8 Nancevallon, Camborne TR14 9DE
Extension to Existing Property

Surface Water Drainage Strategy & Flood Risk Assessment Report

Report Ref. 22021-NVL-RP-0001
Issue 01
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8 Nancevallon, Camborne TR14 9DE

Extension to Existing Property

Surface Water Drainage Strategy & Flood Risk Assessment Report

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Steve Parker BEng (Hons) CEng CWEM MCIWEM
Civil Engineer
SP Civil Design Ltd.

Document History

REF: 22021-NVL-RP-0001

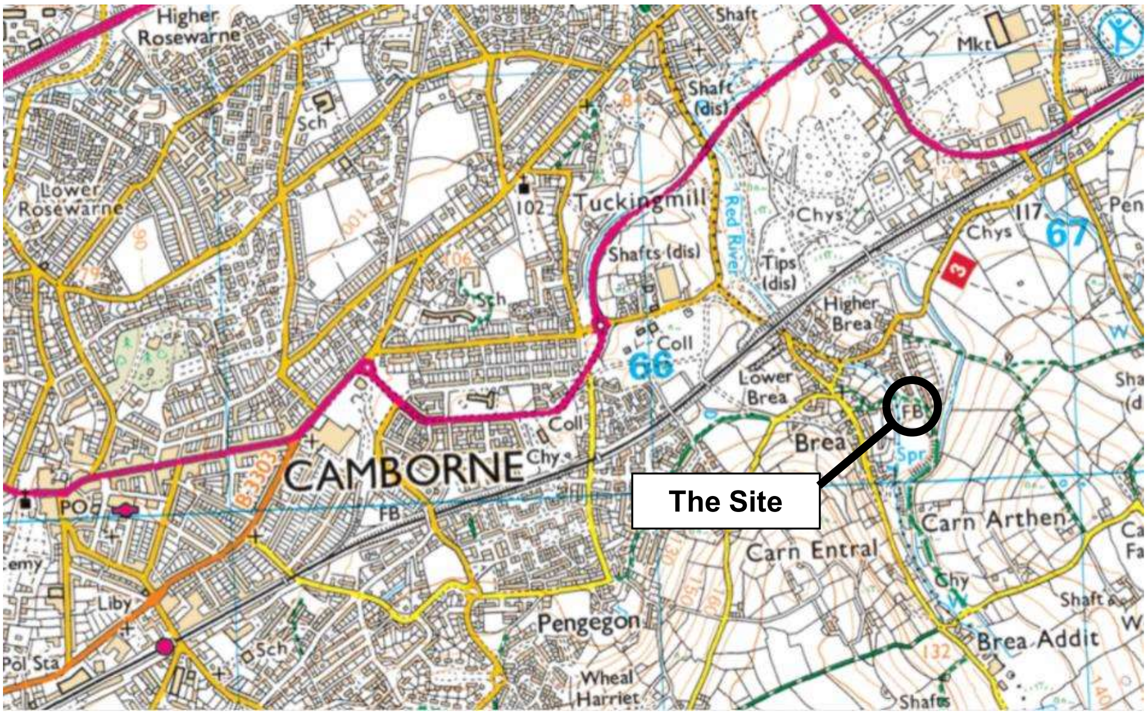
Issue	Description	Originated	Checked	Reviewed	Date
01	First Issue	S. Parker	S. Parker	S. Parker	01.08.2023

Introduction

The client is proposing to construct an extension to the existing dwelling at 8 Nancevallon, Higher Brea, Camborne TR14 9DE, for which a planning application will be required. SP Civil Design Ltd. has been commissioned to develop a Surface Water Drainage Strategy for the proposed development.

While developing the design, it has become apparent that, while the site occupies less than 1 hectare and is not located in a Critical Drainage Area, it is within Zone 3 for planning purposes and is at high risk of flooding. As such, a Flood Risk Assessment is also required.

A site location plan and aerial photograph are given in Figures 1 & 2 below; the architect's proposals are included here in Appendix A; and the proposed site layout is shown on drawing 22021-NVL-DR-1000, included here in Appendix B.



The Site

Figure 1 - Site Location Plan

(c) 2023 Microsoft Corporation. Image courtesy of Ordnance Survey

Figure 2 - Aerial Photograph

Imagery (c) 2023 CNES / Airbus, Getmapping Plc, Infoterra Ltd & Bluesky, Maxar Technologies. Map data (c) 2023 Google

The primary aims of this Surface Water Drainage Strategy & Flood Risk Assessment Report are to demonstrate that suitable & robust drainage solutions will be provided for this proposed development and to provide an objective assessment of the risks of flooding from various sources associated with the proposed development, in line with the National Planning Policy Framework (NPPF), Planning Practice Guidance (PPG) and Drainage Guidance for Cornwall (DGfC).

Site Description

The approximate OSGR for the site is SW 6661 4018. Presently, the site consists of a bungalow, with some minor structures and hard & soft landscaping. It is proposed to construct a single-storey extension to the bungalow, with new associated hard & soft landscaping. Design of these works is being undertaken by others.

The site is broadly L- shaped. It is bounded to the north by the road, to the east & west by neighbouring properties and to the south & west by a small field / open ground, with the Red River circa 25 metres west of the property. Topography of the site itself generally slopes from north-east to south-west towards the Red River, while the general area slopes from south-east to north-west. Approximately 380 metres north-west of the site lies the MLN4 Mainline Paddington to Penzance railway, which runs broadly east to west on a steep embankment, with arches formed through the embankment in two locations to accommodate a road and a footpath.

Environment Agency online flood maps show the site to be at high risk of flooding from rivers and within Flood Zone 3 (i.e. greater than 1% chance of being flooded in any given year). See Figure 3 for details, while Figure 4 shows the wider local area.

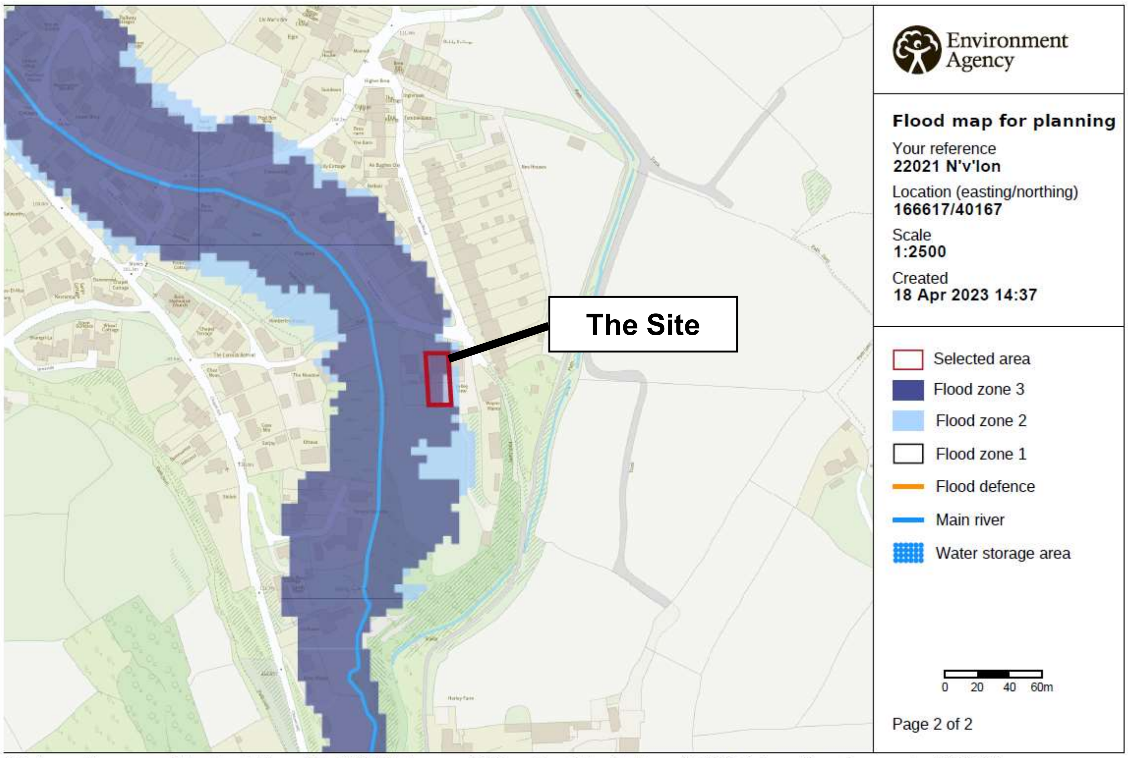


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Figure 3 – Extract From Environment Agency Flood Map for Planning
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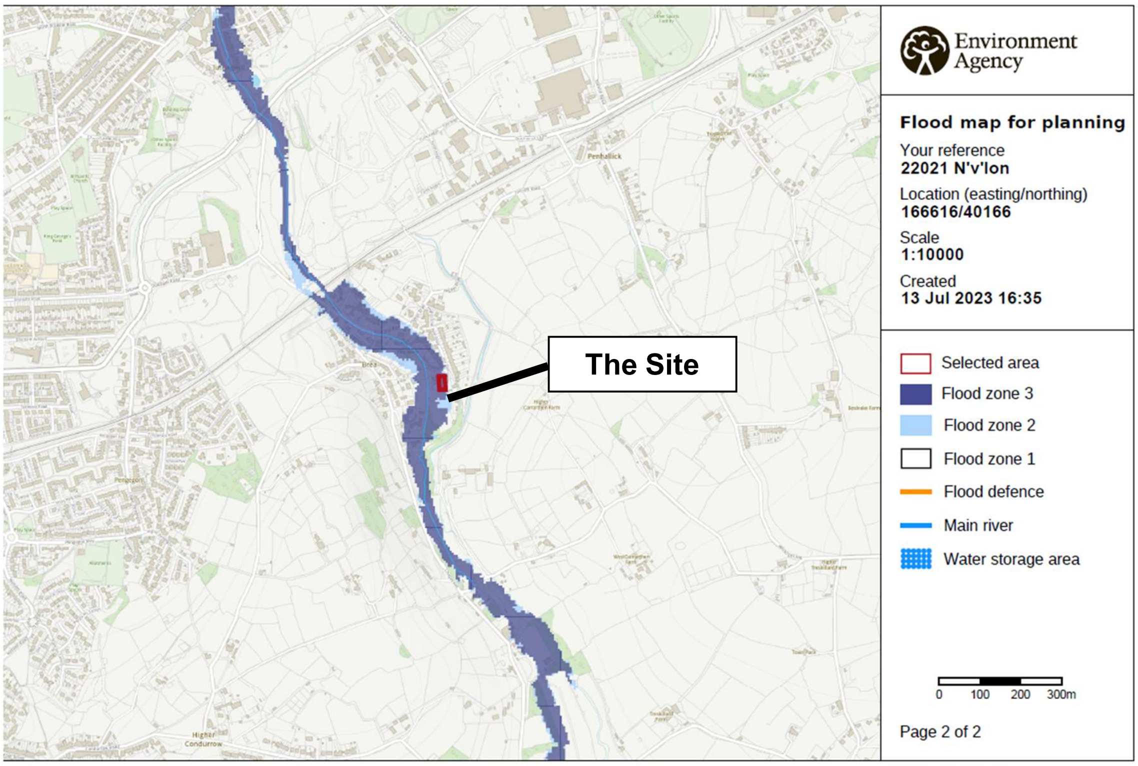

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Figure 4 – Extract From Environment Agency Flood Map for Planning
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The Cornwall Strategic Flood Risk Assessment (SFRA) confirms this information. It also confirms that the site is at medium risk of flooding from surface water (i.e. between 1% & 3.33% chance of being flooded in any given year). The Environment Agency online flood maps show that, for this medium risk of surface water flooding, water depth should be less than 300mm and velocity less than 0.25 m/s.

Cornwall SFRA also confirms that the nearest watercourse, the Red River, is designated Main River. It further confirms that the site is not located within a Critical Drainage Area.

Enquiries with South West Water have confirmed that there is a 150mm diameter public combined sewer and a 3” diameter water main in Nancevallon, immediately north of the property.

Information from the client suggests that surface water from the existing property is disposed of via a soakaway in the garden, which will be either within the footprint of or very close to the new extension and will require replacement.

A search of www.magic.gov.uk highlights the following within 500m of the site:

- West Cornwall Bryophytes SSSI circa 500m west of the site;
- Betty Adit Tailings Works Scheduled Monument circa 300m south of the site;
- The site lies within the Cornwall and West Devon Mining Landscape World Heritage Site;
- 3nr. Grade II Listed Buildings, all circa 450 metres north of the site.

No other areas of interest were found, such as Areas of Outstanding Natural Beauty, National Nature Reserves, Local Nature Reserves, RAMSAR Sites, Special Areas for Conservation, Special Protection Areas, Drinking Water Safeguard Zones, Groundwater Source Protection Zones, etc.

There are no Tree Protection Orders (TPOs) or TPO areas either on or immediately adjacent to the site, the closest is circa 1.2 km north-west of the site.

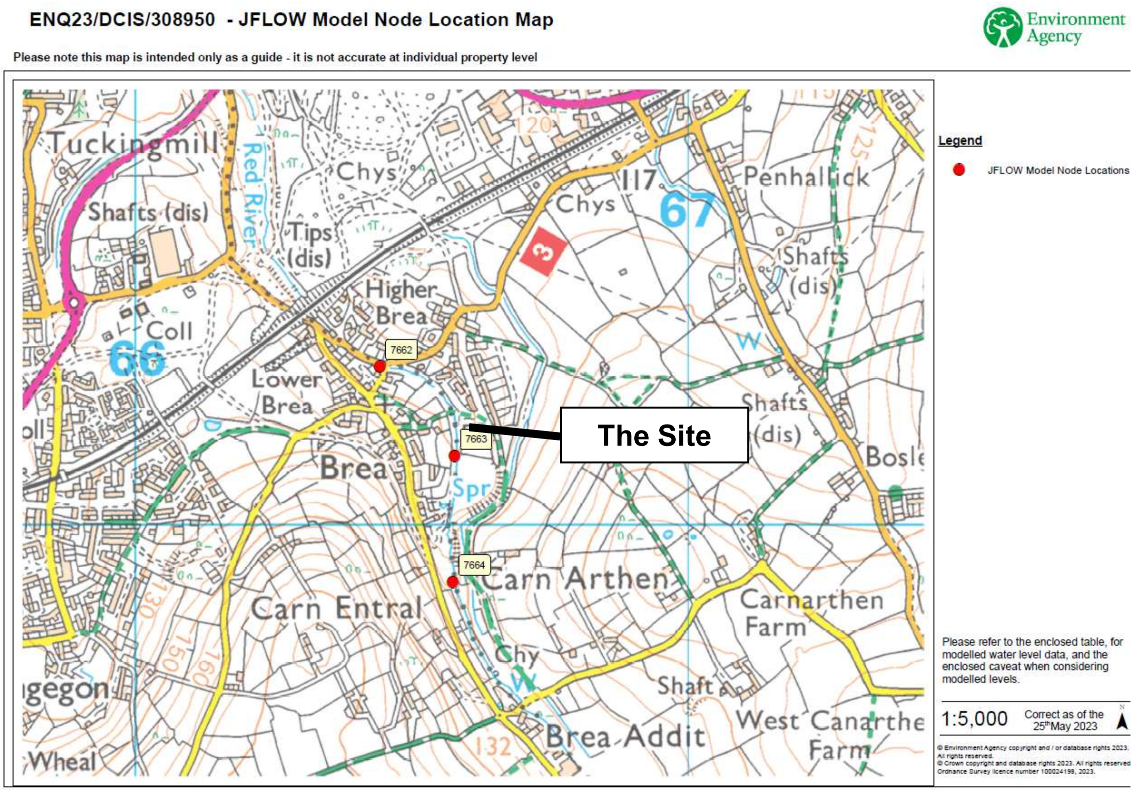
It is considered that the drainage elements associated with the proposed development will have no impact upon any areas of interest.

As part of our investigations, SP Civil Design Ltd. undertook a site visit in June 2023. This confirmed that the Red River flows in open channel away from the site, before entering a culvert at Brea Village Screen, circa 300 metres north-west of the property (OS NGR SW 66379 40325). The culvert passes through an arch through the main railway embankment before outfalling into open channel again some 120 metres north-west of the screen. The route of the river can be seen in Figures 1, 3 & 4 above.

Predicted Flooding Mechanisms

In addition to the information given above, the Environment Agency were consulted & asked to provide more detailed flood risk information in the form of their “Product Data 4”. This has confirmed that they have no recorded instances of flooding at this site.

The data further confirms that, at the closest modelled data point (7663), the modelled 1% Annual Exceedance Probability (AEP) (or 1 in 100 year Return Period) river level is 100.98m AOD, while the 0.1% AEP (or 1 in 1000 year Return Period) level is virtually the same at 100.96m AOD. The locations of the modelled data points relative to the site are shown in Figure 5, while the modelled flood levels are shown in Figure 6.


ENQ23/DCIS/308950 - JFLOW Model Node Location Map

Please note this map is intended only as a guide - it is not accurate at individual property level

Legend

● JFLOW Model Node Locations

Please refer to the enclosed table, for modelled water level data, and the enclosed caveat when considering modelled levels.

1:5,000 Correct as of the 25th May 2023

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Figure 5 –Environment Agency Hydraulic Modelling Node Locations
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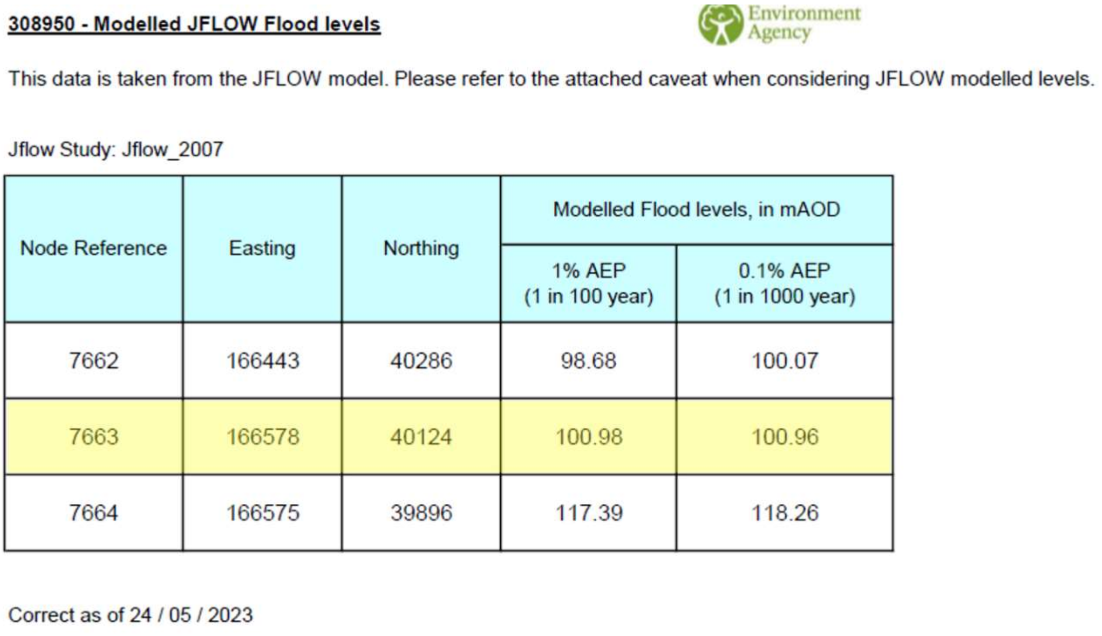

308950 - Modelled JFLOW Flood levels

This data is taken from the JFLOW model. Please refer to the attached caveat when considering JFLOW modelled levels.

Jflow Study: Jflow_2007

Node Reference	Easting	Northing	Modelled Flood levels, in mAOD	
			1% AEP (1 in 100 year)	0.1% AEP (1 in 1000 year)
7662	166443	40286	98.68	100.07
7663	166578	40124	100.98	100.96
7664	166575	39896	117.39	118.26

Correct as of 24 / 05 / 2023

Figure 6 –Environment Agency Hydraulic Modelling Flood Levels

However, the Environment Agency included a caveat / disclaimer with these figures, which states that, while the information is suitable for use *"at a broad catchment scale"*, the modelling method used *"may… fail to produce satisfactory results in some locations"* and is *"not suitable for use in site specific Flood Risk Assessments"*.

Information provided by the architect shows Finished Floor Level in the property as 99.52m AOD, with surrounding ground levels set 150mm below this. These flood levels imply that the property would flood internally to a depth of circa 1.4 metres in a 1% AEP event, which is a considerable depth. If this is accurate, then we consider that far lesser events than a 1% AEP event would also result in significant flooding across the site and the wider local area. However, the Environment Agency has no recorded instances of flooding at this site.

Furthermore, the current occupier of the property states that no flooding has occurred in the 15 years he has lived in the property and claims that the river has not come close to bursting its banks in this time. Anecdotal evidence from the next door neighbour suggests that the site last flooded in the early 2000's, although this did not breach the property threshold (both properties have the same threshold level).

As the site has not flooded in at least the last 20 years, we would therefore question both the magnitude of the flood levels tabulated in Figure 6 and the extent of flood plain shown in Figures 3 & 4. We do not consider that this represents what would happen on site during an extreme storm event.

We consider that the likely flooding mechanism during an extreme storm event is as follows:

- flows within the Red River are likely to stay within the open channel until they reach the Brea Village Screen, where the river enters a culvert;
- this culvert presents the first significant restriction to flow downstream of the site, as it has a smaller cross-sectional area than the open channel and has a much slacker gradient than the open channel. This is likely to be the point at which flows in the system start to back up;
- this backing up will be exacerbated if the screen becomes blocked with debris washed down the channel;
- ground levels at the screen (circa 96.1m AOD) are lower than upstream, so water will overtop the river bank here rather than backing up significantly upstream. The north (road side) bank is lower than the south, so flows would overtop here;
- once water has overtopped the north bank, it will then flow downhill along the road to the north-west, passing north around Pendeen House. The road then becomes a footpath that continues downhill, running through one of the arches through the railway embankment, providing the preferential overland flow path for the water. Although there appear to be minor low spots along this route which would cause some ponding, it generally falls to the north-west. This route broadly follows the same route as the river culvert;
- on the other side of the railway embankment, the river culvert becomes an open channel again and overland flows will re-enter the river at this point, with ground levels at circa 95.4m AOD;

- as reported above, ground levels at the property are circa 99.4m AOD, more than 3 metres higher than ground levels at the village screen. We consider it to be far more likely that river flows would overtop the north bank at the screen and follow the flow path as described, rather than back up and affect the site & surrounding areas.

The route of this assumed flow path is shown on drawing 22021-NVL-DR-1010, included here in Appendix C.

Figures 3 & 4 above suggest that the Environment Agency's hydraulic model does not take into account the presence of the arch through the railway embankment, which would provide a preferential overland flow route for any flood water, thereby reducing flood levels from those tabulated in Figure 6. The client has raised a Flood Map Challenge with the Environment Agency, which is currently being considered.

Surface Water Drainage Proposals

Infiltration is the preferred means of disposal of surface water, in accordance with the drainage hierarchy of Building Regulations 2010 Section H3 - Rainwater Drainage (2015 Edition), also Cornwall Council's Drainage Guidance, Version 2 - January 2010, which states that "*drainage by infiltration should be utilised unless it is not practicable to do so.*"

In situ percolation testing was undertaken in July 2023. 1nr. trial pit was excavated and tests carried out in accordance with the methodology given in BRE Digest 365. Access constraints on site limited both the location & depth of the trial pit. However, test results have determined the soil infiltration rate (f) to be 2.33x10-4 m/s. It is therefore concluded that ground conditions on the site are suitable for infiltration drainage. The results of the percolation testing are included here in Appendix D.

It is proposed to drain the property roofs by conventional gutters & downpipes, with flows conveyed by underground pipes to 1nr. soakaway located in the rear garden of the property. Inspection chambers will be provided at changes of direction & gradient and a catchpit will be provided at the inlet to the soakaway. The new driveway will be constructed of a permeable material to reduce the size of the soakaway and to provide some visual variety of surfacing.

The soakaway will be of the modular plastic "crate" type as these provide the most efficient storage and give flexibility in their layout. It will be located observing the minimum proximities required from the public highway, buildings and other soakaways, as required under Building Regulations Part H.

The layout of the proposed surface water drainage infrastructure is shown on drawing 22021-NVL-DR-1000, included here in Appendix B. Hydraulic design of the pipework & soakaway has been undertaken using Causeway Flow hydraulic modelling software, with the design utilising the worst case 100 year storm with rainfall intensities increased by 50% to allow for the effects of climate change over the lifetime of the development. Impermeable areas have also been increased by 10% to allow for any future "urban creep". The results of this modelling are included here in Appendix E.

Standing Advice for Minor Extensions

In line with Defra's guidance on preparing Flood Risk Assessments, the Environment Agency's standing advice applies to this site, as the development is classed as a minor extension (not exceeding 250m^2) in Flood Zone 3. The plan area of the proposed extension is 115m^2.

This standing advice stipulates that floor levels should be either no lower than existing or at least 300mm above the estimated flood level. The architect's plan in Appendix A shows the proposed floor level in the extension is the same as existing floor level in the rest of the dwelling, at 99.52m AOD, which is in line with the standing advice.

The standing advice also states that flood resistant materials should be used to at least 300mm above the estimated flood level. From the Environment Agency's hydraulic modelling in Figure 6 above, the 1% AEP flood level is 100.98m AOD, thereby implying that flood resistant materials should be used to at least 101.28m AOD or 1.76m above proposed floor level.

As stated above, we question the accuracy of the modelled flood levels and the client has raised a Flood Map Challenge with the Environment Agency, which may result in the site being re-classified outside Flood Zone 3. We therefore consider that providing flood resistant materials to such a depth to be unreasonable in the circumstances. Instead, as the Environment Agency has no record of flooding at this site, as the property occupier & neighbour confirm the site has not flooded for at least 20 years and as the floor level proposed for the extension is the same as the existing dwelling, then we propose that there is no need to provide flood resistant materials in this case.

Flood Risk Assessment

In line with National Planning Policy Framework (NPPF) guidance on the assessment of development flood risk, development proposals need to consider flood risk from all sources.

Fluvial Flooding:

The Environment Agency & Cornwall SFRA online flood maps show the site to be at high risk of flooding from rivers and within Flood Zone 3B for planning purposes. As stated above, the client has raised a Flood Map Challenge with the Environment Agency, which is currently being considered.

However, until this has been determined, for the purposes of this Flood Risk Assessment, fluvial flood risk is therefore considered to be high for both the pre- and post-development scenarios.

Groundwater Flooding:

Groundwater flooding is linked to the ability of the ground to hold water. The Cornwall SFRA states: *"Due to its geology Cornwall has only minor aquifers and generally does not experience much groundwater type flooding"*.

Groundwater flood risk is therefore considered to be very low for both the pre- and post-development scenarios.

Flooding from Drains or Sewers:

There is an existing public sewer in Nancevallon and the existing property discharges foul drainage to this. Although the property is set slightly lower than the road, no evidence has been received to suggest that any flooding has occurred from this sewer in the past.

Risk of flooding from drains or sewers is therefore considered to be very low for both the pre- and post-development scenarios.

Overland Flows:

The Environment Agency & Cornwall SFRA online flood maps show the site to be at medium risk of flooding from surface water, although both depth & velocity of flooding are predicted to be low. The new extension would be built with a threshold 150mm above surrounding ground level, as is the case with the existing property, so any surface water flows would flow around the property to the watercourse.

Risk of flooding from overland flows is therefore considered to be medium for both the pre- and post-development scenarios.

Downstream Flood Risk Due to Site Run-Off:

Overland flow routes show that the existing site could potentially contribute flows to the Red River. The existing soakaway will almost certainly not have been designed to modern standards, so is likely to be unable to cope with the design standards given above. Post-development, the drainage system would capture all flows up to the 1 in 100 year Return Period, plus allowances for climate change and urban creep, and retain them on site for infiltration into the ground.

Risk of downstream flooding from site run-off is therefore considered to be medium for the pre-development scenario, reducing to very low for the post-development scenario.

Flooding From Artificial Sources:

The Environment Agency online flood maps show the site to be at no risk of flooding from reservoirs. There are no other artificial water bodies local to the site that could be considered a flood risk. The nearest water mains are small in diameter and are located such that any flooding from these would not affect the site.

Risk of flooding from artificial sources is therefore considered to be very low for both the pre- and post-development scenarios.

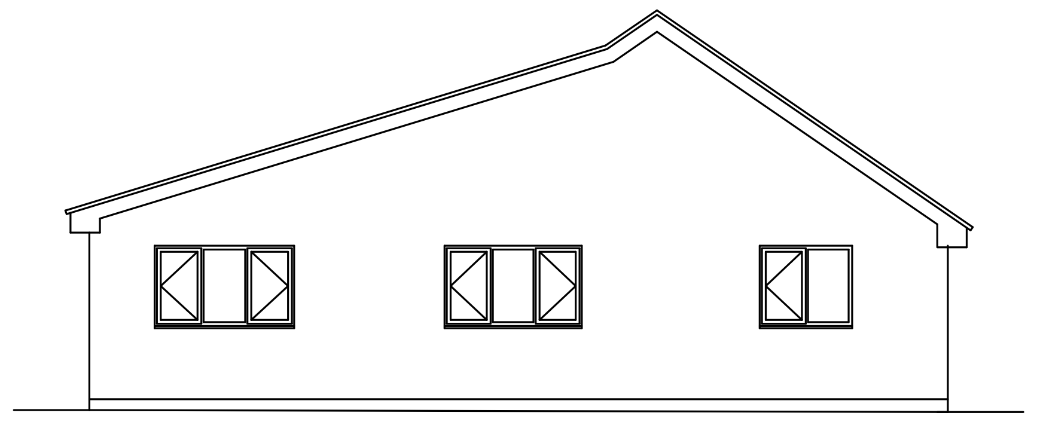
The results of comparing pre- & post-development flood risks are summarised as follows:

	Pre-Development Flood Risk	**Post-Development Flood Risk**
Fluvial Flooding	**High**	**High**
Groundwater Flooding	**Very Low**	**Very Low**
Flooding from Drains or Sewers	**Very Low**	**Very Low**
Overland Flows	**Medium**	**Medium**
Downstream Flood Risk Due to Site Run-Off	**Medium**	**Very Low**
Flooding From Artificial Sources	**Very Low**	**Very Low**

Table 1 – Comparison Of Pre- And Post-Development Flood Risk

It is considered that flood risk to the site and surrounding areas would not be increased above the pre-development risk and, for some flooding sources, would actually be reduced, for all storms up to the 100 year Return Period, plus allowances for climate change and urban creep. The proposed surface water solution provides robust protection against flooding, both for the new extension and for existing downstream areas that may currently be subject to flooding from overland flows, providing an improvement on the current situation.

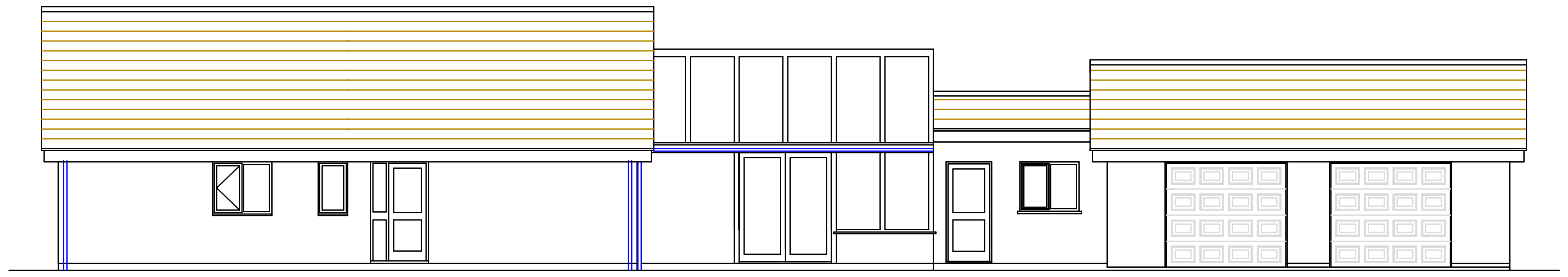
Appendix A – Architect’s Drawing



Proposed North Elevation

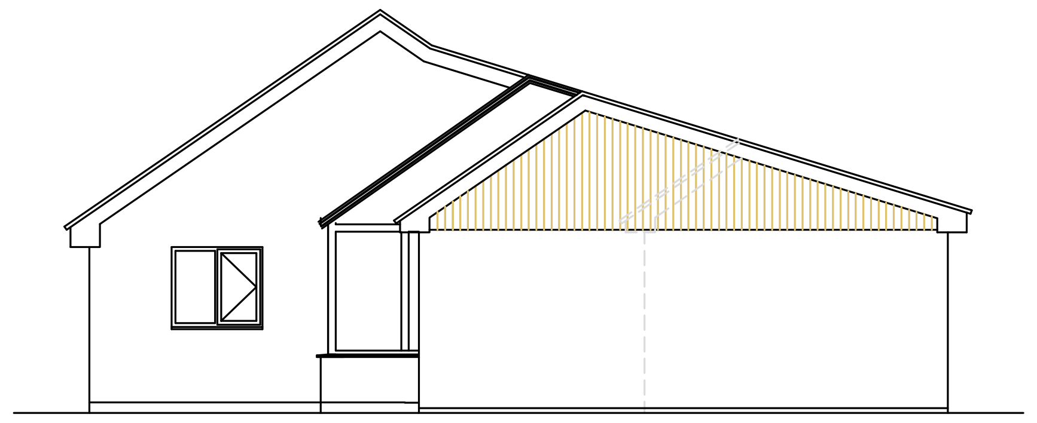
Scale 1:100

Meters



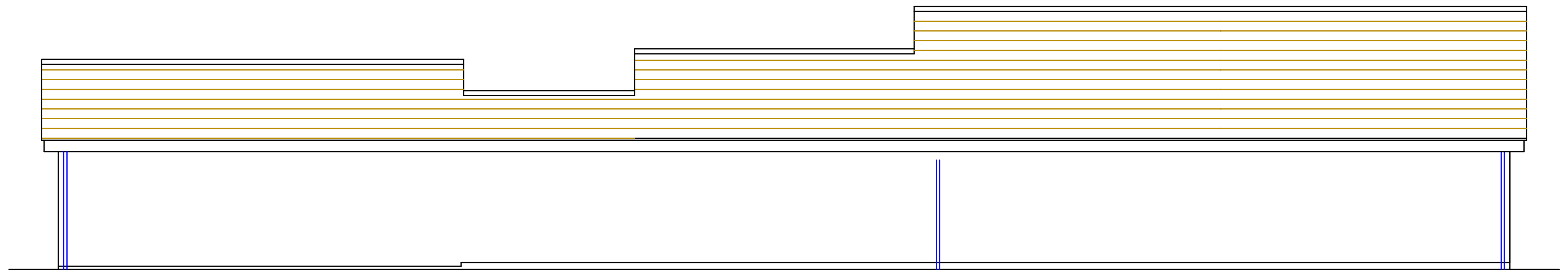
Proposed West Elevation

Scale 1:100



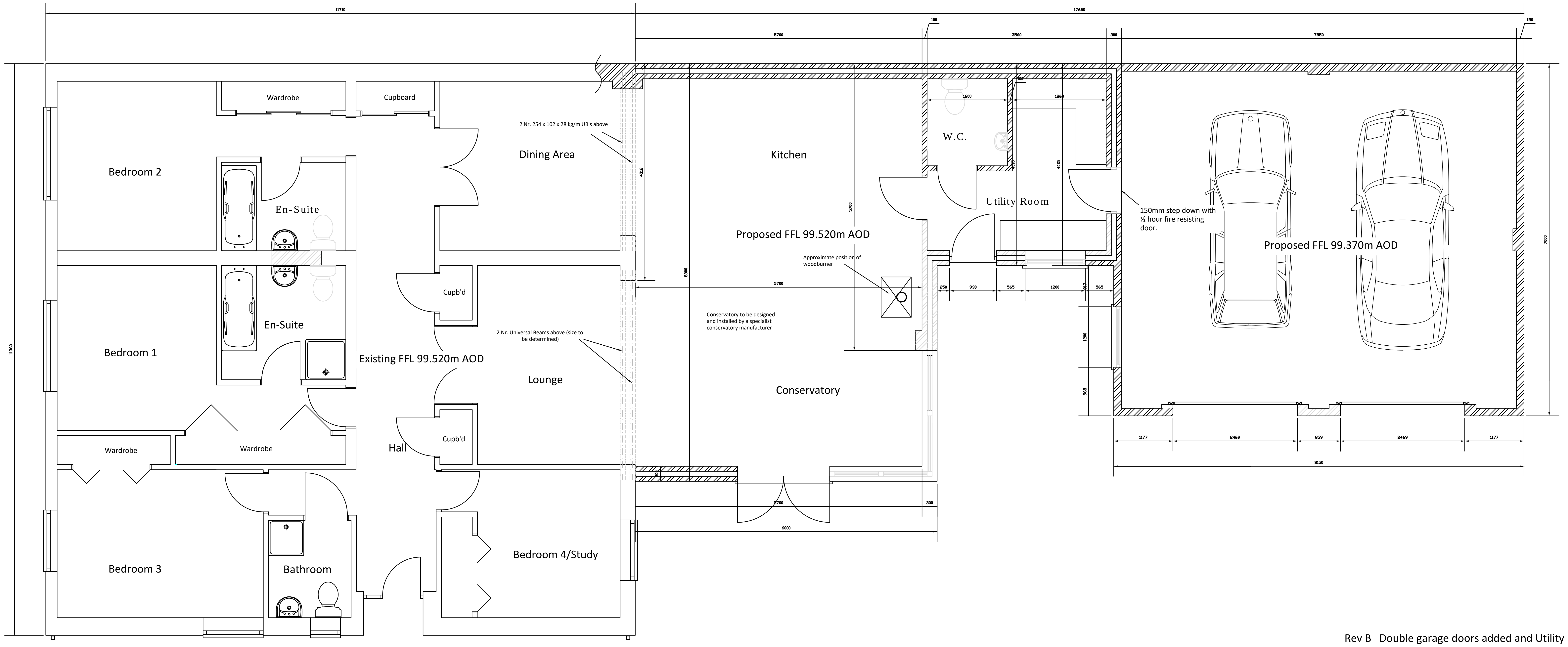
Proposed South Elevation

Scale 1:100



Proposed East Elevation

Scale 1:100



Rev B Double garage doors added and Utility Room WC widened 14-06-2023

Rev A Existing and proposed FFL above Ordnance Datum added 10-05-2023

Proposed Plan

Scale 1:50

Meters

1 0 1 2 3 4 5

Proposed Dwelling Extension & Associated Works
For Mr. I Richards
At
8 Nancevallon, Higher Brea, Camborne
Cornwall
TR14 9DE

Scale
As Shown on A1

Date
January 2023

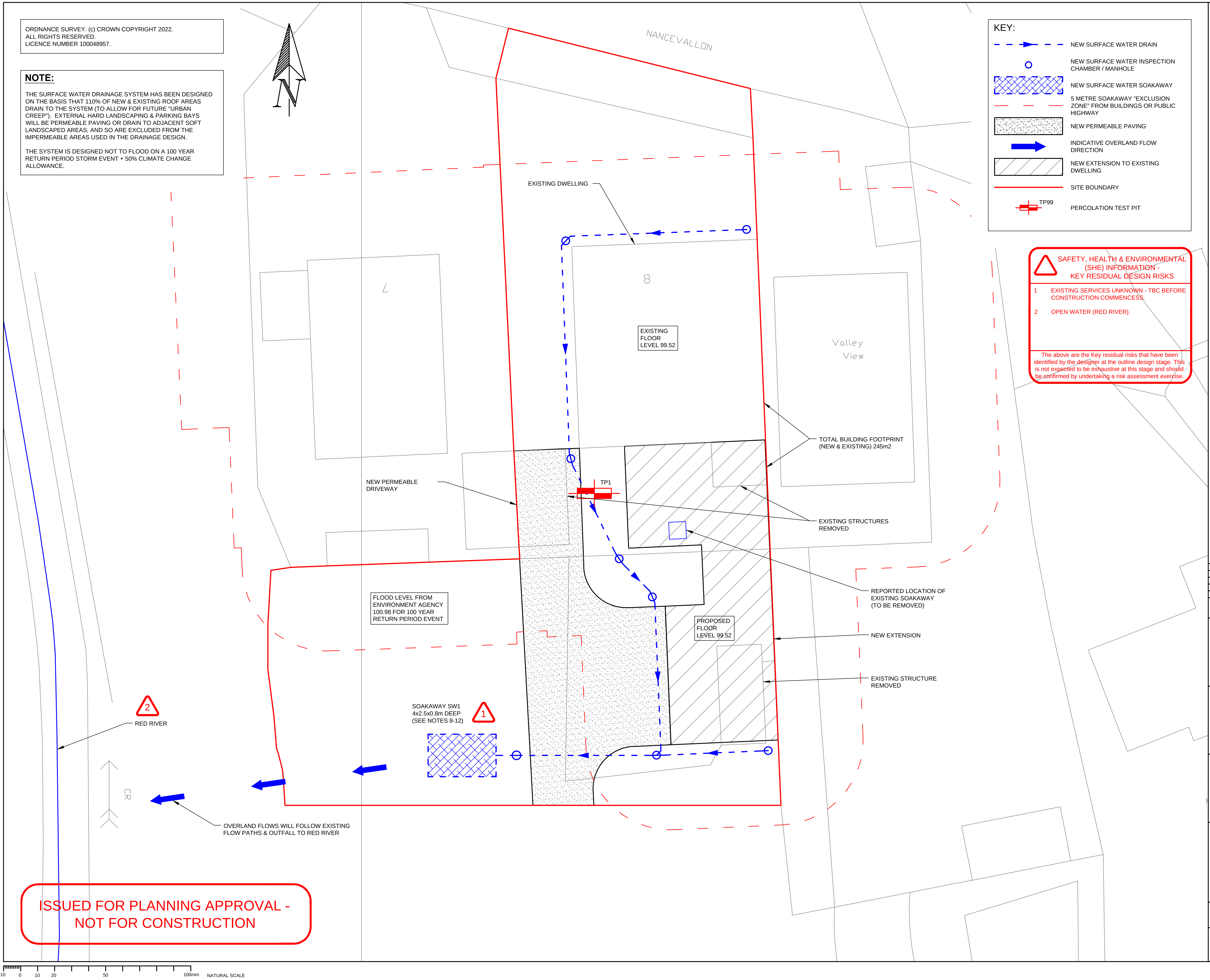
Drawing Nr.
RICHARDS/03/B

Appendix B – Drainage Drawing

NOTE:

THE SURFACE WATER DRAINAGE SYSTEM HAS BEEN DESIGNED ON THE BASIS THAT 110% OF NEW & EXISTING ROOF AREAS DRAIN TO THE SYSTEM (TO ALLOW FOR FUTURE "URBAN CREEP"). EXTERNAL HARD LANDSCAPING & PARKING BAYS WILL BE PERMEABLE PAVING OR DRAIN TO ADJACENT SOFT LANDSCAPED AREAS, AND SO ARE EXCLUDED FROM THE IMPERMEABLE AREAS USED IN THE DRAINAGE DESIGN.

THE SYSTEM IS DESIGNED NOT TO FLOOD ON A 100 YEAR RETURN PERIOD STORM EVENT + 50% CLIMATE CHANGE ALLOWANCE.



KEY:

- - ➤ - -	NEW SURFACE WATER DRAIN
○	NEW SURFACE WATER INSPECTION CHAMBER / MANHOLE
▨	NEW SURFACE WATER SOAKAWAY
— — —	5 METRE SOAKAWAY "EXCLUSION ZONE" FROM BUILDINGS OR PUBLIC HIGHWAY
▒	NEW PERMEABLE PAVING
➡	INDICATIVE OVERLAND FLOW DIRECTION
▨	NEW EXTENSION TO EXISTING DWELLING
—	SITE BOUNDARY
TP99	PERCOLATION TEST PIT

SAFETY, HEALTH & ENVIRONMENTAL (SHE) INFORMATION -
KEY RESIDUAL DESIGN RISKS

1 EXISTING SERVICES UNKNOWN - TBC BEFORE CONSTRUCTION COMMENCESS.

2 OPEN WATER (RED RIVER).

The above are the Key residual risks that have been identified by the designer at the outline design stage. This is not expected to be exhaustive at this stage and should be confirmed by undertaking a risk assessment exercise.

ISSUED FOR PLANNING APPROVAL -
NOT FOR CONSTRUCTION

NOTES

1 THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER SP CIVIL DESIGN LTD. DRAWINGS AND ANY RELEVANT ARCHITECT'S DRAWINGS.

2 ALL LEVELS ARE IN METRES UNLESS STATED OTHERWISE, TO ORDNANCE DATUM, RELATIVE TO TOPOGRAPHICAL SURVEY & DESIGN INFORMATION PROVIDED BY THE ARCHITECT.

3 ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.

4 ALL PIPEWORK & INSPECTION CHAMBERS / MANHOLES SHALL BE IN ACCORDANCE WITH BUILDING REGULATIONS PART H1 SECTION 2, UNLESS OTHER DETAILS ARE SPECIFICALLY DETAILED ON THESE DRAWINGS.

5 ALL PIPEWORK IS ASSUMED TO HAVE MINIMUM 600 COVER UNLESS STATED OTHERWISE, INCLUDING AT GULLY OUTLETS. PIPE PROTECTION MAY BE REQUIRED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS, ESPECIALLY IN TRAFFICKED AREAS.

6 WHERE ESVC OR uPVC PIPES ARE USED, 600 LONG ROCKER PIPES SHALL BE PROVIDED OUTSIDE CHAMBERS & STRUCTURES. WHERE PE PIPES ARE USED, ROCKER PIPES ARE NOT REQUIRED.

7 BUILDING DRAINAGE, i.e. ROOF GUTTERS & INTERNAL SANITARY PIPEWORK, IS TO BE DESIGNED BY OTHERS. ANY DETAILS SHOWN HERE ARE INDICATIVE ONLY.

8 SOAKAWAYS MUST BE LOCATED MINIMUM 5m AWAY FROM BUILDINGS & MINIMUM 5m AWAY FROM OTHER SOAKAWAYS / DRAINAGE FIELDS.

9 SOAKAWAY UNITS SHALL COMPRISE MODULAR GEOCELLULAR BOX STRUCTURES DESIGNED SPECIFICALLY FOR THE PURPOSE OF SUBTERRANEAN CATCHMENT & SOAKAWAY OF WATER AND SHALL HAVE MINIMUM 95% VOIDS. UNITS MUST BE INSTALLED STRICTLY IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

10 SOAKAWAY DETAILS SHOWN HERE ARE INDICATIVE ONLY. PERCOLATION TESTING WILL BE REQUIRED AT EACH SOAKAWAY LOCATION TO DETERMINE ACTUAL SOIL INFILTRATION RATES FOR DETAILED DESIGN.

11 TRIAL PITS ARE REQUIRED TO BE DUG AT EACH SOAKAWAY LOCATION TO CONFIRM THAT THE WATER TABLE IS AT LEAST 1m BELOW THE BASE OF THE SOAKAWAY.

12 NO CHANGES TO DRAINAGE SIZING, CONFIGURATION OR LAYOUT SHOULD BE MADE WITHOUT FIRST CONSULTING THE DESIGNER.

Rev.	Drawn	Chkd.	Apprvd.	Date	Description
01	SDP	SDP	SDP	01/08/23	ISSUED FOR APPROVAL

Client
IAN RICHARDS

Project
EXTENSION TO 8 NANCEVALLON,
CAMBORNE TR14 9DE

Drawing Title
CONCEPTUAL SURFACE WATER DRAINAGE LAYOUT

SP CIVIL DESIGN LTD.
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www.spcivildesign.co.uk
Email: steve@spcivildesign.co.uk

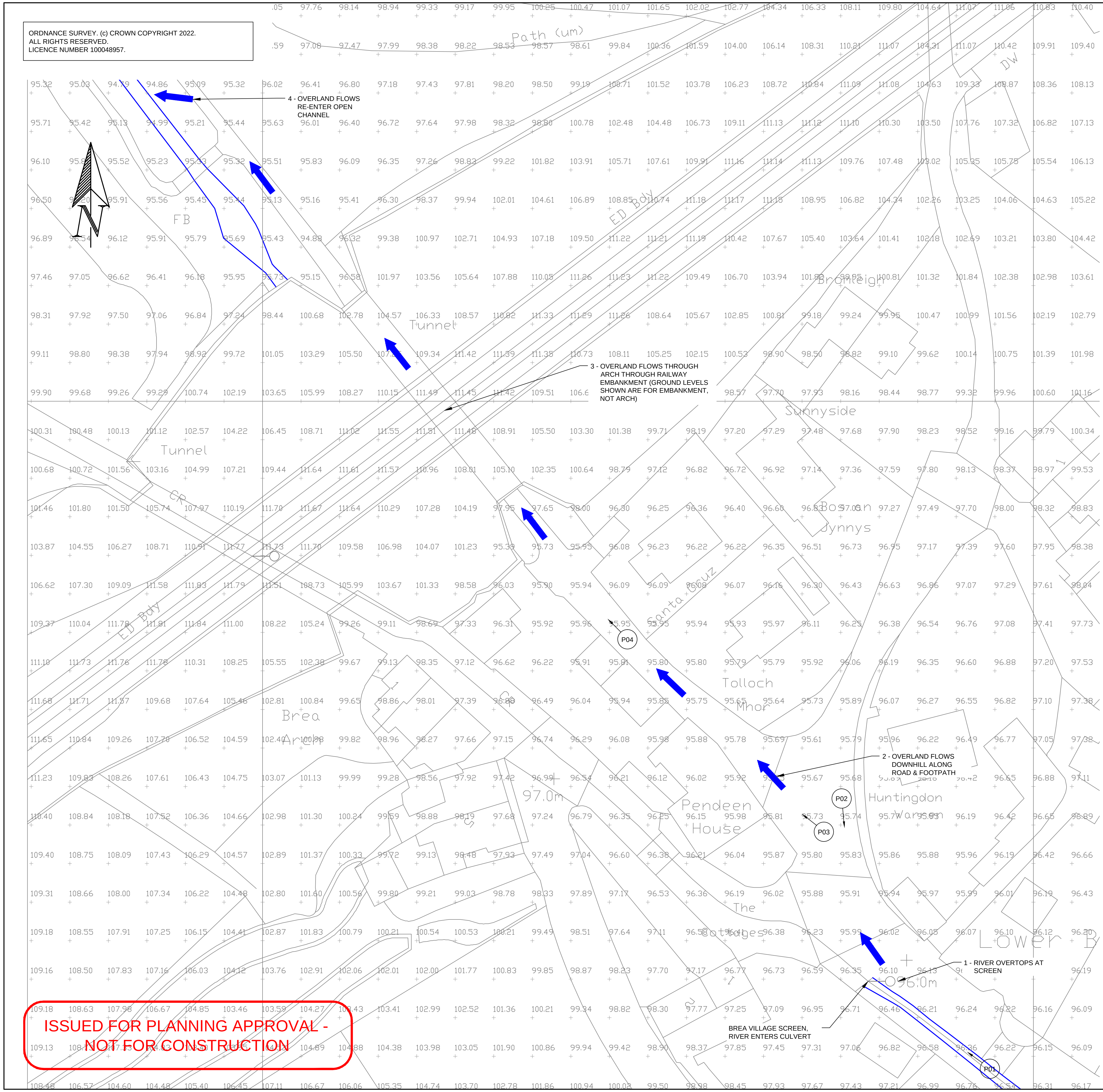
Scale (at A1)	Date	Drawn
1:100	01/08/2023	SDP

Drg. no.	Rev.
22021-NVL-DR-1000	01

ORIGINAL DRAWING SIZE 841 x 594

Appendix C – Predicted Overland Flood Route

C:\Users\User\Documents\Steve\Work\2022\22021 Nancevallon Camborne\04 Design\Drawings\22021-NVL-DR-1000to1010-01.dwg - Plot date and time = 01/08/2023 14:04:56



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10 0 10 20 50 100mm NATURAL SCALE

KEY:

P01	PHOTOGRAPH - REFERENCE & DIRECTION
999.99 +	GROUND LEVEL FROM DIGITAL TERRAIN MODELLING
➡	INDICATIVE OVERLAND FLOW DIRECTION

PHOTO P01
VIEW ALONG OPEN CHANNEL TOWARDS BREA VILLAGE SCREEN

PHOTO P02
VIEW ALONG ROAD BACK TOWARDS BREA VILLAGE SCREEN

PHOTO P03
VIEW ALONG ROAD & FOOTPATH TOWARDS RAILWAY

PHOTO P04
VIEW OF ARCH THROUGH RAILWAY EMBANKMENT

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER SP CIVIL DESIGN LTD. DRAWINGS AND ANY RELEVANT ARCHITECT'S DRAWINGS.
2. ALL LEVELS ARE IN METRES UNLESS STATED OTHERWISE, TO ORDNANCE DATUM, RELATIVE TO DIGITAL TERRAIN MODELLING INFORMATION PROVIDED BY ORDNANCE SURVEY.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.

Rev.	Drawn	Chkd.	Apprvd.	Date	Description
01	SDP	SDP	SDP	01/08/23	ISSUED FOR APPROVAL

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IAN RICHARDS

Project
EXTENSION TO 8 NANCEVALLON, CAMBORNE TR14 9DE

Drawing Title
RED RIVER PREDICTED FLOOD ROUTE

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Scale (at A1)	Date	Drawn
1:250	01/08/2023	SDP

Drg. no.	Rev.
22021-NVL-DR-1010	01

ORIGINAL DRAWING SIZE 841 x 594

Appendix D – Percolation Test Results

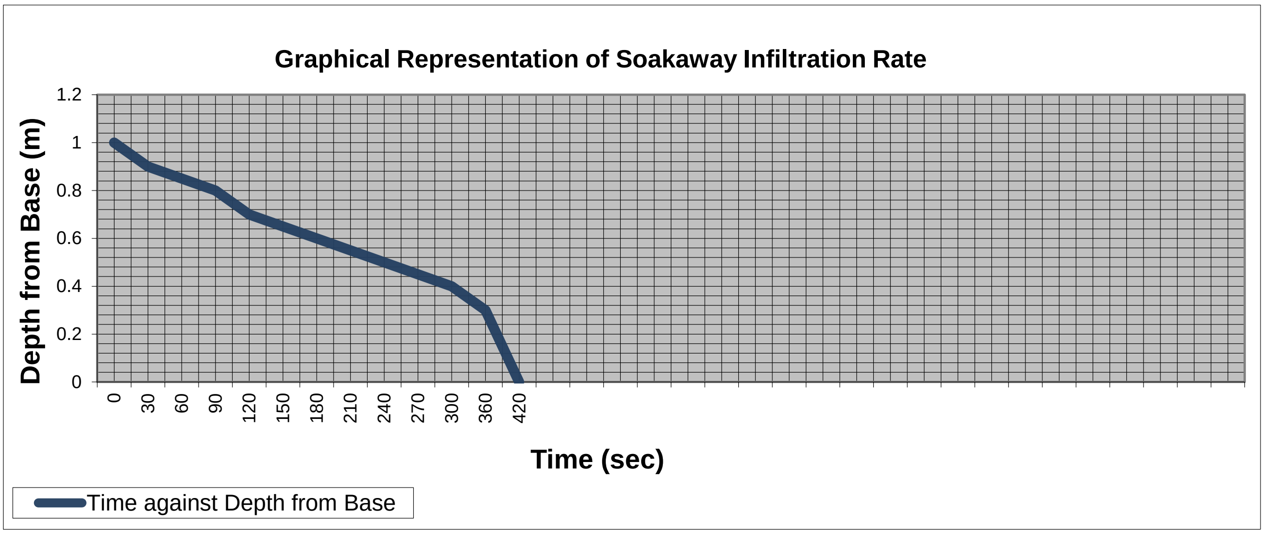
Job No:	YES 2104
Site:	Nancevallon Brea
Date:	25/07/2023
Location	Nancevallon Brea
Test No:	S1 1st fill
Engineer:	AW
Checked by:	AW

Calculations	
Length (m) =	1.1
Width (m) =	0.6
Depth (m) =	1.5
Effective Depth (m of Water) =	1
75% Effective Depth (m) =	0.75
25% Effective Depth (m) =	0.25
50% Effective Depth (m) =	0.5
Volume Outflowing between 75% and 25% Effective depth (cub m) =	0.33
Mean Surface Area of Outflow (sq m) =	2.36
Depth immediately **above 75%** (m) =	0.8
Depth immediately **below 75%** (m) =	0.7
Difference between depths (m) =	0.1
Time immediately **above 75%** (sec) =	90
Time immediately **below 75%** (sec) =	120
Difference between times (sec) =	30
Diff of 75% depth and depth above (m) =	0.05
Time at 75% effective depth (sec) =	105
Depth immediately **above 25%** (m) =	0.3
Depth immediately **below 25%** (m) =	0
Difference between depths (m) =	0.3
Time immediately **above 25%** (sec) =	360
Time immediately **below 25%** (sec) =	420
Difference between times (sec) =	60
Diff of 25% depth and depth above (m) =	0.05
Time at 25% effective depth (sec) =	370
Time of Outflow between 75% and 25% (sec)	**265**

Time (min)	**Time (sec)**	**Water Level (m bgl)**	**Depth from Base (m)**
0	**0**	0.5	**1**
0.5	**30**	0.6	**0.9**
1	**60**	0.65	**0.85**
1.5	**90**	0.7	**0.8**
2	**120**	0.8	**0.7**
2.5	**150**	0.85	**0.65**
3	**180**	0.9	**0.6**
3.5	**210**	0.95	**0.55**
4	**240**	1	**0.5**
4.5	**270**	1.05	**0.45**
5	**300**	1.1	**0.4**
6	**360**	1.2	**0.3**
7	**420**	1.5	**0**

Soil Infiltration Rate (cub m/sec)

0.000527662



YES
YOUR ENVIRONMENTAL SOLUTIONS LTD

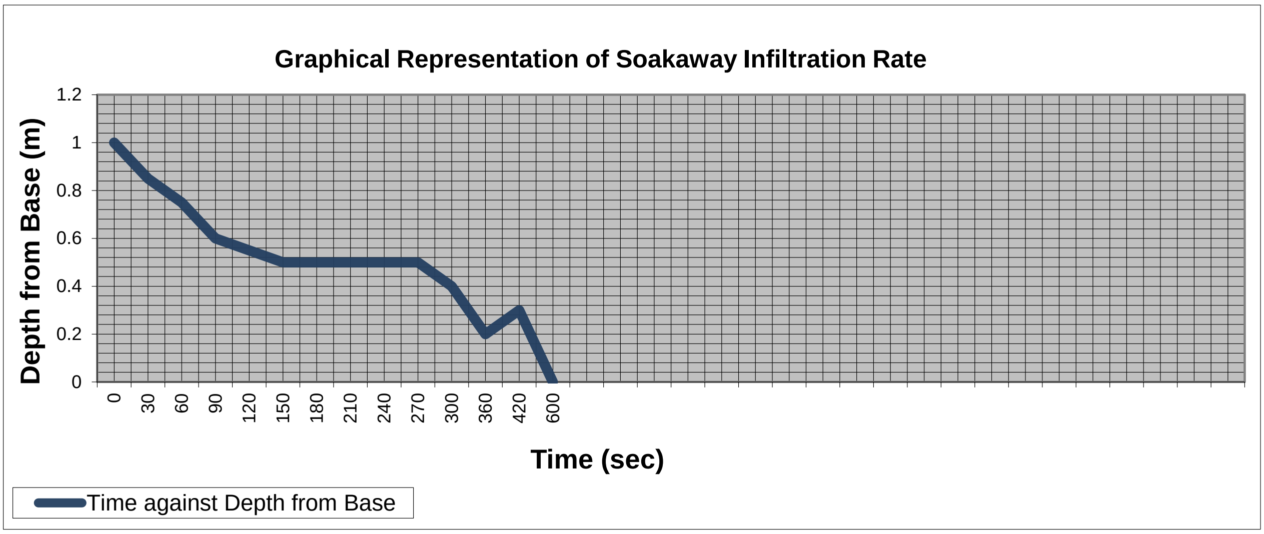
Job No:	YES 2104
Site:	Nancevallon Brea
Date:	25/07/2023
Location	Nancevallon Brea
Test No:	S1 2nd fill
Engineer:	AW
Checked by:	AW

Calculations	
Length (m) =	1.1
Width (m) =	0.6
Depth (m) =	1.5
Effective Depth (m of Water) =	1
75% Effective Depth (m) =	0.75
25% Effective Depth (m) =	0.25
50% Effective Depth (m) =	0.5
Volume Outflowing between 75% and 25% Effective depth (cub m) =	0.33
Mean Surface Area of Outflow (sq m) =	2.36
Depth immediately **above 75%** (m) =	0.85
Depth immediately **below 75%** (m) =	0.75
Difference between depths (m) =	0.1
Time immediately **above 75%** (sec) =	30
Time immediately **below 75%** (sec) =	60
Difference between times (sec) =	30
Diff of 75% depth and depth above (m) =	0.1
Time at 75% effective depth (sec) =	60
Depth immediately **above 25%** (m) =	0.3
Depth immediately **below 25%** (m) =	0
Difference between depths (m) =	0.3
Time immediately **above 25%** (sec) =	420
Time immediately **below 25%** (sec) =	600
Difference between times (sec) =	180
Diff of 25% depth and depth above (m) =	0.05
Time at 25% effective depth (sec) =	450
Time of Outflow between 75% and 25% (sec)	**390**

Soil Infiltration Rate (cub m/sec)

0.00035854

Time (min)	**Time (sec)**	**Water Level (m bgl)**	**Depth from Base (m)**
0	**0**	0.5	**1**
0.5	**30**	0.65	**0.85**
1	**60**	0.75	**0.75**
1.5	**90**	0.9	**0.6**
2	**120**	0.95	**0.55**
2.5	**150**	1	**0.5**
3	**180**	1	**0.5**
3.5	**210**	1	**0.5**
4	**240**	1	**0.5**
4.5	**270**	1	**0.5**
5	**300**	1.1	**0.4**
6	**360**	1.3	**0.2**
7	**420**	1.2	**0.3**
10	**600**	1.5	**0**


Graphical Representation of Soakaway Infiltration Rate

YES
YOUR ENVIRONMENTAL SOLUTIONS LTD

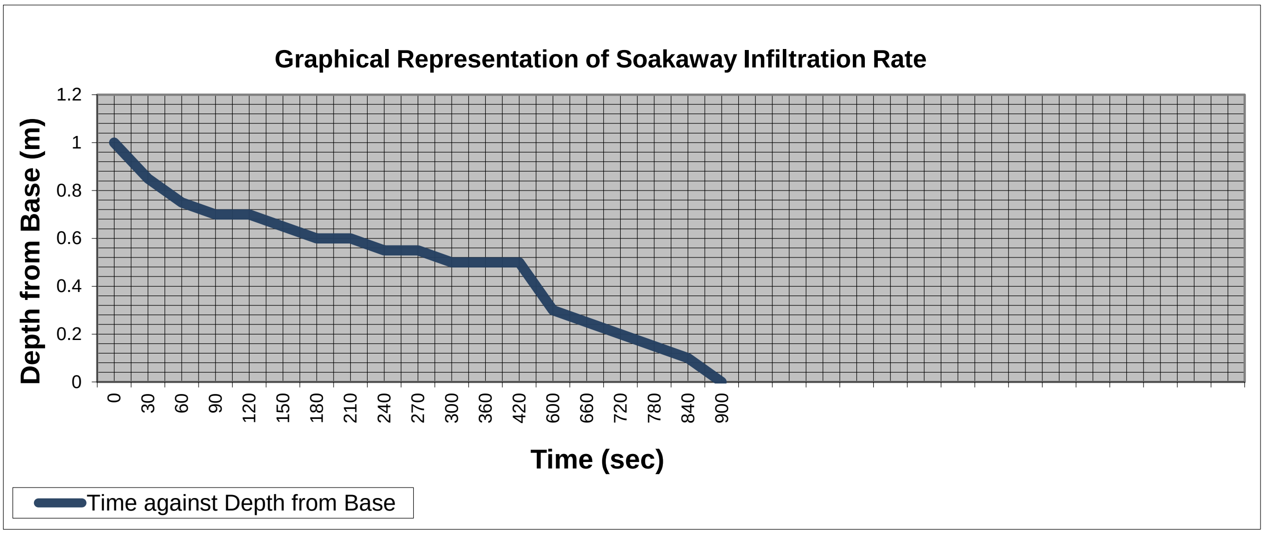
Job No:	YES 2104
Site:	Nancevallon Brea
Date:	25/07/2023
Location	Nancevallon Brea
Test No:	S1 3rd fill
Engineer:	AW
Checked by:	AW

Calculations	
Length (m) =	1.1
Width (m) =	0.6
Depth (m) =	1.5
Effective Depth (m of Water) =	1
75% Effective Depth (m) =	0.75
25% Effective Depth (m) =	0.25
50% Effective Depth (m) =	0.5
Volume Outflowing between 75% and 25% Effective depth (cub m) =	0.33
Mean Surface Area of Outflow (sq m) =	2.36
Depth immediately **above 75%** (m) =	0.85
Depth immediately **below 75%** (m) =	0.75
Difference between depths (m) =	0.1
Time immediately **above 75%** (sec) =	30
Time immediately **below 75%** (sec) =	60
Difference between times (sec) =	30
Diff of 75% depth and depth above (m) =	0.1
Time at 75% effective depth (sec) =	60
Depth immediately **above 25%** (m) =	0.3
Depth immediately **below 25%** (m) =	0.25
Difference between depths (m) =	0.05
Time immediately **above 25%** (sec) =	600
Time immediately **below 25%** (sec) =	660
Difference between times (sec) =	60
Diff of 25% depth and depth above (m) =	0.05
Time at 25% effective depth (sec) =	660
Time of Outflow between 75% and 25% (sec)	**600**

Time (min)	**Time (sec)**	**Water Level (m bgl)**	**Depth from Base (m)**
0	**0**	0.5	**1**
0.5	**30**	0.65	**0.85**
1	**60**	0.75	**0.75**
1.5	**90**	0.8	**0.7**
2	**120**	0.8	**0.7**
2.5	**150**	0.85	**0.65**
3	**180**	0.9	**0.6**
3.5	**210**	0.9	**0.6**
4	**240**	0.95	**0.55**
4.5	**270**	0.95	**0.55**
5	**300**	1	**0.5**
6	**360**	1	**0.5**
7	**420**	1	**0.5**
10	**600**	1.2	**0.3**
11	**660**	1.25	**0.25**
12	**720**	1.3	**0.2**
13	**780**	1.35	**0.15**
14	**840**	1.4	**0.1**
15	**900**	1.5	**0**

Soil Infiltration Rate (cub m/sec)

0.000233051



Appendix E – Hydraulic Calculations

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	17.000	Drain Down Time (mins)	240
Ratio-R	0.300	Additional Storage (m³/ha)	0.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	**Climate Change (CC %)**	**Additional Area (A %)**	**Additional Flow (Q %)**
100	50	10	0

Node SW1 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.83898	Invert Level (m)	97.580	Depth (m)	0.800
Side Inf Coefficient (m/hr)	0.83898	Time to half empty (mins)	54	Inf Depth (m)	
Safety Factor	3.0	Pit Width (m)	2.500	Number Required	1
Porosity	0.95	Pit Length (m)	4.000		

Results for 100 year +50% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	CPS01	88	98.805	0.155	5.3	0.0304	0.0000	SURCHARGED
120 minute winter	SW1	88	98.804	0.174	5.3	7.6048	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	CPS01	1.001	SW1	18.6	1.260	0.809	0.0175
60 minute winter	SW1	Infiltration		1.6			