A30 – CHIVERTON TO CARLAND CROSS

WRITTEN DETAILS OF SURFACE AND FOUL WATER DRAINAGE SYSTEM

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Contents

Executive Summary

The A30 is the most important route serving the county of Cornwall. In the Southwest, it runs from the M5 motorway at Exeter in Devon, along the middle of the south-west peninsula, to Penzance. The route is approximately 103 miles in length, 77 miles of which are dual carriageway. The section between Carland Cross and Chiverton Cross is single carriageway and is part of the key strategic link between the motorway network and west Cornwall.

The A30 Chiverton to Carland Cross scheme (the scheme) is included in the Roads Investment Strategy (RIS) published in December 2014, as: 'Upgrading the A30 to dual carriageway north of Truro, connecting together the dual carriageway sections around Bodmin in the east with Redruth bypass in the west. Coupled with the Temple to Higher Carblake scheme and smaller scale safety enhancements on the route, this improves the A30 to a consistent standard from Camborne to the M5'.

This scheme is included in the Highways England Delivery Plan to commence construction in the RIS 1 period, i.e. by the end of March 2020, with a planned opening to traffic on 31st December 2022. It involves upgrading the 8.7 miles of the section between Chiverton and Carland Cross of the A30 to dual two lane carriageway, as outlined in Figure 12.1.

This report provides details of the Stage 5 Detailed Design for the drainage systems being provided for the scheme. The report outlines the knowledge of the existing systems, provides a detail of the drainage systems designed and identifies impacts that scheme may have upon water quality and flooding. This includes the mitigation measures that are being provided.

1 Introduction

The Costain Jacobs Partnership (CJP) has been commissioned by Highways England to undertake the detailed design and construction of the A30 Chiverton to Carland Cross scheme.

The purpose of this report is to provide written details of the surface and foul water drainage for the works in line with the Part 2, Schedule 2 Requirement 13 – (1) “No part of the authorised development is to commence until written details of the surface and foul water drainage system for that part, reflecting the mitigation measures in chapter 13 of the environmental statement and including means of pollution control have been submitted to and approved in writing by the Secretary of State following consultation with the relevant planning authority and the local highway authority.”

This report aims to set out the highway drainage design principles and parameters for discussion and agreement with Highways England (HE), the Environment Agency (EA), Cornwall Council (CC), and other relevant statutory bodies.

The report addresses the drainage strategy relating to the permanent works and does not deal with the temporary works and construction issues.

The report will have the following sections:

- Existing Foul Sewerage
- Existing Surface Water Sewerage
- Existing Highway Drainage
- Proposed Drainage
- Attenuation
- Cross Drainage Culverts
- Flooding
- Water Quality
- Elements of High Risk or Complexity
- Tables
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2 Existing Foul Sewerage

The existing foul sewerage is believed to be in private ownership with no public foul sewers in the ownership of South West Water Ltd being affected by the scheme.

The existing foul sewerage is believed to comprise of septic tanks, cess pits or package sewage treatment systems all within the curtilage of private or business premises remote from the scheme.

No foul sewerage works form part of the scheme.

3 Existing Surface Water Sewerage

There is no evidence of a surface water system, owned by South West Water Ltd, serving properties in the area immediately adjacent to the scheme and no sewer records for the area have been provided during the preliminary design to suggest otherwise.

The design has proceeded on the basis that the only surface water provision in the affected area is the highway drainage system maintained by Cornwall Council.

4 Existing Highway Drainage

The following existing drainage information has either been obtained from Highways England's Drainage Data Management System (HADDMS) or assumed from topographical survey information, site walkovers and site imagery. No specific drainage or CCTV surveys were undertaken prior to detailed design. Where information is now required to progress the detailed design appropriate surveys have been organised and will be undertaken by Costain.

Surveys are planned for the watercourse at the point of outfall from the ponds and of the highway drainage systems in the existing roads where the scheme will tie in as per agreement with Highways England.

It appears that the existing A30 is primarily drained using traditional kerb and gully systems on embankments, and by combined surface and sub surface filter drains in cuttings. On some older sections of the road, the carriageway appears to be drain over the edge into adjacent field ditches.

Many of the existing minor side roads appear to have no defined drainage system and rely on over the edge drainage into field ditches or runoff into adjacent land.

Due to the age of some road sections, it is thought unlikely that attenuation is present. As a result, the existing highway runoff is likely to discharge uncontrolled into field ditches and adjacent watercourses. The exception to this is at Chiverton junction, where there is an attenuation pond located to the west of the existing junction.

Surveys may also be undertaken to determine the condition of the piped drainage within the de-trunked section of the A30, subject to the agreement of Highways England.

4.1 Chiverton Roundabout

The existing roundabout and adjoining arms are drained by a combination of kerb drainage and kerb and gully systems. The topography would suggest that the surface water eventually discharges to the River Tinney to the south. There is an attenuation pond located to the west of the junction which it is believed attenuates this drainage.

4.2 Chybucca (A30 – B2384) Junction

This section of the A30 is drained by a kerb and gully system. There is an existing low point to the west of the junction, which is likely to discharge to the adjacent River Kenwyn.

4.3 Tresawsen to Town & Country Motor Centre

Road gullies are present in this area draining to a low point south of Tresawsen. It is anticipated that this discharges to the watercourse adjacent to Nanteague Farm.

4.4 Zelah Bypass

Zelah bypass is drained by a combination of combined filter drains and kerb and gully systems. These drain to several low points along the bypass. The presence of oil interceptors is recorded on HADDMS.

HADDMS records two unnamed tributaries connecting to the river Allen as culverts beneath the existing bypass adjacent to Zelah, as shown the existing A30 draining to the western tributary at the downstream end of the culvert.

4.5 Carland Cross Roundabout

The existing roundabout is drained via a kerb and gully system. The northern side of the roundabout is in cutting with a filter drain intercepting the cutting runoff and running north-eastwards. The existing roundabout is located in a low point along the existing A30 alignment. HADDMS data record that the A39 junction drains to the south east, the roundabout and remaining junctions drain to the east with the 375mm drain being located in the central reserve. The outfall is located to the north east of the existing A30.

There are no known pollution control measures at Carland Cross or at the other existing junctions within the scheme.

5 Highway Drainage Detail

5.1 Hierarchy of Discharge

DMRB CG501 – Design of Highways Drainage Systems states below the order of preference for the disposal of highway surface water:

1. Ground;
2. Surface water course; or
3. Surface water sewer.

5.2 Groundwater

Preliminary infiltration tests to BRE Digest 365 were carried out along the scheme in February 2018, as detailed in the Ground Investigation Report Addendum. The results indicate a wide range of infiltration values between 2.11×10^{-3} m/s and 1.95×10^{-6} m/s. Testing was typically conducted at 0.5-2m below existing ground level. The results are summarised in Section 11, Table 11.1.

The infiltration test results are inconclusive; hence infiltration may not be practical, consequently the consented design was based on the assumption of discharge to adjacent watercourses, with the exception of two ponds, Ponds 3 and 5, where infiltration may be possible subject to further trials. The consented design does not accommodate an alternative to infiltration. At Pond 3, there is a multi-species crossing beneath the new A30 that connects with a proposed ditch and may be utilised as an outfall. Pond 5 has no alternative other than shallow infiltration trenches or shallow pond, to maximise the permeability of the surface layers.

The detailed design has proceeded on the same basis and is discussed further below.

The Ground Investigation Report Addendum indicates that groundwater was encountered as shallow as 2m below ground level in various locations along the alignment. This may result in difficulties implementing infiltration. Groundwater is still currently being monitored under the continuing Phase 4 Ground Investigation. Once the results are received, the detailed design will be reviewed. The results of the ground water investigation will be made available to Cornwall Council.

Where the highway is in cutting, combined surface and sub-surface drains are proposed (in accordance with CG501 Table 3.5.1). These should reduce the groundwater level below the pavement construction.

The possibility that groundwater interception may impact springs or private water supplies will be confirmed through a hydrogeological study and may require a separate system installed in order to maintain the springs or other mitigation measures to be provided. Once these data are received, they will be made available to Cornwall Council.

5.3 Design Principles

A preliminary drainage layout has been produced and this is being progressed through detailed design. The detailed design has been developed following the principles established during the preliminary design for the consented scheme.

The A30 scheme mainline and junction slip road drainage will be adopted and maintained by Highways England. All other highway drainage will be the responsibility of Cornwall Council. Separate drainage networks and attenuation/infiltration ponds are provided for each statutory body.

Realignment of the existing side roads will require the scheme drainage to connect into existing networks. These will provide either a like for like or a reduction of impermeable area discharging into the existing networks. Approval will be sought from Cornwall Council.

At the junctions, the area of existing pavement will reduce consequently the runoff to existing points of discharge will reduce, which is particularly significant where the existing discharge is to Critical Drainage Areas (CDA).

The drainage system is being designed in accordance with the requirements of the Design Manual for Roads and Bridges (DMRB) and will incorporate the Cornwall Council highway drainage requirements where applicable to the local roads. Where possible, the drainage provided incorporates sustainable drainage system principles set out in CIRIA C753 The SuDS Manual. Where applicable, the design will comply with the requirements of the CDA.

The highway drainage is designed to accommodate a 1 in 1 year return period event without surcharging.

The design ensures that there is no surface water flooding on the highway for a 1 in 5 year return period event and no surcharging of combined surface and sub-surface drains into the pavement construction.

The design ensures that the attenuation ponds/ infiltration basins can accommodate the 1 in 100 year event with an allowance for climate change.

The allowance for climate change as applied to the Highways England section is 20% increase with a review of the impacts of a 40% allowance. For the local roads, the climate change allowance is 40% in accordance with Cornwall Council drainage requirements. All ponds will be designed to store the 1 in 100 year plus 40% climate change volume.

At locations where infiltration is not possible, the highway surface water runoff is attenuated to the Greenfield Runoff Rate (GRR) to mitigate the impact on the existing watercourses.

Attenuation ponds/infiltration basins are designed in accordance with DMRB CD532 Vegetated Drainage Systems for Highway Runoff. There is a total of 20 ponds, 12 serve the Highways England section of the scheme and 8 serve the Cornwall Council roads. Of those serving the Cornwall Council roads, two are infiltration basins.

The ponds have a maximum water storage depth of 1.5m with 0.3m freeboard to the top of the pond. A permanent water depth of 0.15m is provided as required by Cornwall Council. Side slopes are graded to 1:3 for maintenance access with one side at 1:5 for better access and to allow mammal escape from the pond

In critical drainage areas, the specific requirements will be adhered to as detailed in Section 8.

Where areas of existing carriageway are retained and will contribute to the new drainage system, the restricted flow at the outfalls will include the 1 in 1 year return period flows from the existing carriageway as well as the GRR from the widened section. This has been agreed with Cornwall Council at the preliminary design stage.

The design does not include the retention of existing drainage except at the scheme limits where new drainage connects to the existing.

Pavement edge drainage details have been selected in line with the recommended solutions flow chart in DMRB CG501 Table 3.4.

In cuttings, the surface runoff is drained to combined surface and sub-surface filter drains in the verge in accordance with Manual of Contract Documents for Highway Works (MCHW) – Highway Construction Detail (HCD) B1 Type 1A and possibly grass surfaced as suggested by the preliminary design.

On embankments, the surface water runoff is drained via surface water channels in the verge in accordance with MCHW – HCD B14 Type A. Where the longitudinal gradient is 2% or steeper, the surface water channel may be replaced with either a slip formed or pre cast concrete combined channel and pipe system (slot drain) to eliminate the need for weir outlets.

Where kerbs are required, the surface water runoff will be drained via gully outlets to carrier pipes in accordance with HCD B9 Type 21A.

Where the road is super-elevated the drainage in the central reserve will utilise either a slot drain or channel system formed behind the hard strip by omitting the surface course and using the central barrier as a kerb.

Lined cut-off ditches at the top of cuttings and unlined cut-off ditches at bottom of embankments intercept natural runoff and outfall to the natural drainage system. If the natural topography falls away from the road alignment, cut off ditches will not generally be provided other than to mitigate local flooding risk.

Fin or narrow filter drains, in accordance with HCD F18, are used to drain the pavement foundation on embankments, in the central reserve where super-elevated and the verge where a surface water channel system is installed. Elsewhere, when the highway is in cutting or at grade, the pavement foundation drainage utilises combined surface and sub-surface drains.

The scheme drainage is designed to facilitate maintenance in accordance with Highways England Asset Maintenance Requirements.

6 Attenuation

Where infiltration is viable, then the attenuation provision is based on the infiltration rate in accordance with BRE 365.

Where infiltration is not viable, the surface water discharge is attenuated to the principles outlined in Section 5, prior to discharge into suitable adjacent watercourses.

The GRR has been calculated through a hydrological assessment using the Institute of Hydrology 124 method (IH124) as agreed with Cornwall Council. The results are given in Table 6.1.

Table 6.1 IH 124 Results

Return Period (years)	Greenfield Runoff Rate (GRR) l/s/ha
1	2.8
2	3.2
5	4.4
30	6.8
100	8.6

A flow control device is installed immediately downstream of each pond to control the outflow. The type of flow control device will be either an orifice plate or vortex flow control. This is to be confirmed following detailed design and is dependent on the type suitability for the flow rates required.

The outfalls and attenuation pond storage volumes are shown in Table 6.2 and Table 6.3 below. The volumes have been calculated on the basis of no infiltration, as infiltration values at the pond locations are currently inconclusive.

The volumes shown below are based on the consented design and may reduce subject to the value engineering undertaken in the detailed design.

Table 6.2 Highways England Attenuation Pond Volumes

Approximate Mainline Chainage (m)	Attenuation Pond Outfall Reference	Storage Volume Required (m^3)	Cornwall Council Critical Drainage Area?
0+500	A	2250	Y
1+500	B	2200	N
2+000	C	5300	Y
4+100	D	7680	N
6+000	E	4470	Y
7+100	F	7270	Y
8+900	G	7850	Y
10+900	H	3400	Y
11+900	I	3370	Y
13+300	J	870	N
13+500	K	660	N
14+200	L	4500	N

Table 6.3 Cornwall Council Attenuation Pond Volumes

Approximate Mainline Chainage (m)	Attenuation Pond Outfall Reference	Storage Volume Required (m^3)	Cornwall Council Critical Drainage Area?
1+600	1	3076	N
4+100	2	1720	N
4+600	3	230 (Infiltration)	N
6+600	4	90	Y
8+000	5	800 (Infiltration)	N
9+700	6	70	Y
11+000	7	105	Y
13+200	8	1140	N

Access tracks will be provided to the ponds for maintenance. The tracks will be 3m wide (including room for turning where necessary) and constructed from unbound material. There is a 4m wide access track around each pond to facilitate excavator access during maintenance.

7 Cross Drainage

Several watercourses/streams cross the route of the scheme. Flows in these watercourses will be maintained within their catchment through culverts where possible.

No EA designated main river crossings are required for the scheme.

The proposed cross drainage culverts are designed to convey the 100 year event plus a 40% allowance for climate change. A freeboard of 300mm or a quarter of the diameter, whichever is greater is to be provided. The culverts may require a 150mm embedment for environmental purposes.

The culverts are designed in accordance with the requirements of DMRB CD529 Design of Outfall and Culvert Details, CIRIA Report C689 Culvert design and operation guide, and Cornwall Council Drainage requirements.

Where the upstream culvert catchment has not been readily defined, the minimum culvert diameter is to be 1200mm in accordance with the DMRB.

Culvert crossings have been coordinated with the environmental mitigation measures to rationalise and combine crossing points where possible. The culverts have been upsized to accommodate the environmental requirements where necessary.

The following table, Table 7.1, shows the proposed cross drainage solutions. Culverts sizes are confirmed following detailed design. There are also mammal passes across the scheme, the location and size of which are included within the Environmental Statement.

In addition to those below, there are a number of smaller culverts, or piped ditches, where service access or tracks cross the cut-off ditches. The sizes of these are generally 600mm, and are shown on the drainage drawings.

Table 7.1 Cross Drainage

Approximate Chainage	Solution	Size/Diameter
6+050	Proposed culvert to account for existing watercourse.	1.2m
8+900	Proposed culvert to account for existing watercourse and associated existing culvert on A30.	2.4m [box]
9+250	Proposed culvert to account for existing watercourse and associated existing culvert on A30.	2.4m [box]
11+050	Proposed culvert to account for existing watercourse.	1.2m
13+600	Proposed culvert to account for existing culvert on A30	1.2m

8 Flooding

The Flood and Water Management Act 2010 (FWMA) provides guidance and information on managing flood risk and surface water. It provides a framework which allows different organisations to work together to develop solutions to surface water flooding problems.

FWMA provides the lead local flood authorities (LLFA), in this case Cornwall Council and the Environment Agency (EA) with power to request information required in connection with their flood risk management functions.

Cornwall Council are responsible for managing flood risk from surface water, groundwater and ordinary watercourses within their area. They are also the consenting authority for works near or within watercourses.

The EA are responsible for managing main rivers and are the consenting authority for works near or within main rivers. Cornwall Council are responsible for works near or within ordinary watercourses and discharges into Critical Drainage Areas (CDA).

The Environment Agency fluvial flood risk maps form Figure 12.1 – Figure 12.3 in Section 12. The scheme is located entirely within Flood Zone 1 with very low risk of fluvial flooding (less than 1 in 1000 year annual probability of fluvial flooding).

The risk of flooding from surface water along the scheme is generally very low; however, the EA maps show four locations where the risk is higher. These locations are; Zelah, Zelah Bypass, Marazanvose and Tresawsen, shown in Figure 12.4 – Figure 12.7.

At Zelah, Figure 12.4, the surface water flood risk extents shown on the EA map are at low points in the existing topography. OS mapping shows two existing culverts underneath the A30 at these locations. These culverts may not be accounted for in the EA surface water flood modelling, therefore, the flood risk may be lower than shown. Culverts are to be provided in the scheme downstream of these locations to minimise the risk of surface water flooding.

At Zelah bypass, Figure 12.5, the EA maps show a small parcel of land which is at medium to high risk of surface water flooding. This is likely to arise from surface water runoff from the field being constrained by the existing A30 earthworks. Cut off ditches are provided (where applicable) on the scheme in such instances to convey the flow to an adjacent watercourse.

At Marazanvose, Figure 12.6, the surface water flood risk is shown at the low point in the existing topography along the existing side road. This road will be removed by the scheme and a positive drainage network provided in the proposed highway.

At Tresawsen, Figure 12.7, the surface water flood risk is shown at a low point in the existing topography and is likely to become a small watercourse during a storm event. A culvert will be provided at this location to minimise the risk of surface water flooding.

A Flood Risk Assessment is required as part of the National Planning Policy Framework and will be submitted to the Environment Agency (EA) for approval.

The EA flood risks maps show no risk of flooding from reservoirs.

Chiverton junction falls within the Environment Agency's Critical Drainage Area Truro- River Tinney, with the rest of the scheme sitting outside. The scheme eventually drains into the Truro – Kenwyn, Allen, Tinney and Tregolls Road CDA.

Where the proposed surface water network discharges directly into the Truro - River Tinney CDA the runoff rate mimics the Greenfield Runoff Rate (GRR) with the maximum discharge set at the 1 in 1 year flow rate.

Where the drainage from the scheme discharges to the Rivers Kenwyn, Allen or Tregolls Road CDA, the runoff rate mimics the Greenfield Runoff Rate (GRR) with the maximum discharge rate set at the 1 in 10 year flow rate. Elsewhere, the proposed discharge (for new impermeable areas) mimics the existing greenfield performance.

A separate Flood Risk Assessment has been prepared and submitted as part of the DCO Environmental Assessment.

9 Water Quality

To mitigate the potential impacts of the scheme on the water environment, a water quality assessment has been undertaken in accordance with the best practice detailed in DMRB LA113 Road Drainage and the Water Environment and the Highways England Water Risk Assessment Tool (HEWRAT).

The assessment ensures that surface water discharges would not lead to deterioration in the classification status of the receiving surface water bodies and groundwater. The process also assesses the risk of accidental spillage from the scheme to the receiving environment and the management of flood risk.

The existing water quality measures are currently unknown, and no pollution prevention measures have been observed during site visits. Asset data provided by Highways England has indicated the presence of some petrol interceptors, however, the location of these is yet to be confirmed.

The HEWRAT assessment is contained within the Environmental Statement Chapter 13 Road Drainage and Water Environment. It has concluded that, through the use of grassed filter drains, infiltration to ground and detention basins, the risk of pollution is reduced to an acceptable level.

Forebays to intercept silt and other pollutants will be provided, as requested by the Local Lead Flood Authority, Cornwall Council. The exception to this will be for ponds which have a volume less than 500m^3, or else where space constraints do not allow for the inclusion of forebays.

10 Elements of High Risk or Complexity

The Ground Investigation Report Addendum infiltration results are inconclusive but indicate that infiltration may be possible at some locations across the scheme. The results do not provide sufficient information to evaluate infiltration options for surface water discharge, consequently all but two ponds have been designed to account for no infiltration, although further trials may result in a revision of this assumption.

As discussed in Section 5, groundwater has been encountered within 2m of the existing ground levels in various locations along the alignment. The ongoing groundwater monitoring will provide further information once the results have been received. There is a risk that attenuation ponds in these locations will need to be lined to prevent the loss of storage volume from the ingress of ground water.

Watercourse details such as water levels, bed levels and section details at culvert and drainage outfall locations are currently unknown. These details will be confirmed by surveys being undertaken during the detailed design stage and may affect the current design proposals.

As discussed in Section 5, there will be a need to connect new drainage into the existing highway network. Approval will be required from Cornwall Council. The existing drainage network details are currently unknown and will need to be confirmed by survey.

The WSP Draft Ground Investigation Report indicates that there are disused mine workings within the vicinity of the scheme. These areas have been avoided, by the preliminary drainage design, where known. There is a residual risk that unknown workings may be encountered and affect the drainage proposals.

11 Tables

Table 11.1 Preliminary Infiltration Results

Trial Pit	Approximate Chainage	Infiltration Rate, m/s
TP-P-001	200	1.4×10^{-4}
TP-P-004	1300	2.76×10^{-4}
TP-P-005	2000	2.78×10-4
TP-P-009	6000	Unable to calculate due to raising water level
TP-P-013	8900	1.63×10^{-5}
TP-P-014	8900	Insufficient drop in water level
TP-P-015	11150	3.59×10^{-5}
TP-P-017	13900	2.29×10^{-3}
BH-S-036	11000	Result unavailable

12 Figures

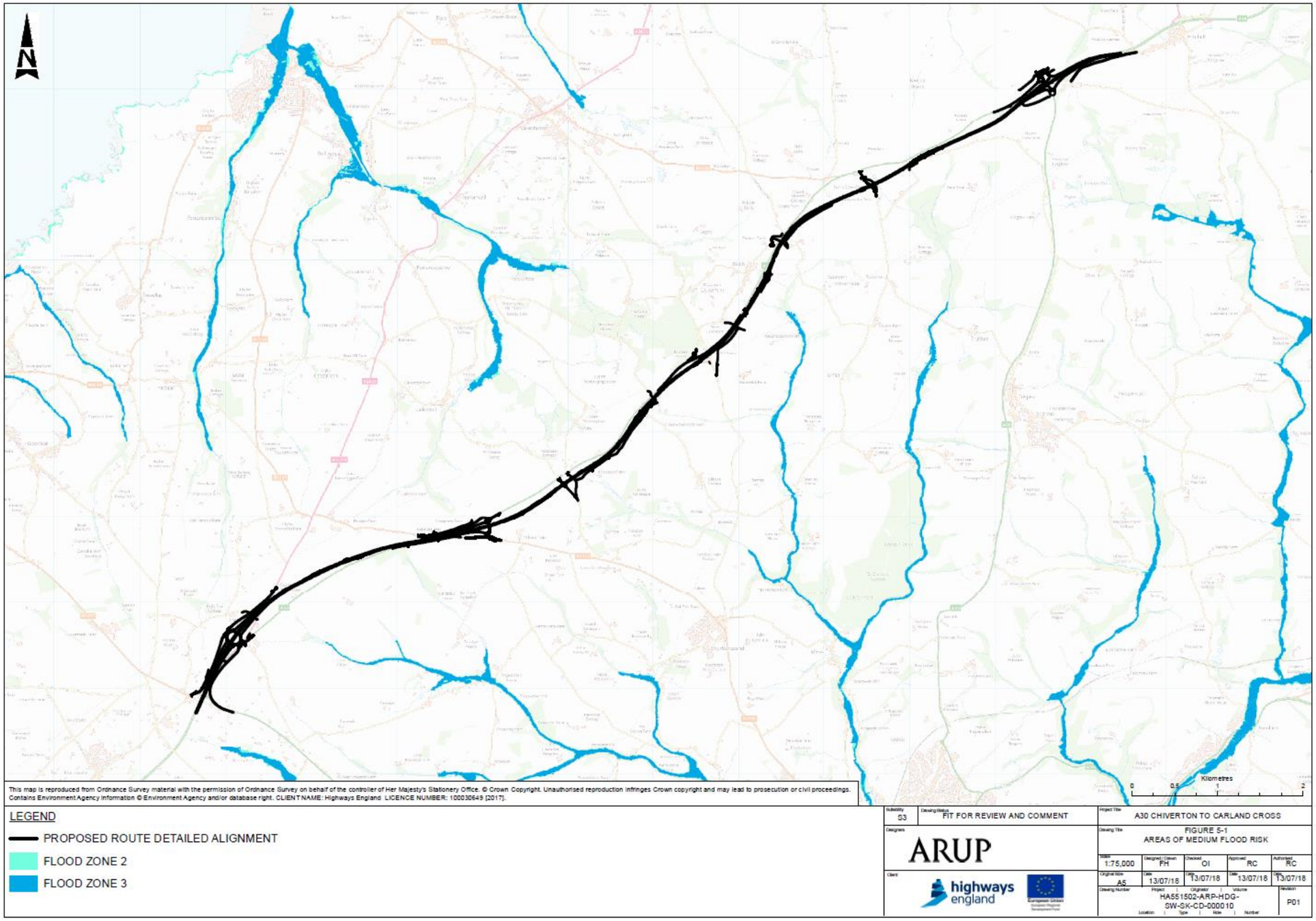


Figure 12.1 EA Fluvial Flood Zones 2 and 3 – Whole Route

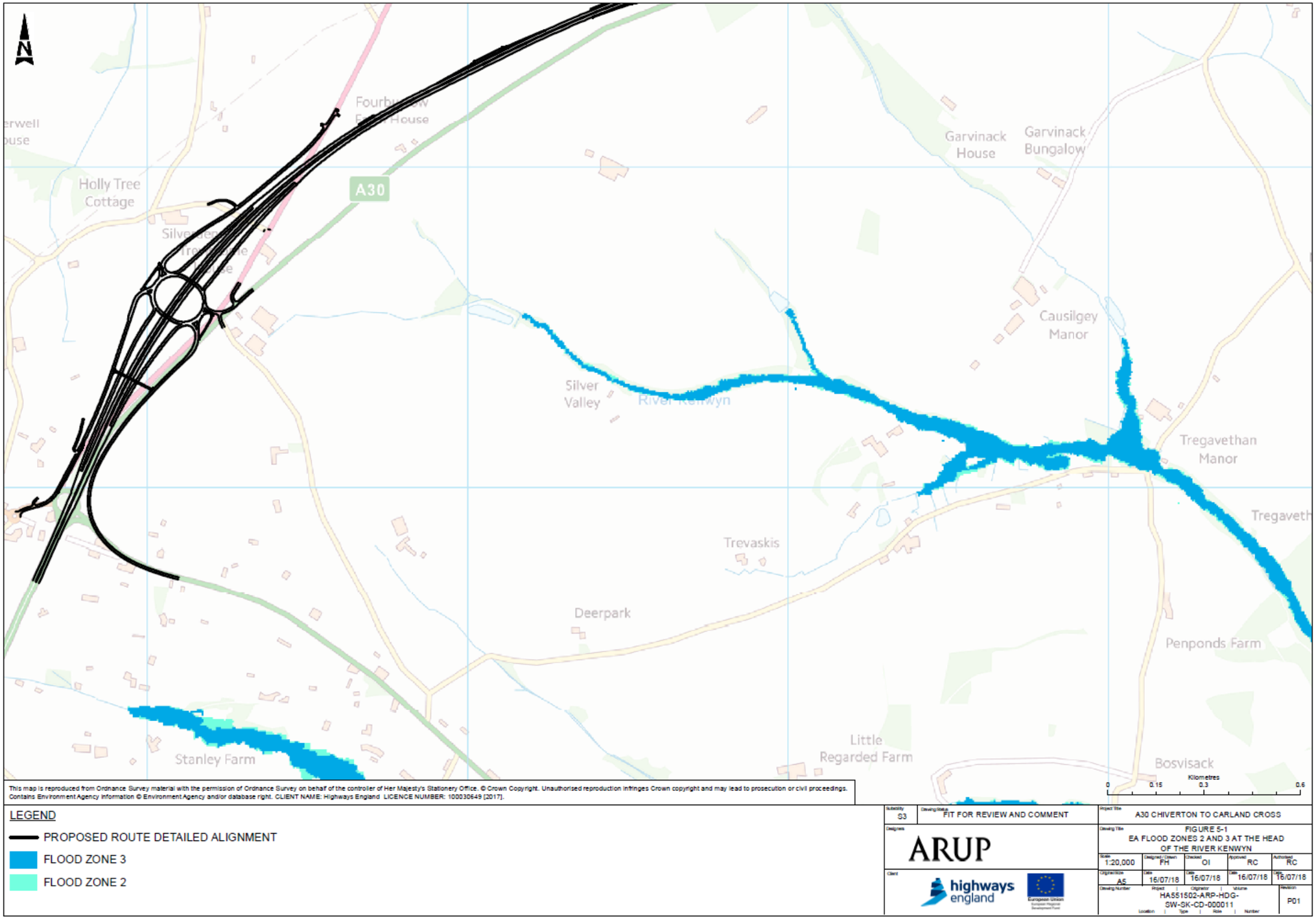


Figure 12.2 EA Fluvial Flood Zones 2 and 3 at the Head of the River Kenwyn

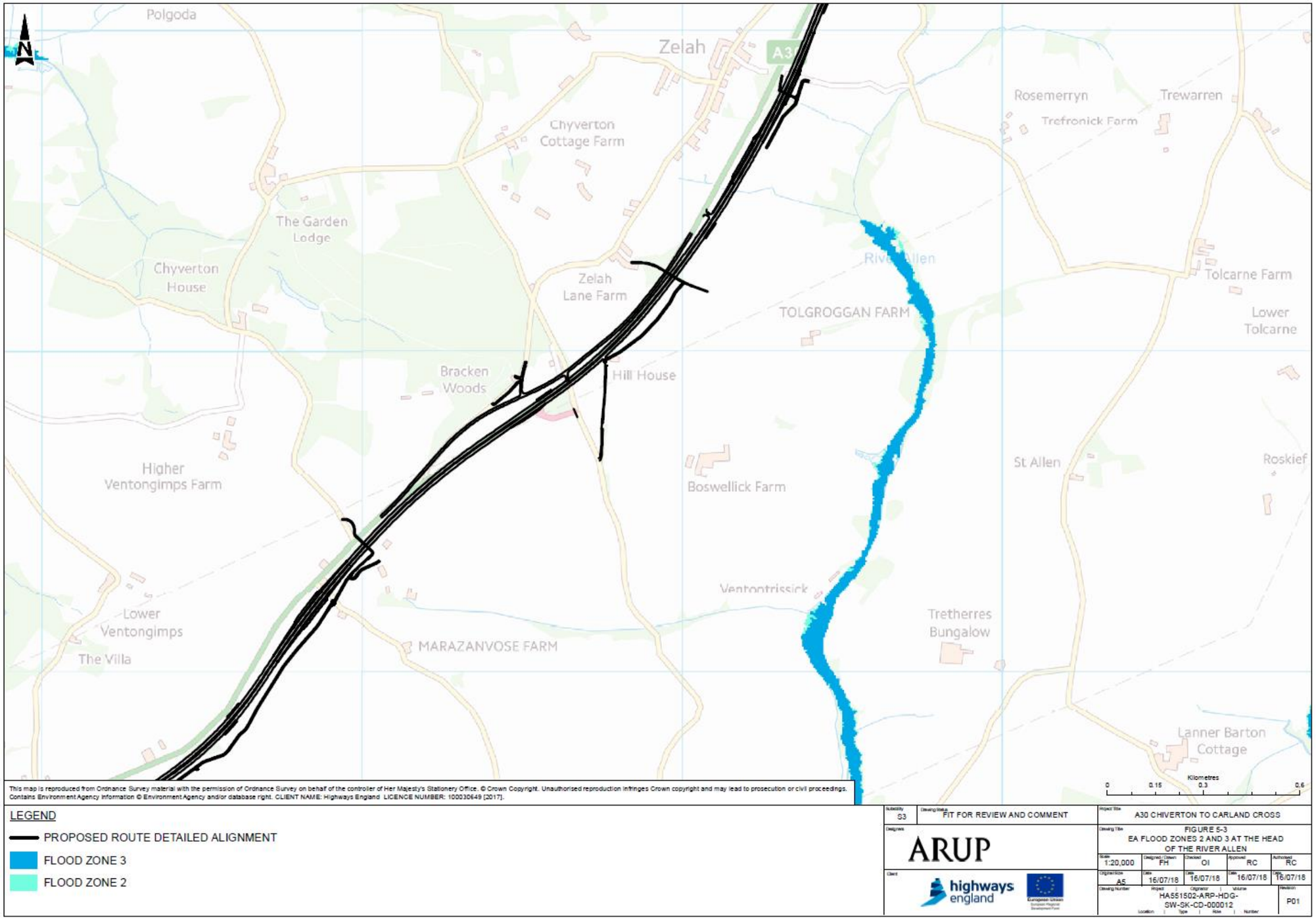


Figure 12.3 EA Fluvial Flood Zones 2 and 3 at the Head of the River Allen

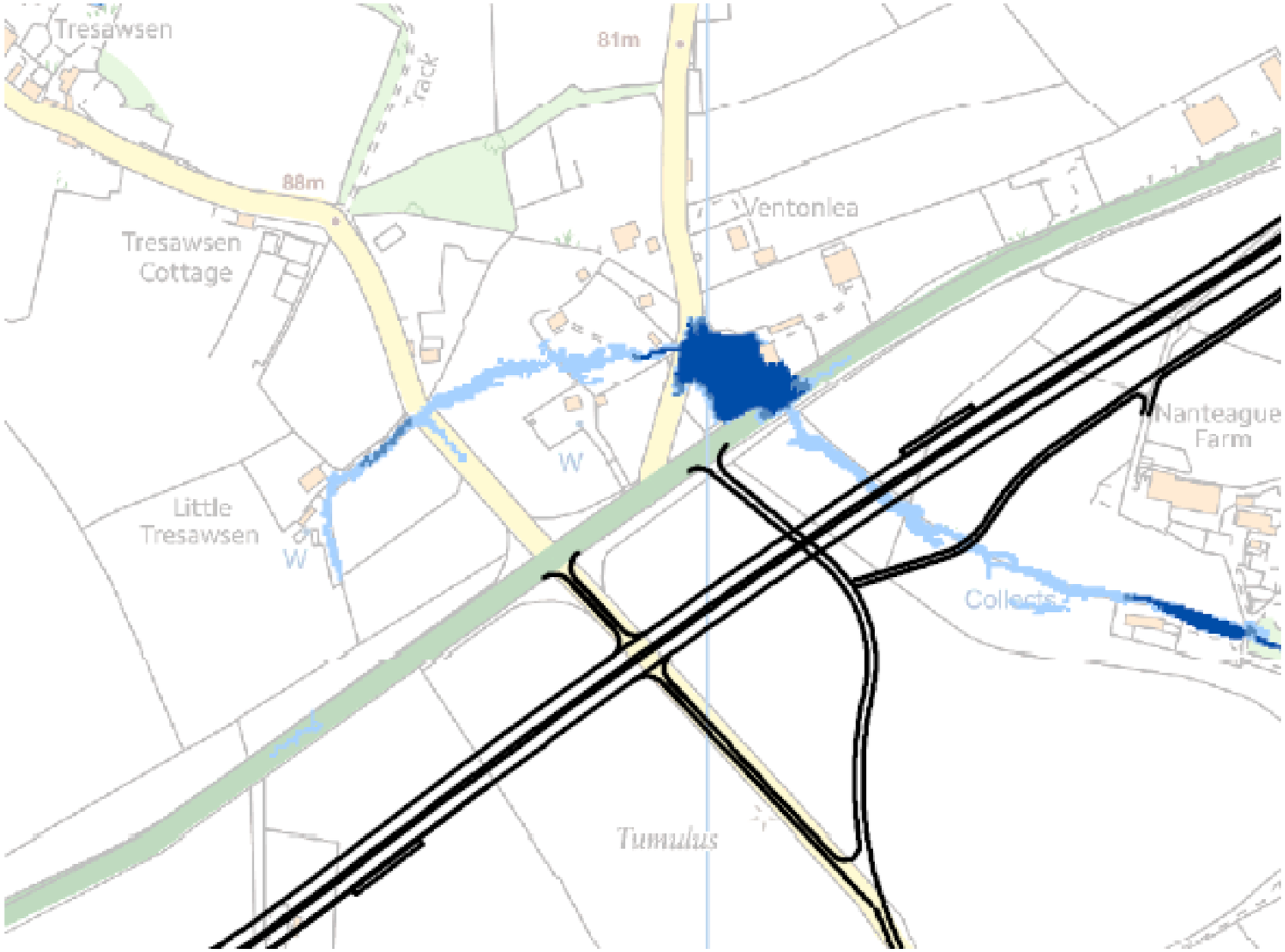
Figure 12.4 EA Flood Map Zelah - Surface Water Flooding

Figure 12.5 EA Flood Map Zelah Bypass - Surface Water Flood [Ref 13.1]

LEGEND

- PROPOSED ROUTE DETAILED ALIGNMENT
- HIGH RISK - GREATER THAN 3.3% CHANCE OF FLOODING
- MEDIUM RISK - BETWEEN 1% AND 3.3% CHANCE OF FLOODING
- LOW RISK - BETWEEN 0.1% AND 1% CHANCE OF FLOODING

Figure 12.6 EA Flood Map Marazanvose - Surface Water Flooding



LEGEND

- PROPOSED ROUTE DETAILED ALIGNMENT
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- MEDIUM RISK - BETWEEN 1% AND 3.3% CHANCE OF FLOODING
- LOW RISK - BETWEEN 0.1% AND 1% CHANCE OF FLOODING

Figure 12.7 EA Flood Map Tresawsen - Surface Water Flood

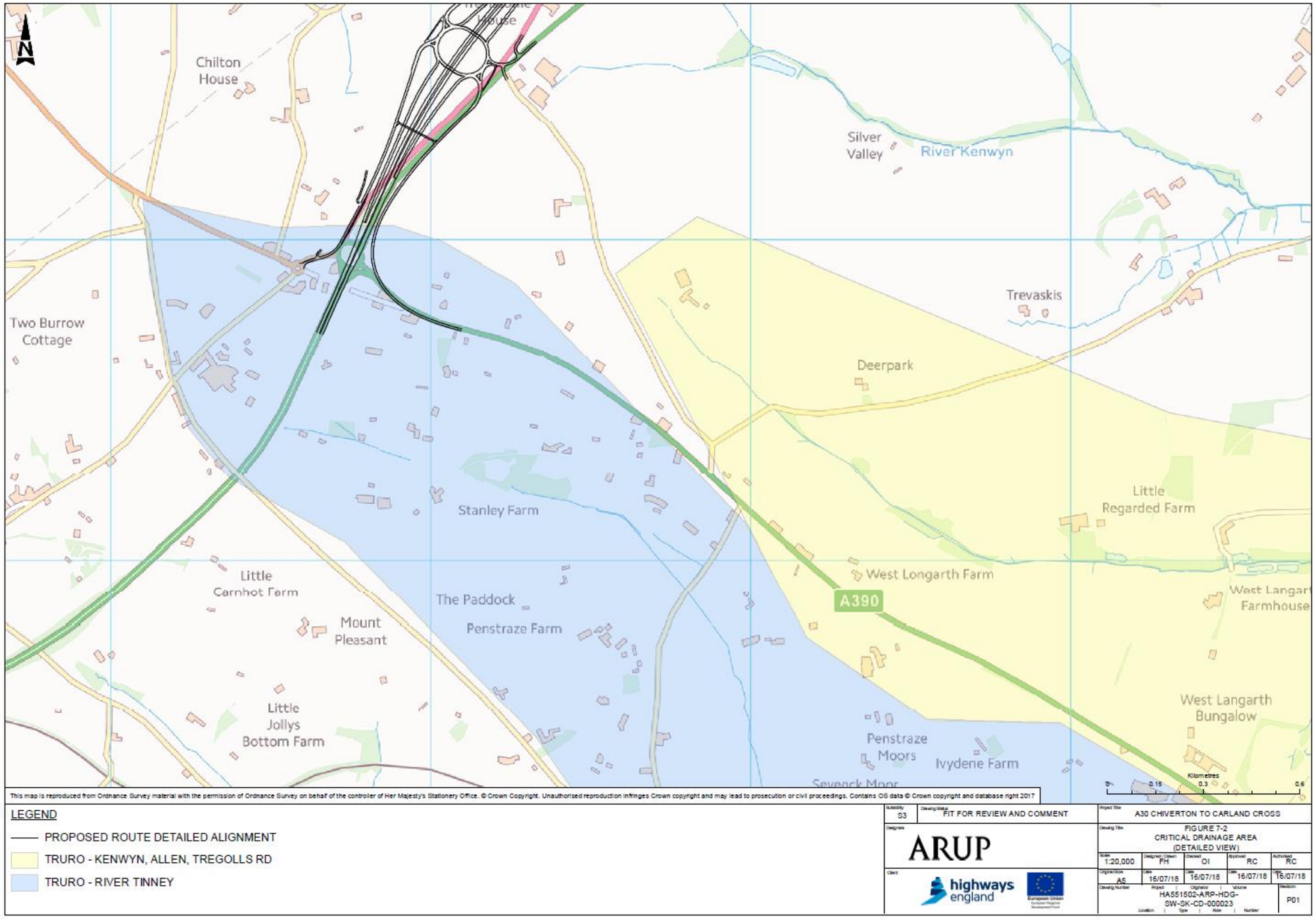

Figure 12.8 Cornwall Council - Critical Drainage Area

13 Abbreviations List

CDA	Critical Drainage Area
CC	Cornwall Council
DMRB	Design Manual for Roads and Bridges
EA	Environment Agency
FWMA	Flood and Water Management Act
GRR	Greenfield Runoff Rate
HADDMS	Highways England's Drainage Data Management System
HCD	Highway Construction Details
HE	Highways England
LLFA	Lead Local Flood Authority
MCHW	Manual of Contract Documents for Highway Works

14 Bibliography

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