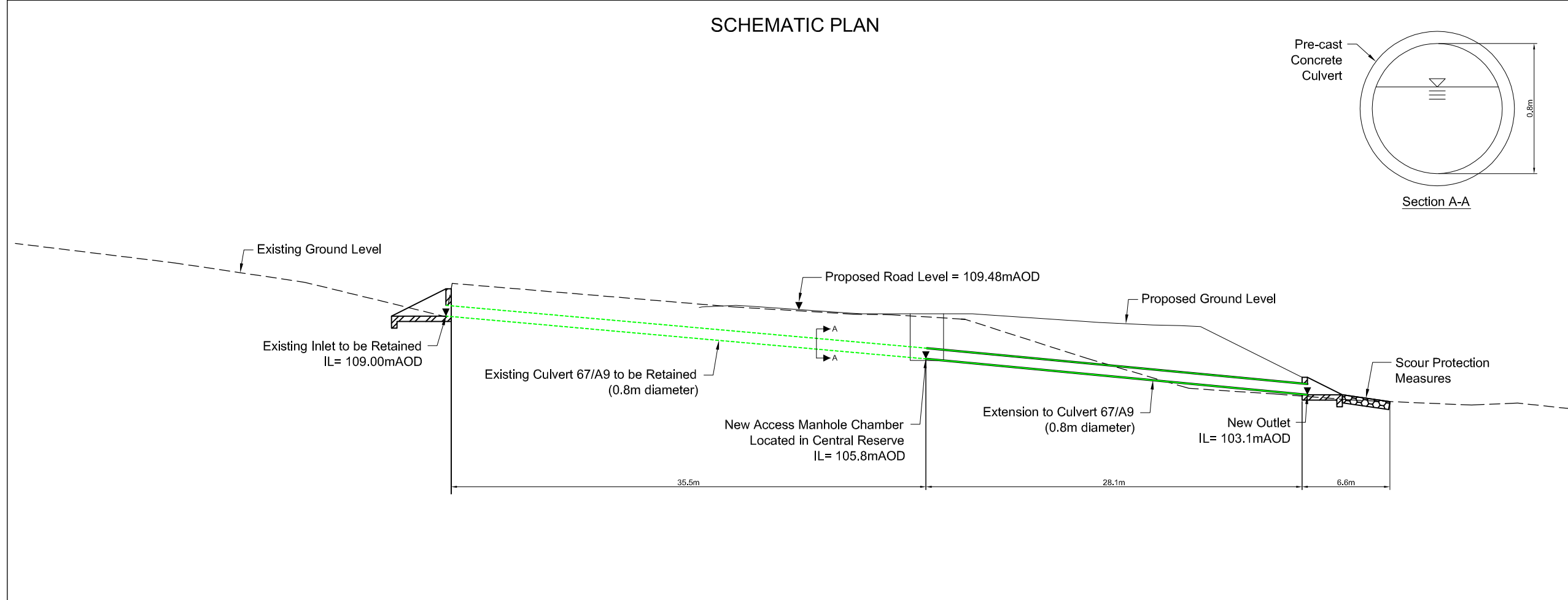
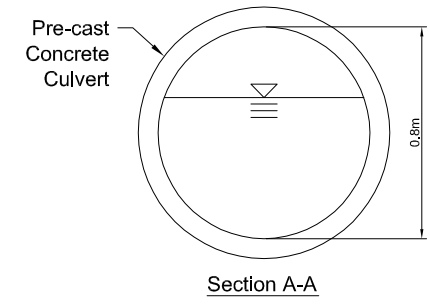
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  8. Where shown 'cascades' are required to safely convey the design flood event (0.5% AEP (200-year) plus allowance for climate change). The cascade geometry shown on the drawing is indicative only and will be subject to further development at detailed design stage. The nature of the cascade will take one of the following forms,
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    - Natural cascade with natural gravels, cobbles and rock forming individual steps.
    - Concrete cascade with stone pitching.
 The nature of the cascade will be determined at the detailed design stage taking into account hydraulic requirements, topography and nature of the underlying strata and its susceptibility to fluvial erosion.
  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.

**SCHEMATIC PLAN**



**WATERCOURSE 67 LONGSECTION**

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	23/01/17	FOR INFORMATION	COR	JW	LMG	

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Drawing title  
**PITLOCHRY TO KILLIECRANKIE  
 PROPOSED MODIFICATIONS  
 TO CULVERT ON  
 WATERCOURSE WF67**

Drawing status  
**FOR INFORMATION**

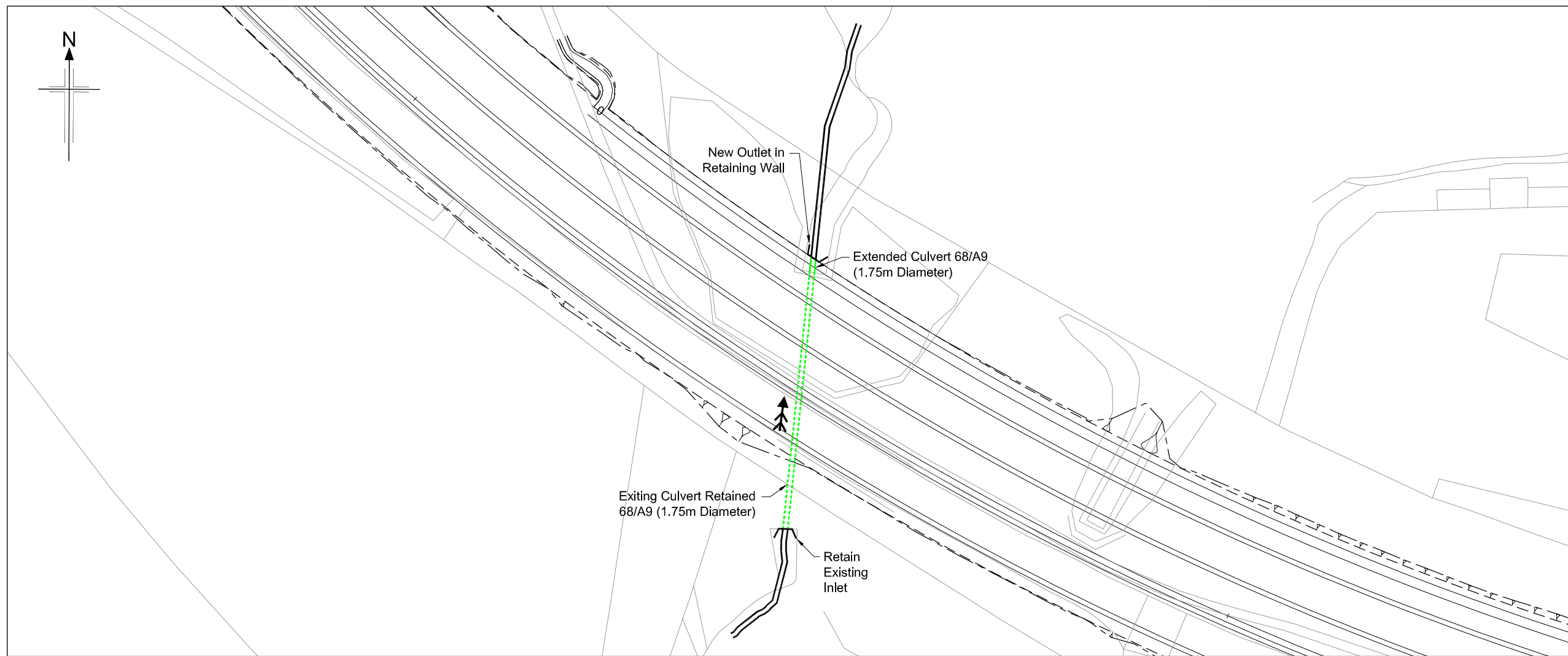
Scale  
 NTS @ A1 DO NOT SCALE

Jacobs No.  
 B2140004

Drawing number  
**Figure A.11.8.10** Rev  
**0**

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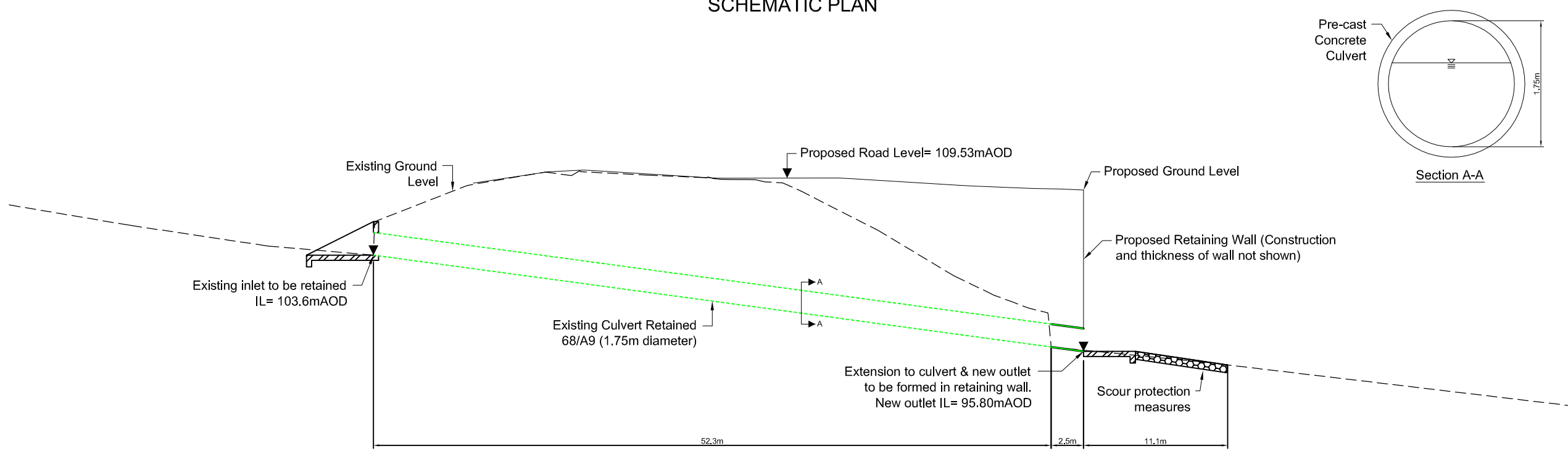
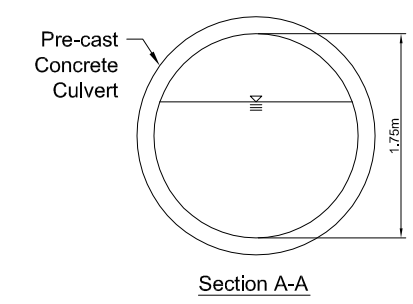
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- Legend:**
- New culvert/extension
  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - - - Inlet/outlet headwall (retained)
  - Pre-earthworks drain and outfall
  - Access chamber
  - Flow direction
  - IL Invert Level

- Notes:**
1. All dimensions are in meters unless noted otherwise.
  2. All levels are in meters above ordnance datum.
  3. All details shown on this drawing are indicative only and subject to development at detailed design.
  4. This drawing shall be read in conjunction with the 'Watercourse Crossing report' only and not in isolation.
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    - Concrete cascade with stone pitching.
 The nature of the cascade will be determined at the detailed design stage taking into account hydraulic requirements, topography and nature of the underlying strata and its susceptibility to fluvial erosion.
  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.

**SCHEMATIC PLAN**



**WATERCOURSE 68 LONGSECTION**

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	25/01/17	FOR INFORMATION	CON	JW	LMG	

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**PITLOCHRY TO KILLIECRANKIE  
 PROPOSED MODIFICATIONS  
 TO CULVERT ON  
 WATERCOURSE WF68**

Drawing status: **FOR INFORMATION**

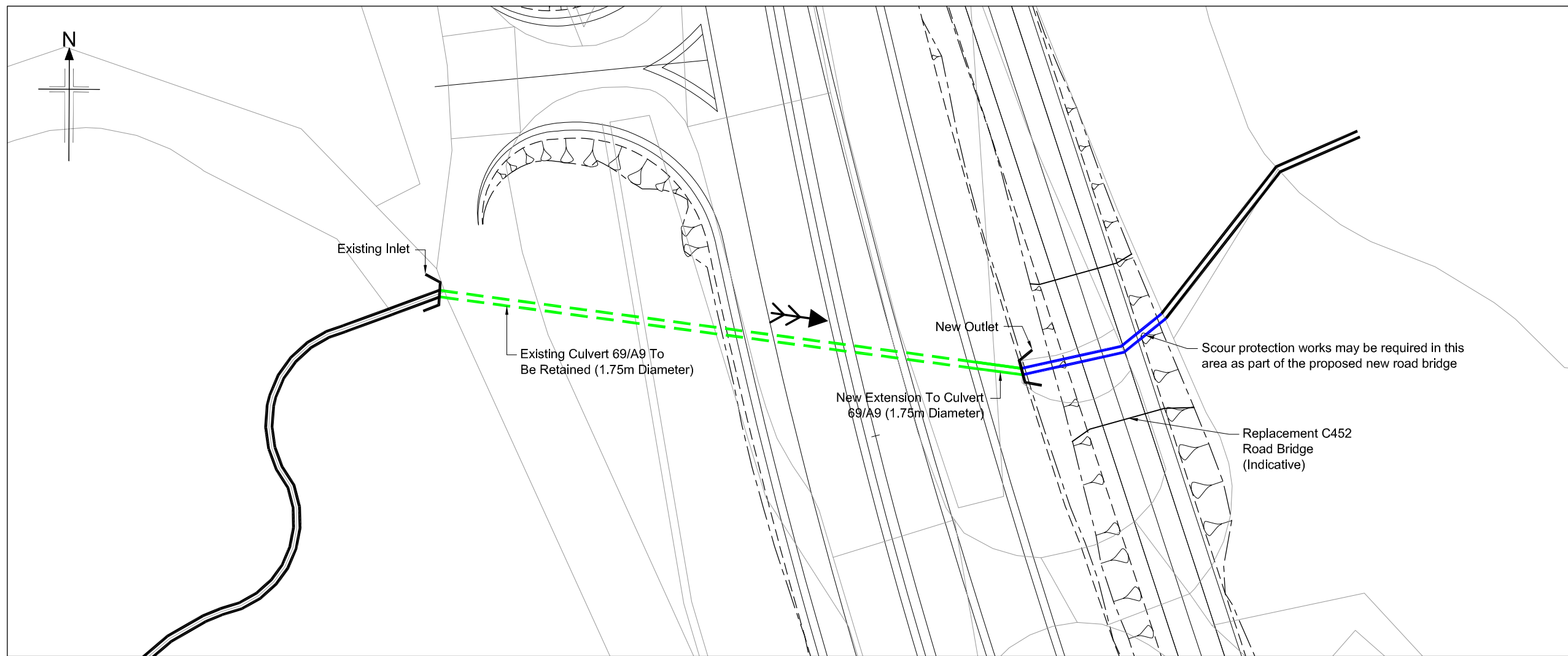
Scale: **NTS @ A1** **DO NOT SCALE**

Jacobs No. **B2140004**

Drawing number **Figure A.11.8.11** Rev **0**

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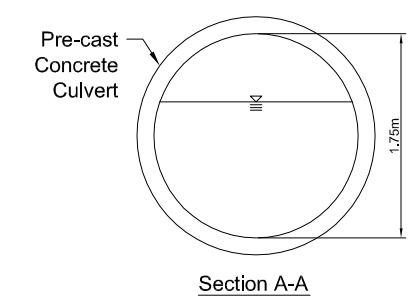
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- Legend:**
- New culvert/extension
  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - Inlet/outlet headwall (retained)
  - Pre-earthworks drain and outfall
  - Access chamber
  - Flow direction
  - IL

- Notes:**
1. All dimensions are in meters unless noted otherwise.
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  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.

**SCHEMATIC PLAN**



Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd
1	16/06/17	FOR INFORMATION	CON	JW	LMG	
0	29/01/17	FOR INFORMATION	CON	JW	LMG	

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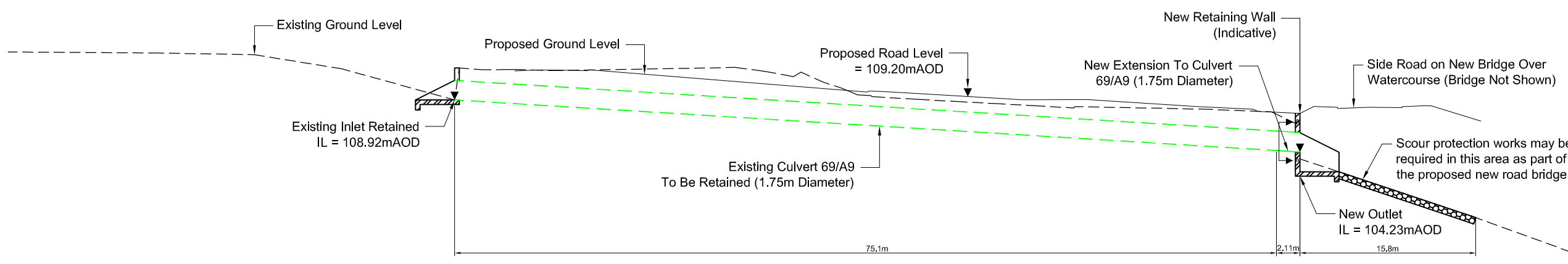


**PITLOCHRY TO KILLIECRANKIE PROPOSED MODIFICATIONS TO CULVERT ON WATERCOURSE WF69**

Drawing status: **FOR INFORMATION**

Scale: **NTS @ A1** DO NOT SCALE  
 Jacobs No. **B2140004**

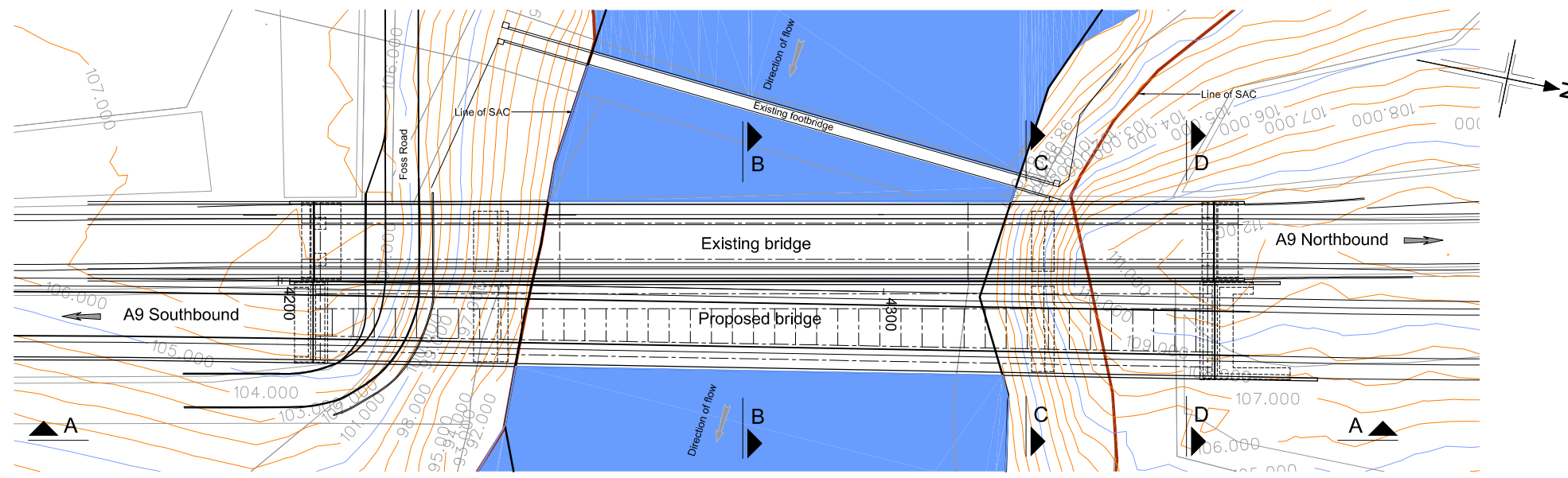
Drawing number: **Figure A.11.8.12** Rev **0**



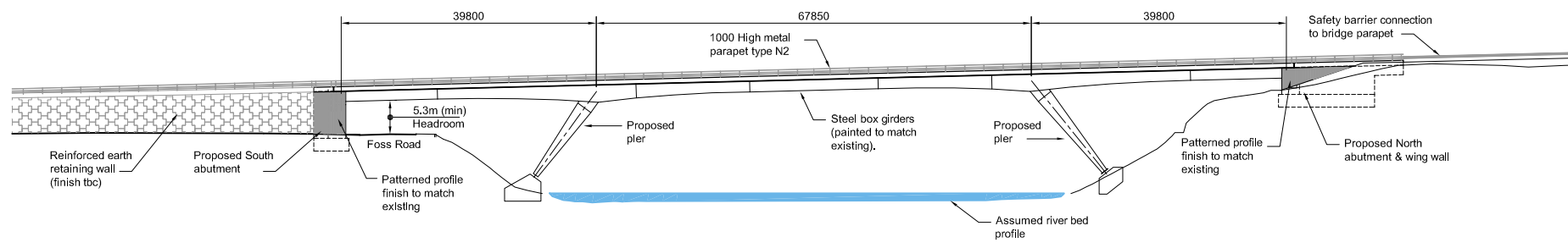
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**WATERCOURSE 69 LONGSECTION**

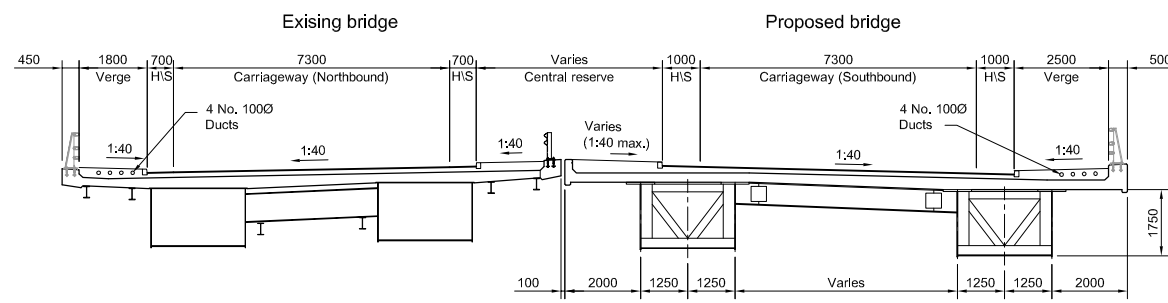
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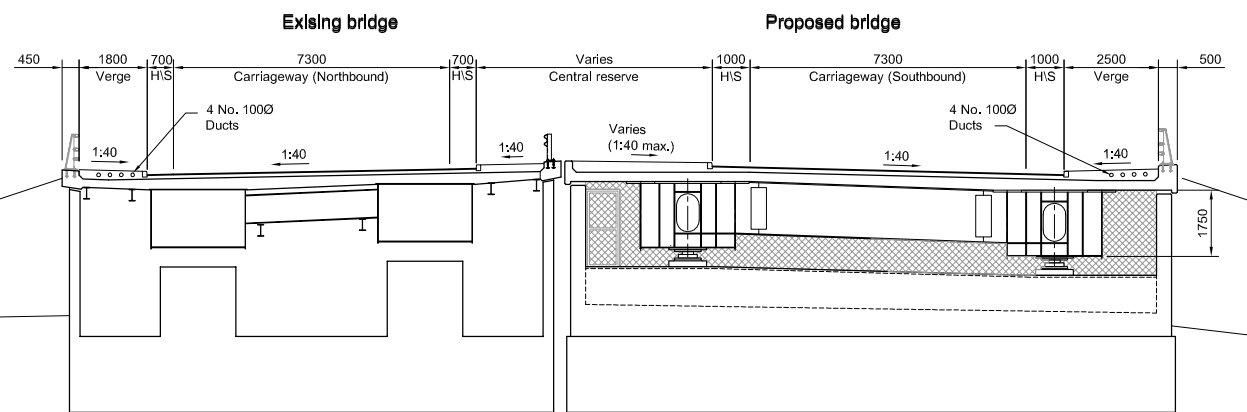
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SCALE 1 : 500



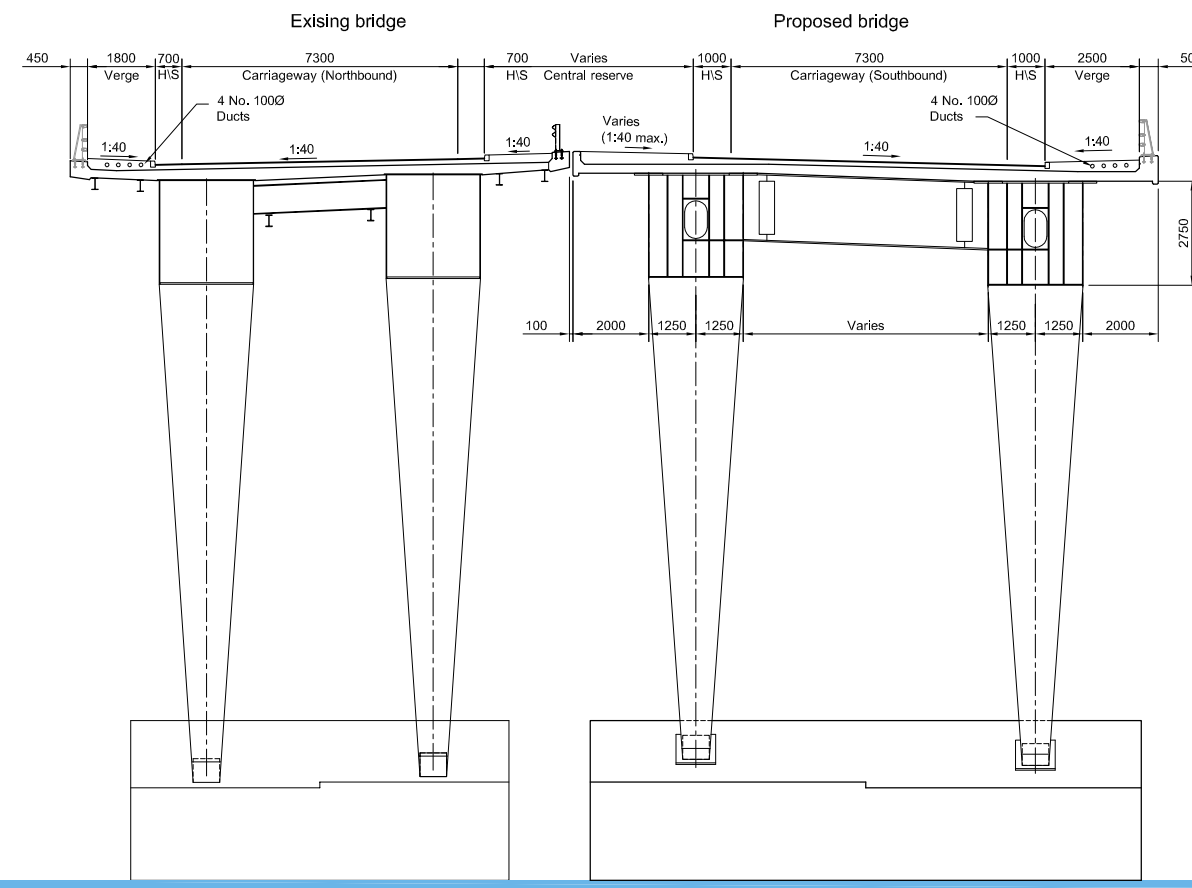
**ELEVATION A - A**  
SCALE 1 : 500



**SECTION B - B**  
SCALE 1 : 100



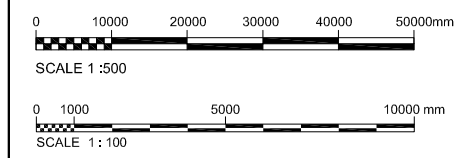
**SECTION D - D**  
SCALE 1 : 100



**SECTION C - C**  
SCALE 1 : 100

- Notes**
- All dimensions are in millimetres unless noted otherwise.
  - All levels in metres Above Ordnance Datum.
  - All chalmages are in metres.
  - All exposed arrises to have 25x25 chamfers unless noted otherwise.
  - All details shown on this drawing are indicative only and subject to development.
  - Do not scale from this drawing.
  - Concrete finishes :  
 (F) - Formed surfaces.  
 (U) - Unformed surfaces.
  - Concrete protection :  
 (B) - Buried surfaces.  
 (W) - Spray applied waterproofing.  
 (S) - Surface impregnation

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :	
CONSTRUCTION	- None
MAINTENANCE / CLEANING	- None
DECOMMISSIONING / DEMOLITION	- None
It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement	



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Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Appr'd
P2	27 Apr 2017	DESIGN FIX 3a - ISSUED FOR REVIEW	GPA	PG	MM	
P1	04 Nov 2016	DESIGN FIX 3 - ISSUED FOR REVIEW	GPA	PG	MM	

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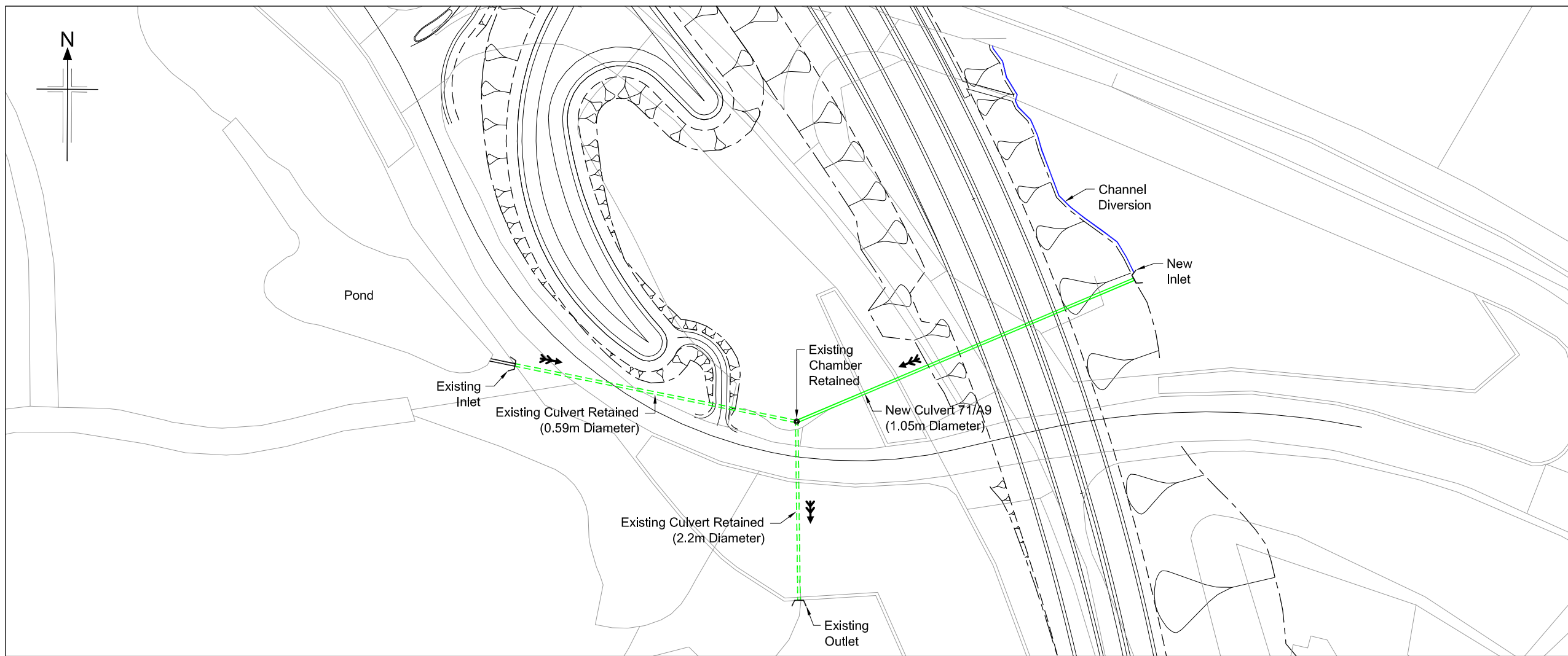
Client  
Project  
Drawing title

**DMRB STAGE 3  
PITLOCHRY TO KILLIECRANKIE  
CLUNIE UNDERBRIDGE  
GENERAL ARRANGEMENT**

Drawing status  
**PRELIMINARY**

Scale	AS SHOWN @ A1	DO NOT SCALE
Jacobs No.	B2140004	
Drawing number	Figure A.11.8.13	Rev P2

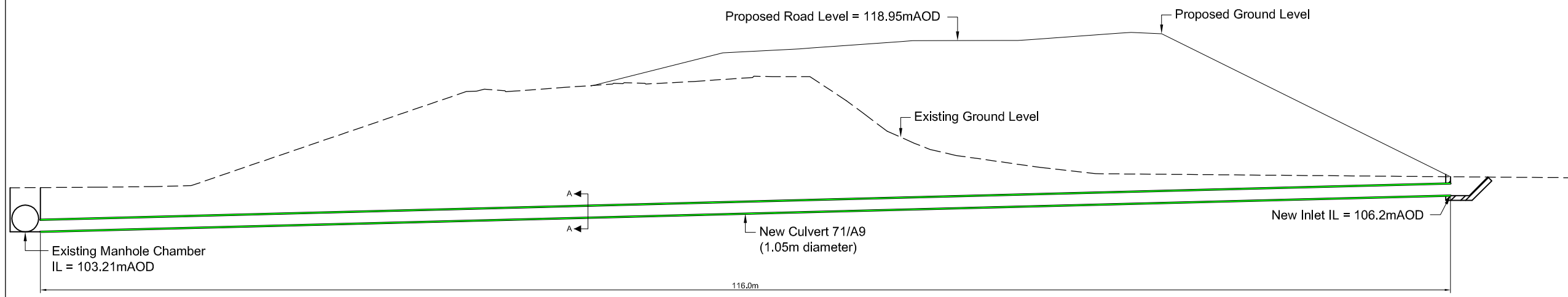
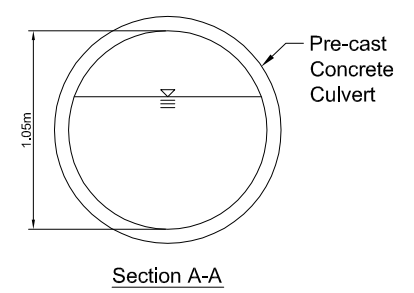
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- Legend:**
- New culvert/extension
  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - - - Inlet/outlet headwall (retained)
  - Pre-earthworks drain and outfall
  - Access chamber
  - Flow direction
  - IL Invert Level

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**SCHEMATIC PLAN**



**WATERCOURSE 71 LONGSECTION THROUGH A9 CULVERT**

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Client: **TRANSPORT SCOTLAND**  
 CON-DHAIL ALBA

Project: **A9 DUALLING**  
 PERTH TO INVERNESS  
 Pìobachry ce K111caurak'le

Drawing title: **PITLOCHRY TO KILLIECRANKIE PROPOSED MODIFICATIONS TO CULVERT ON WATERCOURSE WF71**

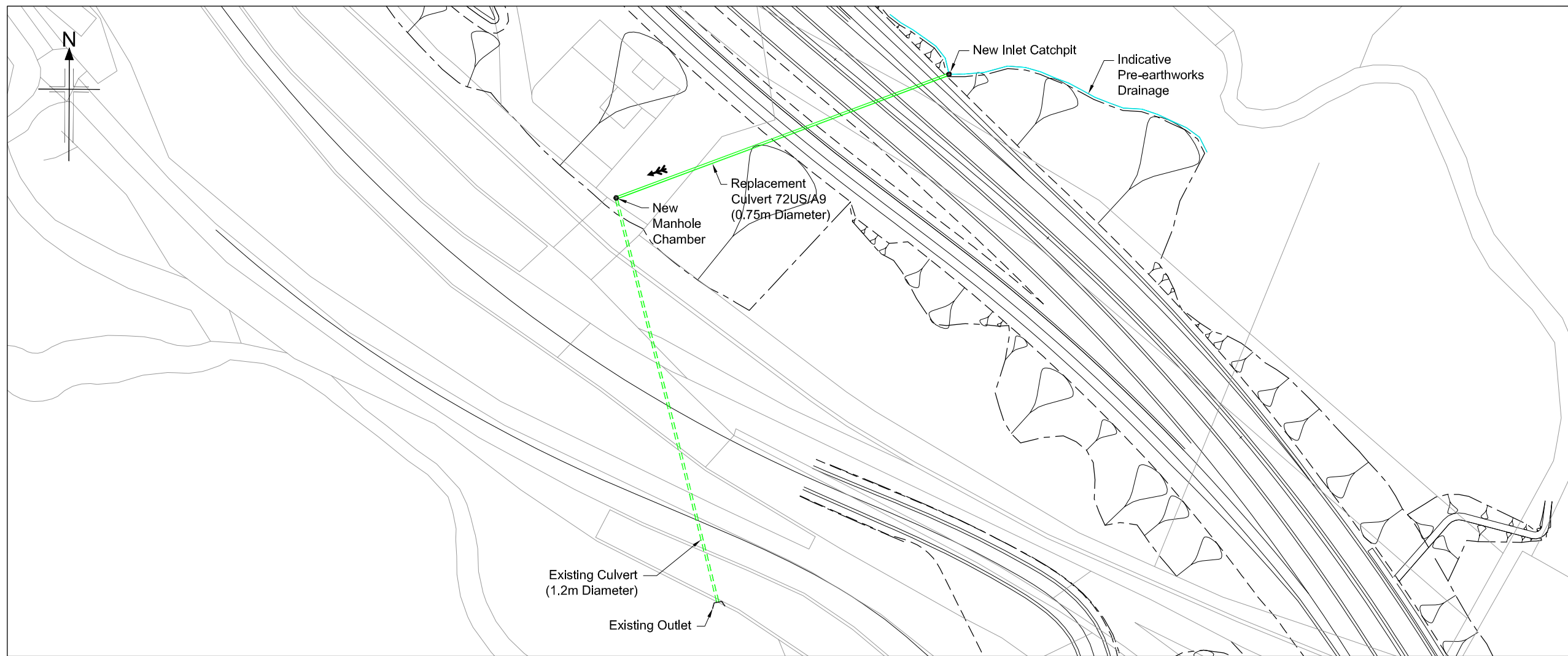
Drawing status: **FOR INFORMATION**

Scale: **NTS @ A1** **DO NOT SCALE**

Jacobs No. **B2140004**

Drawing number: **Figure A.11.8.14** Rev **0**

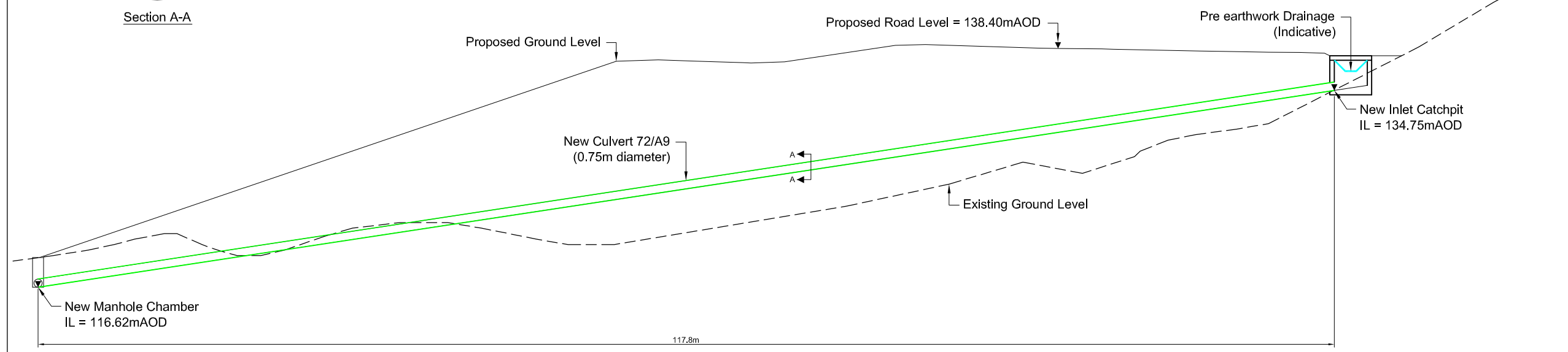
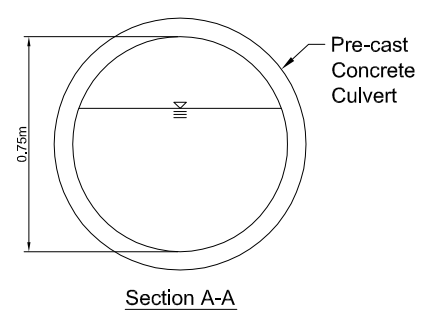
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- Legend:**
- New culvert/extension
  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - - - Inlet/outlet headwall (retained)
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  - Flow direction
  - IL Invert Level

- Notes:**
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  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.

**SCHEMATIC PLAN**



**WATERCOURSE 72 LONGSECTION THROUGH A9 CULVERT**

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	28/01/17	FOR INFORMATION	COR	JW	LMG	

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**PITLOCHRY TO KILLIECRANKIE  
 PROPOSED MODIFICATIONS  
 TO CULVERT ON  
 WATERCOURSE WF72**

Drawing status: **FOR INFORMATION**

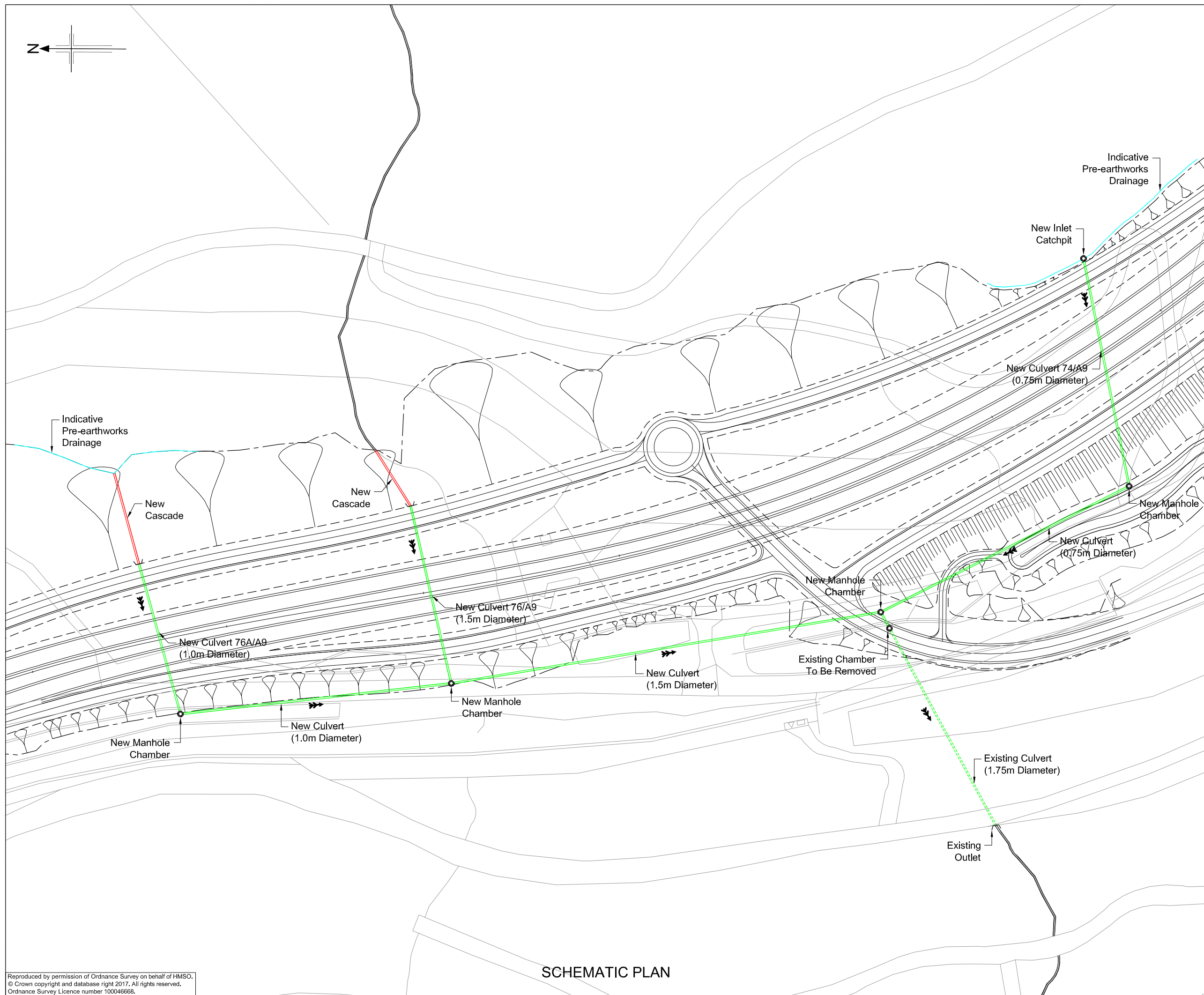
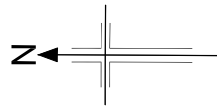
Scale: **NTS @ A1** **DO NOT SCALE**

Jacobs No. **B2140004**

Drawing number **Figure A.11.8.15** Rev **0**

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Legend:

	New culvert/extension
	Retained culvert
	Realigned/regraded channel
	Cascade
	Inlet/outlet headwall (new)
	Inlet/outlet headwall (retained)
	Pre-earthworks drain and outfall
	Access chamber
	Flow direction
	Invert Level

- Notes:
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0	28/01/17	FOR INFORMATION	CON	JW	LMG	
Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd

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Client

Project

Drawing title

**PITLOCHRY TO KILLIECRANKIE  
 PROPOSED MODIFICATIONS  
 TO WATERCOURSES  
 WF74 & WF76**

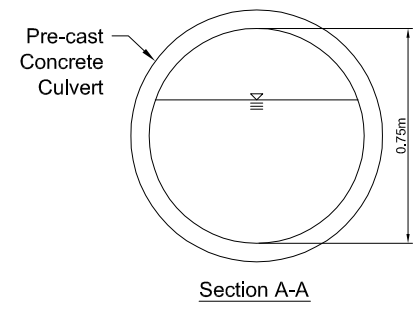
Drawing status	FOR INFORMATION	
Scale	NTS @ A1	DO NOT SCALE
JACOBS No.	B2140004	
Drawing number	Figure A.11.8.16	Rev 0

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**SCHEMATIC PLAN**

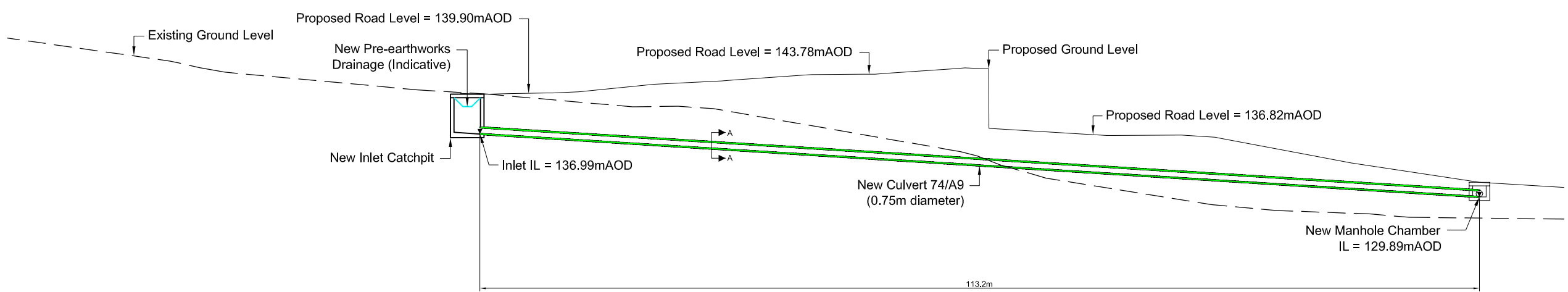
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- Legend:
- New culvert/extension
  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - - - Inlet/outlet headwall (retained)
  - Pre-earthworks drain and outfall
  - Access chamber
  - ←←← Flow direction
  - IL Invert Level

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    - Bedrock channel cascade.
    - Natural cascade with natural gravels, cobbles and rock forming individual steps.
    - Concrete cascade with stone pitching.
 The nature of the cascade will be determined at the detailed design stage taking into account hydraulic requirements, topography and nature of the underlying strata and its susceptibility to fluvial erosion.
  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.



Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd
0	06/04/17	FOR INFORMATION	COR	JW	LMG	



Drawing title

**PITLOCHRY TO KILLIECRANKIE  
PROPOSED MODIFICATIONS  
TO CULVERT ON  
WATERCOURSE WF74**

Drawing status

**FOR INFORMATION**

Scale: NTS @ A1 DO NOT SCALE

Jacobs No. B2140004

Drawing number

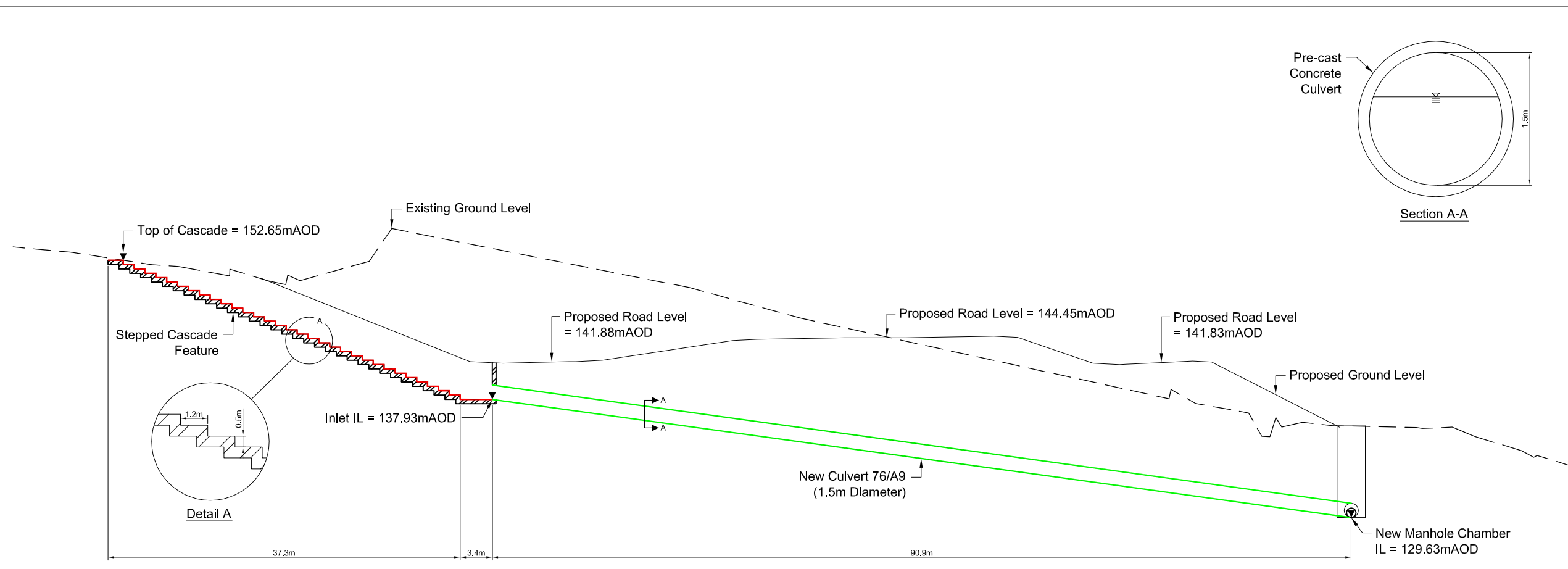
Figure A.11.8.17

Rev 0

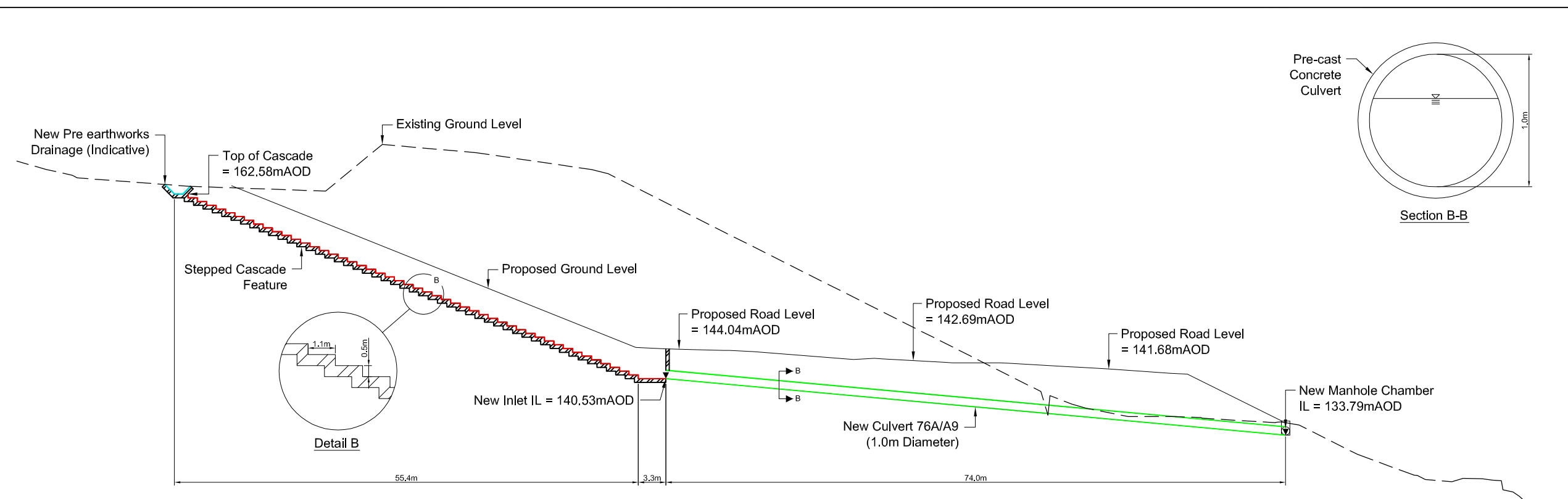
**WATERCOURSE 74 LONGSECTION**

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WATERCOURSE 76 LONGSECTION



WATERCOURSE 76 (TRIBUTARY) LONGSECTION

**Legend:**

- New culvert/extension
- - - Retained culvert
- Realigned/regraded channel
- Cascade
- Inlet/outlet headwall (new)
- - - Inlet/outlet headwall (retained)
- Pre-earthworks drain and outfall
- Access chamber
- Flow direction
- IL Invert Level

- Notes:**
1. All dimensions are in meters unless noted otherwise.
  2. All levels are in meters above ordnance datum.
  3. All details shown on this drawing are indicative only and subject to development at detailed design.
  4. This drawing shall be read in conjunction with the 'Watercourse Crossing report' only and not in isolation.
  5. All 'new' and 'extended' culverts have been designed in accordance with the relevant provisions of DMRB.
  6. Where required 'scour protection measures' shall be provided within the zone indicated on the drawing. The nature and the extent of the scour protection measure will be further developed at detailed design stage in accordance with the relevant provisions of DMRB, taking into account flow hydraulics, channel geometry and channel morphology.
  7. Where shown culverts shall be 'embedded' with natural river deposits to the depth shown.
  8. Where shown 'cascades' are required to safely convey the design flood event (0.5% AEP (200-year) plus allowance for climate change). The cascade geometry shown on the drawing is indicative only and will be subject to further development at detailed design stage. The nature of the cascade will take one of the following forms,
    - Bedrock channel cascade.
    - Natural cascade with natural gravels, cobbles and rock forming individual steps.
    - Concrete cascade with stone pitching.
 The nature of the cascade will be determined at the detailed design stage taking into account hydraulic requirements, topography and nature of the underlying strata and its susceptibility to fluvial erosion.
  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	05/04/17	FOR INFORMATION	CON	JW	LMS	

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Client

Project

Drawing title

**PITLOCHRY TO KILLIECRANKIE  
 PROPOSED MODIFICATIONS  
 TO WATERCOURSE  
 WF76**

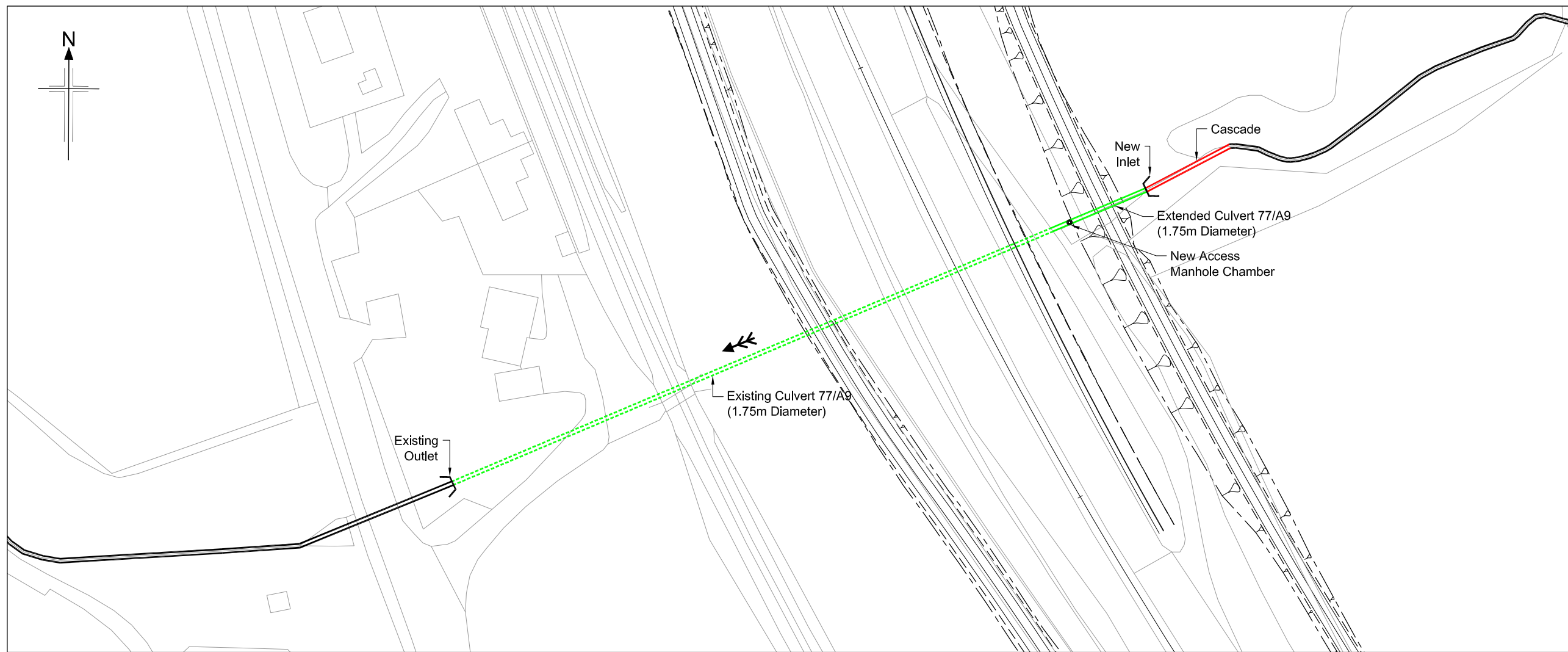
Drawing status

FOR INFORMATION

Scale	NTS @ A1	DO NOT SCALE
Jacobs No.	B2140004	
Drawing number	Figure A.11.8.18	Rev 0

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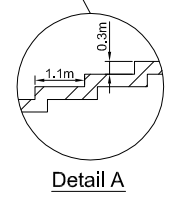
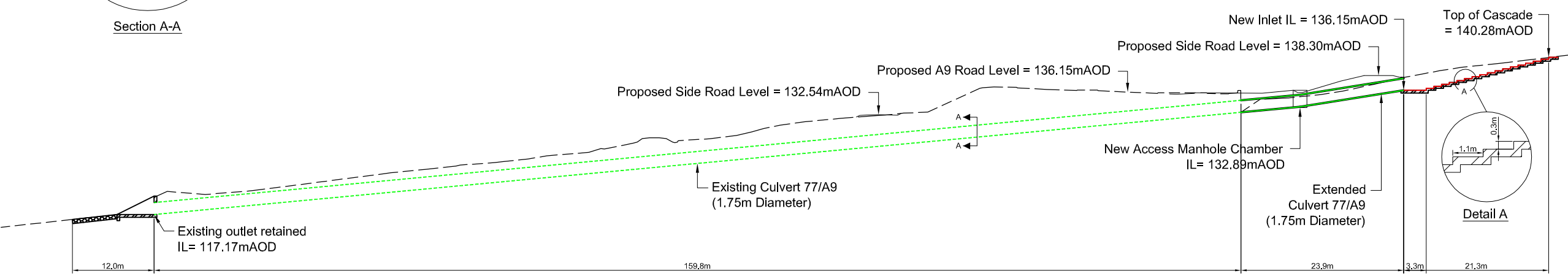
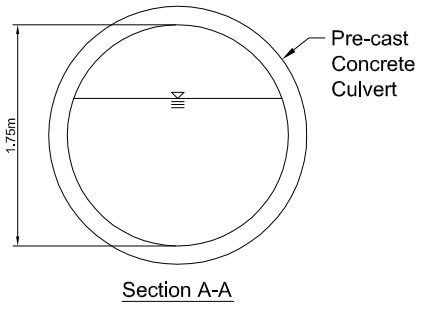
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- Legend:**
- New culvert/extension
  - - - Retained culvert
  - Realigned/regraded channel
  - Cascade
  - Inlet/outlet headwall (new)
  - - - Inlet/outlet headwall (retained)
  - Pre-earthworks drain and outfall
  - Access chamber
  - Flow direction
  - IL Invert Level

- Notes:**
1. All dimensions are in meters unless noted otherwise.
  2. All levels are in meters above ordnance datum.
  3. All details shown on this drawing are indicative only and subject to development at detailed design.
  4. This drawing shall be read in conjunction with the 'Watercourse Crossing report' only and not in isolation.
  5. All 'new' and 'extended' culverts have been designed in accordance with the relevant provisions of DMRB.
  6. Where required 'scour protection measures' shall be provided within the zone indicated on the drawing. The nature and the extent of the scour protection measure will be further developed at detailed design stage in accordance with the relevant provisions of DMRB, taking into account flow hydraulics, channel geometry and channel morphology.
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    - Concrete cascade with stone pitching.
 The nature of the cascade will be determined at the detailed design stage taking into account hydraulic requirements, topography and nature of the underlying strata and its susceptibility to fluvial erosion.
  9. Where shown mammal ledges will be provided within the culvert in accordance with the relevant provisions of DMRB.

**SCHEMATIC PLAN**



**WATERCOURSE 77 LONGSECTION**

0	30/01/17	FOR INFORMATION	CON	JW	LMG	
Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd

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Client: **TRANSPORT SCOTLAND**  
CON-DHAIL ALBA

Project: **A9 DUALING**  
PERTH TO INVERNESS  
Pìobachry ce Kìlliecrankie

Drawing title:  
**PITLOCHRY TO KILLIECRANKIE PROPOSED MODIFICATIONS TO CULVERT ON WATERCOURSE WF77**

Drawing status: **FOR INFORMATION**

Scale: **NTS @ A1** **DO NOT SCALE**

Jacobs No.: **B2140004**

Drawing number: **Figure A.11.8.19** Rev: **0**

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