Llangwm, Pembrokeshire

Powells Chartered Surveyors

Technical Note 001v2 – Drainage Strategy

CTP-21-0221

August 2021

1. Introduction

1.1 Cotswold Transport Planning (CTP) provide expert Transport Planning, Highways, Infrastructure and Flood Risk consultancy services throughout the UK.

1.2 CTP were appointed by Powells Chartered Surveyors to provide drainage consultancy in support of a planning application and SAB advice to support a SAB application.

1.3 The proposed development consists of construction of 54 residential dwellings along with associated parking provision, vehicular access, and landscaping. A proposed site plan is included in **Appendix A**.

1.4 This Technical Note will cover the existing drainage arrangement, the proposed surface water drainage arrangement, and demonstrate compliance with the principles of Sustainable Drainage Systems (SuDS).

2. Existing Site Conditions

2.1 The existing site is currently undeveloped and is accessed via an access road from a mini roundabout from the west of the site.

2.2 Existing ground levels fall approximately from north-west to south-east, from an elevation of 51mAOD to 40mAOD.

2.3 A topographical survey plan is included within **Appendix B**.

3. Existing Drainage

3.1 Welsh Water asset records (**Appendix C**) indicate the presence of a 150mm diameter foul public sewer running southeast to the south of the application site in the "The Kilns". Welsh Water have indicated this as their preferred location of connection for the development.

3.2 Welsh Water do not have any records of surface water or combined sewers in the vicinity of the site; however, the topographical survey indicates that there are gullies within the adopted roads to the west of the application site.

4. Existing Geology

4.1 Online British Geological Society (BGS) mapping indicates that the site is underlain by the South Wales Lower Coal Measures, with no superficial deposits recorded.

4.2 The Cranfield Soil and Agrifood Institute 'Soilscapes' online mapping tool indicates the local geology to be 'freely draining slightly acid loamy soils'.

4.3 Infiltration testing was carried out in February 2021. A copy of the report is included within **Appendix D**.

4.4 Tests were carried out at three different locations. Varying infiltration rates were found; however, very good rates were found to the southeast of the site at depths between 1m and 2m beneath ground level.

4.5 No ground water was encountered within any of the trial pits.

4.6 Given the above, a methodology of discharge to the ground at the south-eastern part of the site will be set out.

5. Proposed Drainage

5.1 The drainage strategy drawing is included in **Appendix E**.

5.2 There will be a mixed drainage scheme across the site based on viability of infiltration and availability of space for plot soakaways.

5.3 Plots 49 to 54 have no infiltration potential due to the underlying ground conditions. For these plots surface water runoff shall be collected through gravity-fed gutters and downpipes for the proposed buildings, which will be diverted through rainwater butts overflowing into the network if unused. Driveways will collect in gullies and feed into the network.

5.4 Within access roads, gullies will be used to convey water from west to east across the site into a conveyance swale across the eastern end of the site to a large infiltration basin to the southeast.

5.5 Where 5m from buildings can be achieved, plot soakaways will be used, for plots 1-33 a rate of $1.7x10^{-5}$ was used and for plots 34-48 a rate of $2.6x10^{-4}$ which are the worst recorded rates in each of the relevant soakaways.

5.6 All plot soakways are designed for $84m^2$ impermeable areas, which exceeds the combined area of the largest plot and garage combined.

5.7 FEH calculations in **Appendix F** show the greenfield (Qbar) rate as **28.1l/s** for an area of 2.75ha.

5.8 A rate of $2.6x10^{-4}$ has been used for infiltration at the basin as the lowest rate recorded in the relevant area.

5.9 An invert level of 40mAOD has been used as the basin invert, which is within the layer of the permeable strata identified in the geotechnical report.

5.10 An impermeable area of 0.746ha has been calculated from the current layout, which includes all areas not shown to drain to a plot soakaway or permeable paving.

5.11 MicroDrainage calculations showing the required storage volume at the basin are shown in **Appendix G**. The related area is then shown in the drainage strategy drawing shown in **Appendix E**.

5.12 All positively drained areas shall drain via pipes to a conveyance swale along the eastern boundary of the site, which will be baffled where gradients exceed 1 in 20 to allow water quality management by reduction of velocity of flows.

5.13 All roof areas will discharge via a rainwater butt designed in accordance with BS8515:2009 with an overflow into the network or plot soakaway as required.

5.14 It is anticipated that the site wide drainage system shall be offered for adoption to Pembrokeshire SAB (conveyance swale and basin).

5.15 Foul drainage generated from the development shall be conveyed to the public foul sewer within The Kilns as shown in **Appendix D**.

5.16 It is anticipated that the sites foul drainage will be adopted by Welsh Water under a S104 adoption agreement.

Wales Government SuDS Requirements

5.17 The proposed scheme meets the requirements laid out in the Welsh Government's document 'Statutory Standards for Sustainable Drainage Systems'.

5.18 **S1)** The standards give a five-level priority list for the destination of surface runoff, which is as follows:

1) **Surface water runoff is collected for use;**

   Rainwater butts should be fitted at suitable locations (for example, by rainwater downpipes at the rear of properties) to provide a non-potable water resource designed in accordance with BS8515:2009.

2) **Surface water runoff is infiltrated to ground;**

   Site testing shows infiltration suitable, and it proposed to discharge via an infiltration basin to the south east of the application site. A factor of safety of 10 will be applied in line with table G1.1 of Statutory National Standards for Sustainable drainage systems for Wales.

3) **Surface water runoff is discharged to a surface water body;**

   Not applicable

4) **Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system;**

   Not applicable

5) **Surface water runoff is discharged to a combined sewer.**

   Not applicable

5.19 **S2)** In addition to the above hierarchy, the standard also gives a set of principles for SuDS schemes. For surface water hydraulic control, these are as follows:

- To manage water on or close to the surface and as close to the source of the runoff as possible, rainwater harvesting, and a conveyance swale will manage surface water as close to source as practicable.
- Interception of the first 5mm will be met by the provision of rainwater harvesting, permeable paving, plot soakaways and a conveyance swale.

5.20 **S2)** In addition to the above hierarchy, the standard also gives a set of principles for SuDS schemes. For surface water hydraulic control, these are as follows:

- To manage water on or close to the surface and as close to the source of the runoff as possible, rainwater harvesting, and a conveyance swale will manage surface water as close to source as practicable.
- Interception of the first 5mm will be met by the provision of rainwater harvesting and a conveyance swale.
- As infiltration will take place on site, no above ground flows from impermeable surfaces will leave the site.
- Due to the location of the site, a robust factor of safety of 10 will be used and a 300mm freeboard so that the likelihood of failure of the basin is very low.

5.21 **S3)** Water quality will be managed on site as follows:

- Interception of the first 5mm will be met by the provision of rainwater harvesting and a conveyance swale.
- The pollution hazard level on the site does not exceed "Low" under the Simple Index Approach with the requirements of the Simple Index Approach set out below

			Pollution Hazard Indices		
Runoff Area Land Use Description		*Hazard Level*	Suspended Solids	Metals	Hydrocarbons
Low traffic roads (e.g. residential roads and general access roads, < 300 traffic movements/day)		Low	0.5	0.4	0.4
Landuse Pollution Hazard Index		**Low**	**0.5**	**0.4**	**0.4**
SuDS Component Description			Suspended Solids	Metals	Hydrocarbons
Swale			0.5	0.6	0.6
Pond or wetland			0.7	0.7	0.5

Aggregated Surface Water Pollution Mitigation Index		0.85	0.95	0.85

- All areas of the site will drain through a conveyance swale and then an infiltration basin so that “the SuDS management train” requirement is met, as below.
- The site is not located in a Groundwater Source Protection Zone so there are no additional specific sensitivities.

  The above is the “worst case” scenario, and situations can be improved on plot by permeable paving or plot soakaways.

5.22 **S4)** Amenity value will be added to the site as follows:

- The conveyance swale will be located adjacent to walking routes and site green space, giving additional value to these areas, and aiding to create aesthetically pleasing spaces.
- The infiltration basin is likely to include vegetation above the basin invert levels in areas that exceed the max water level.

5.23 **S5)** Biodiversity value will be added to the site as follows:

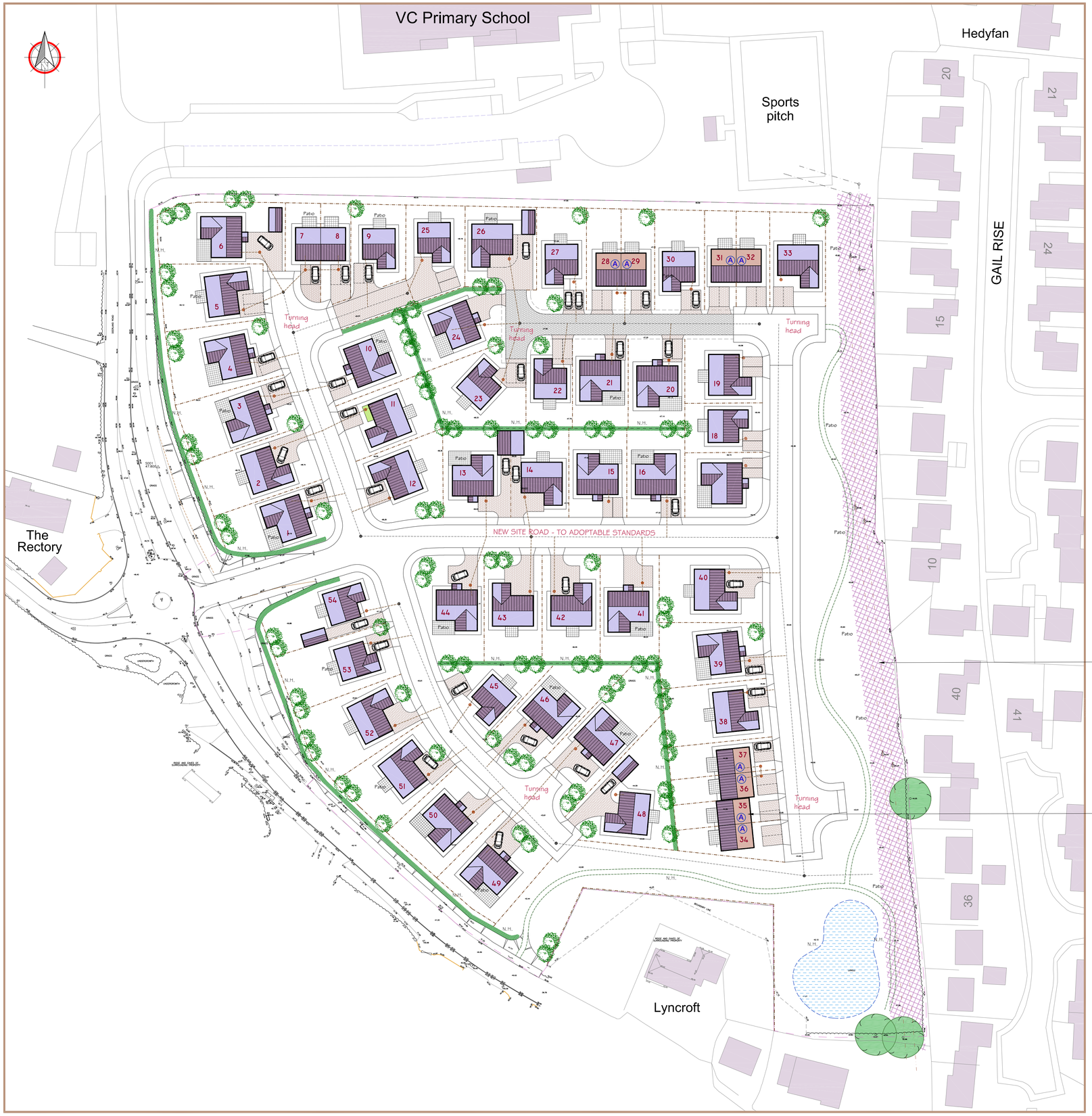
- Both the swales and the infiltration basin will add wetland areas to promote biodiverse environments. At full SAB stage, a species and planting strategy will be submitted alongside the SuDS features to demonstrate the effects on habitats going forward.

5.24 **S6)** Operation and maintenance:

- The conveyance swale and infiltration basin will be required to be offered for adoption by the SAB. It is also anticipated that once drainage leaves the curtilage of the individual property in a pipe, it will be adopted by the SAB, before discharging into the conveyance swale.
- Where drainage features are within the property curtilage, such as permeable paving, rainwater butts and plot soakaways, the maintenance of these assets will be up to the individual property owner.

- It is expected that ongoing maintenance of the site wide shared drainage features will be undertaken by the SAB.
- A maintenance and operation plan will be submitted at full SAB stage detailing periods of maintenance for all the Suds features including (but not limited to):
    - Underground Pipes
    - Swale
    - Infiltration Basin

Appendix A



54 no. UNITS

[DRAFT SKETCH LAYOUT]

PROPOSED ILLUSTRATIVE SITE LAYOUT

Scale - 1:500

SITE AREA = 2.802 Ha

1:1 0 20 40 60 70

A1 ORIGINAL DRAWING SIZE

Revision	Description	Date

Drawing: PROPOSED SITE LAYOUT

Client: Stuart-Powells Chartered Surveyors.

Project / Title: Proposed outline Planning application for Residential Development to land north of the Kilns, Llangwm, Pembrokeshire (Land Allocation - HSG/063/LDP2/1)

Dwg No.	Job No.	Paper	Scale
P03	1814	A1	1:500
	Rev.	Drawn PNW	Date MAY 2021

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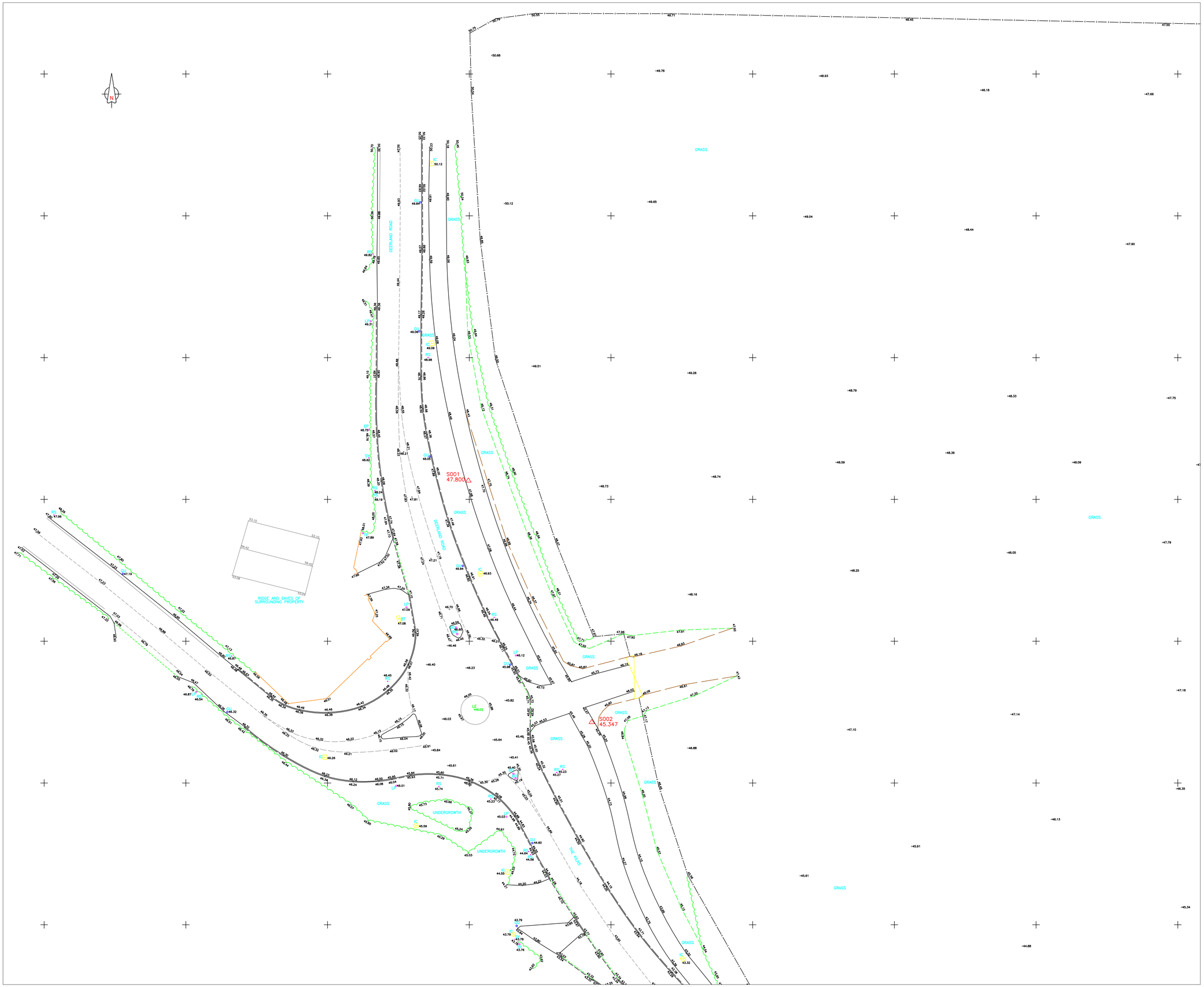
Appendix B



Key Plan:

1. Some layers are frozen.

2. The survey has been orientated to a local grid based on the OSGB 36 National Grid (OSTN15 via OSGM15). The level datum GPS derived at S001.

3. Station Co-Ordinates

Station	Easting	Northing	Level
S001	198639.868	209862.639	47.800
S002	198657.294	209828.570	45.347

4. Wall heights have been surveyed as string information.

5. Trees are positioned accurately, Boles & Canopys are to scale.

6. All dimensions are in metres.

7. All dimensions / levels should be checked on site prior to design and construction.

Survey Key:

The following are a list of codes used to identify various street furniture and surfaces for Monument Surveys. Service covers have an outline to define the size/orientation.

General Abbreviations

AB	Air Brick	MH	Manhole
AV	Air Valve	MK	Marker Post
BB	Belisha Beacon	MO	Mooring
BE	Bench	MS	Mile Stone
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Trees

Diameter of Bole / Canopy / Species
Approx. Tree Height

Tree Stumps

S1 to S5 – 0.1 dia. to 0.5 dia.

Pipes (Invert Level)

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Project

LAND NORTH OF THE KILNS, LLANGWM
PEMBROKESHIRE

Drawing

EXISTING LAYOUT 3D ANNOTATED TOPOGRAPHICAL SURVEY

Drawn by: RM	Date: APR 21
Checked by: CJ	Date: APR 21
Approved by: MONUMENT GEOMATICS	Date: APR 21

Drawing No. MG2071_S1

Revision

Drawing Scale: 1:250 @ A1

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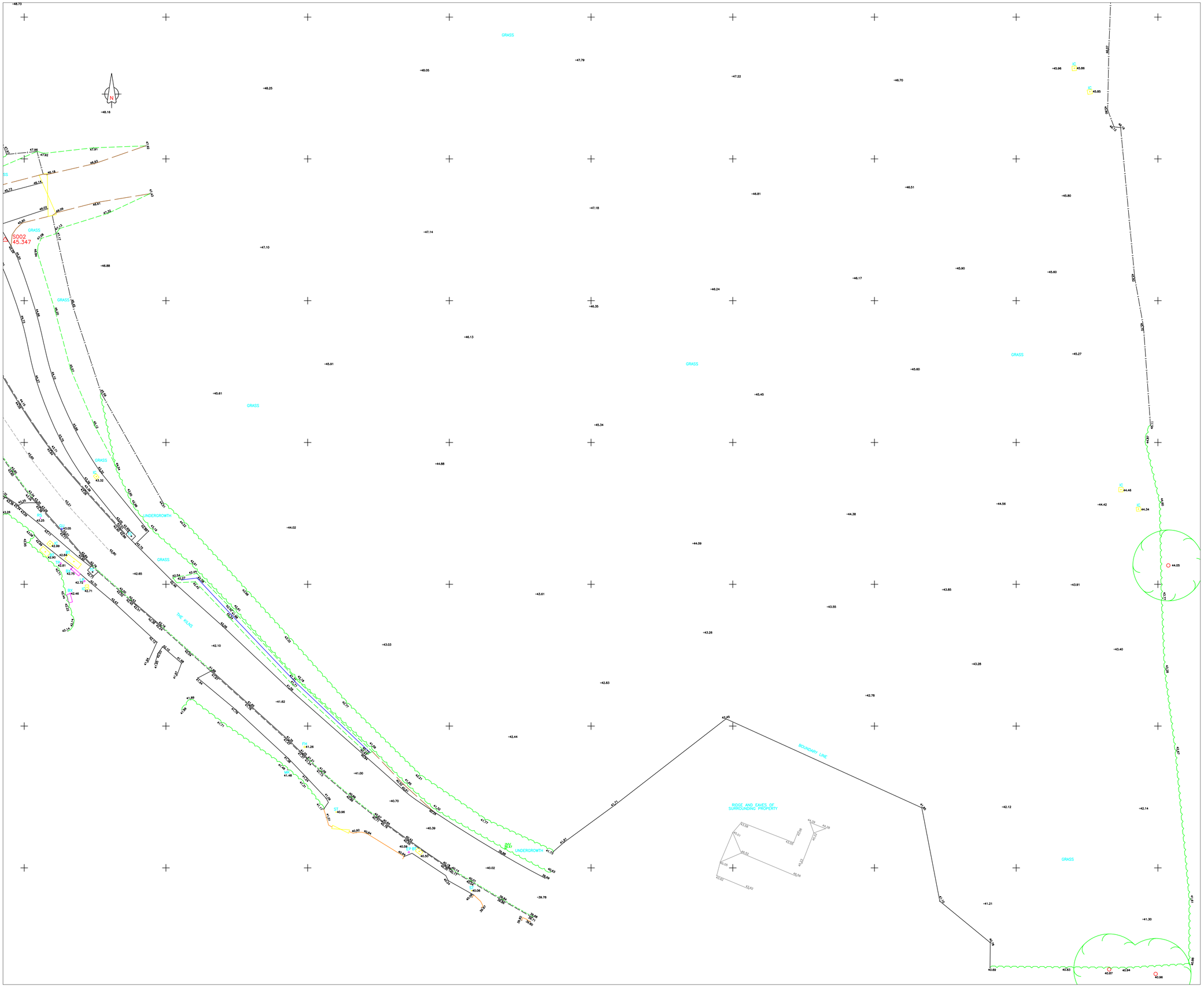

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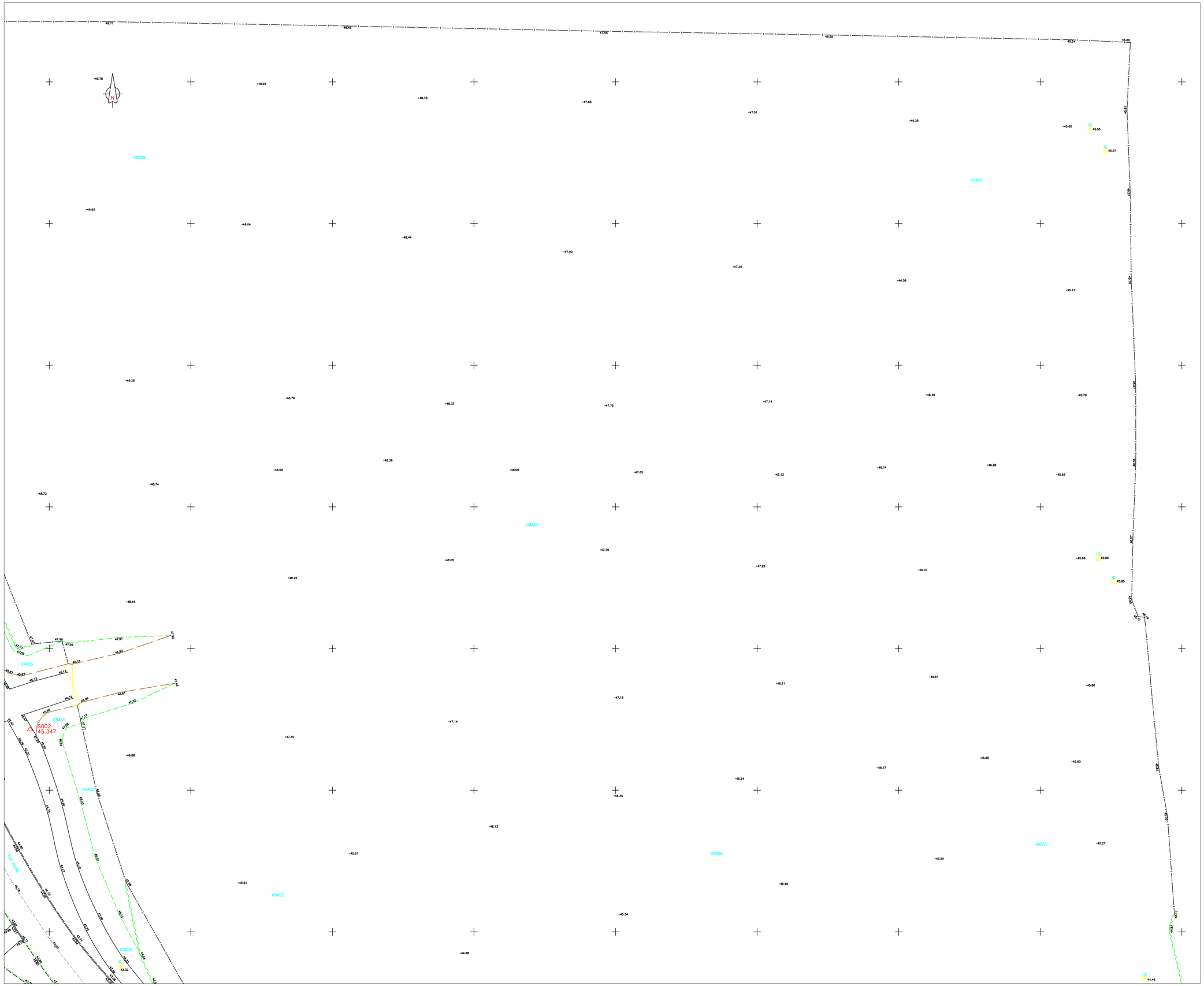

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Drawing No.	Revision
MG2071_S3	

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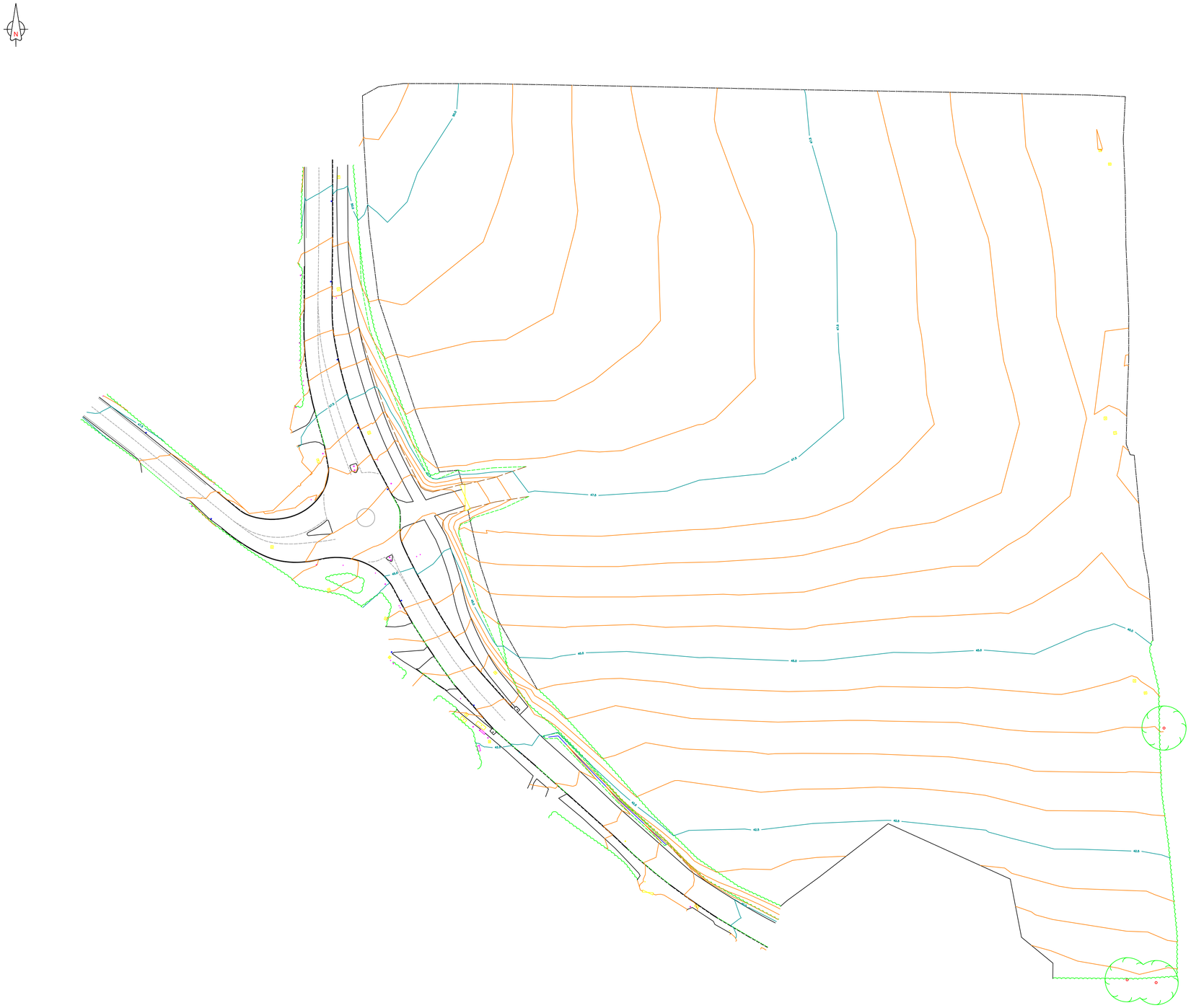

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EXISTING LAYOUT
TOPOGRAPHICAL SURVEY
WITH CONTOURS

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Drawing No.	Revision
MG2071_S4	

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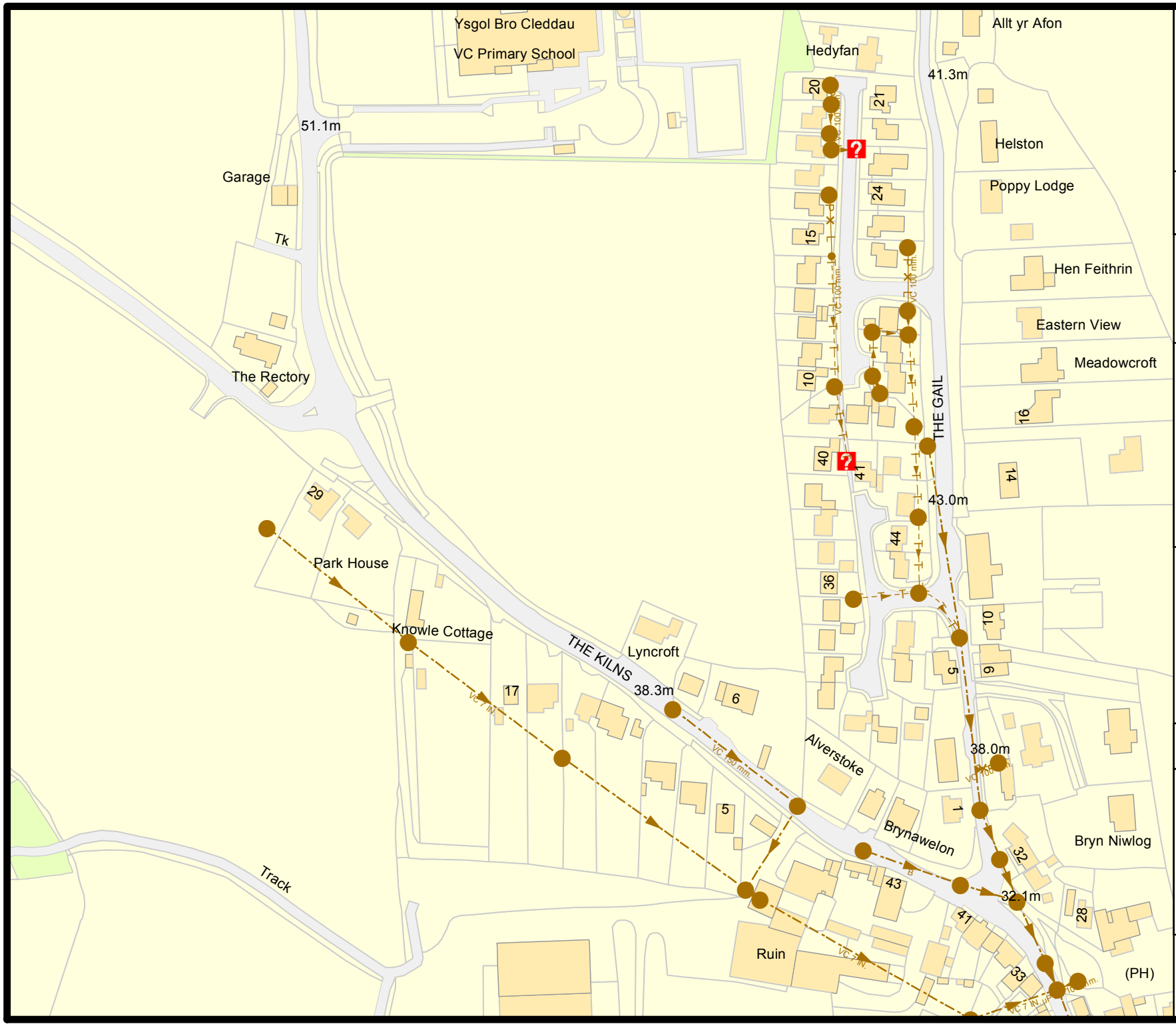
Appendix C



Dŵr Cymru
Welsh Water

Sewer Plan PPA0005322

N
W E
S

LEGEND(Representative of most common features)

Waste network:

- Foul chamber
- Surface water chamber
- Combined chamber
- Combined sewer overflow
- Special purpose chamber
- Treatment works
- Pumping station
- Outfall
- Lamphole
- Storm Overflow
- Rising main
- Gravity sewer
- Private sewer
- Private sewer subject to Sect. 104 adoption agreement
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

NB: Sewer symbol colour indicates the type.

RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - Former S24 sewers (for indicative purposes only)

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF) . It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

Dŵr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus. The onus of locating apparatus before carrying out any excavations rests entirely on you. The information which is supplied by the Company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 which is based upon the best Information available and, in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a water main, service pipe, sewer, lateral drain or disposal main and any associated apparatus laid before 1 September 1989, or, if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the Company's right to be compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

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Map Ref:	198742,209789
Map scale:	1:2000
Printed by:	Natalie Walmsley
Printed on:	26 Nov 2020

Appendix D

Ground Investigation
Unit 3 Westfield Court, Barns Ground, Kenn, Clevedon, Bristol, BS21 6FQ
Email: mail@ground-investigation.com
Tel: 01275 876903

Mr Paul Graham
CTP House
Knapp Road
Cheltenham
Gloucestershire
GL50 3QQ

7th May 2021

By e-mail to paul@cotswoldtp.co.uk

Dear Paul,

The Kilns, Llangwm

In-Situ Soil Infiltration Tests

This letter report presents the findings of the soil infiltration tests recently undertaken in connection with the above project.

The following items are enclosed for your information.

- Figure 1 - Plan Showing Test Positions.
- Engineering Records of Trial Pits (Enclosure A).
- Soakaway Test Results (Enclosure B)

The works are summarised under the following headings.

1.0 Introduction and Terms of Reference

1.1 Ground Investigation Limited has been instructed by Cotswold TP, to carry out soil infiltration tests at a parcel of agricultural land at The Kilns in Llangwm, Haverfordwest.

1.2 The trial pits and soakaway tests have been undertaken to provide information on the near surface ground conditions in the context of proposed soakaway drainage. This letter report presents the findings of the works completed.

2.0 Fieldworks

2.1 The intrusive works were completed on 6th May 2021, under the supervision of Ground Investigation Limited. The works comprised the mechanical excavation of four trial pits, labelled as TP1 to TP4. Within three of the trial pits, soil infiltration tests were undertaken in general accordance with the procedure described in BRE Digest 365. The fourth pit was excavated to 3 m depth and left open for around 4 hours to determine if there were any

groundwater seepages or inflows within the depth of the trial pit, during the time of the fieldworks.

2.2 A wheeled excavator was employed to excavate the trial pits, which were located at approximate positions specified by the Client, as shown on Figure 1.

2.3 As the excavation progressed at each position, details of the strata succession were recorded, together with observations concerning the incidence and behaviour of any groundwater seepages, and the stability of the trial pit sides.

2.4 Upon completion, the trial pits were backfilled with the excavated arisings. The engineering records of the trial pits are presented in Enclosure A.

3.0 Encountered Ground Conditions

3.1 Within the trial pits, directly beneath a 0.4 m thick layer of Topsoil, deposits interpreted as the South Wales Lower Coal Measures Formation were encountered to the full depth of the investigation.

3.2 The deposits exhibited some significant variations, ranging between primarily coarse- and fine-grained completely weathered materials at shallow depths. The solid geology was encountered beyond the completely weathered materials as siltstone and/or sandstone, at depths ranging between 1.2 and 2.5 m, where present.

4.0 Soil Infiltration Tests

4.1 Soil infiltration tests were undertaken at the positions of TP2 to TP4, which were excavated to depths of between 1.8 and 2.0 m.

4.2 Within TP2, the infiltration stratum comprised the completely weathered deposits of the South Wales Lower Coal Measures Formation, being described as a dense cobbly gravel with varying fractions of clay, silt and sand.

4.3 Within TP3, the infiltration stratum comprised very weak to weak, highly fractured siltstone of the South Wales Lower Coal Measures Formation.

4.4 Within TP4, the infiltration stratum comprised extremely weak silty sandstone of the South Wales Lower Coal Measures Formation.

4.5 The pits were then rapidly filled with clean water, and the water level within each pit was then monitored over time. The results of the infiltration tests, together with a graphical representation of the monitoring data, are included within Enclosure B.

4.6 Given the variable nature of the material at the specified test depths, variable infiltration rates ranging from around 10^{-7} to 10^{-4} m/s were calculated. However, these variations appeared to reflect the encountered variations in the soil types.

4.7 In the above regard, the completely weathered gravels at the location of TP2 from 1.0 to 2.0 m depth, returned relatively high infiltration rates in the order of 2.6 to 4.0×10^{-4} m/s.

4.8 The silty sandstone at the location of TP4 from 1.7 to 2.0 m depth, returned moderate infiltration rates in the order of 1.7 to 2.3×10^{-5} m/s.

4.9 Conversely, the siltstone at the location of TP3 from 1.2 to 1.8 m depth, returned a very low infiltration rate in the order of 9.9×10^{-7} m/s.

5.0 Conclusions

5.1 Given the variations in the encountered ground conditions, which returned variable infiltration rates, careful consideration would need to be afforded to the use of traditional soakaways, and in particular, their locations and invert levels with regards to the geology. For example, it is unlikely that a soakaway would perform satisfactorily if constructed within the siltstone bedrock, e.g. encountered within TP2 at 1.2 m depth.

5.2 However, for soakaways that are constructed within the coarse-grained, completely weathered deposits of the South Wales Lower Coal Measures Formation (e.g. in TP2 from 0.4 to 2.0 m depth), an infiltration rate of around 2.6 to 4.0×10^{-4} m/s could be used for preliminary design purposes.

5.3 Within the silty sandstone encountered in the northern area of the site (TP4 at 1.7 to 2.0 m depth), an infiltration rate of around 2×10^{-5} m/s could potentially be used for preliminary design purposes.

5.4 It should be noted that the Environment Agency usually requires that soakaways are constructed within natural ground, with their base at least 1 m above the water table.

I trust the above comments together with the enclosed items are sufficient for the purposes of your interpretation. If you require any further information, please do not hesitate to contact us.

Yours sincerely,

Richard Colwill
CHARTERED GEOLOGIST
BSc (Hons), MRes, CGeol, FGS

Enc.

FIGURES

TP2/SA **Trial Pit/Soakaway Test**

Ground Investigation

Unit 3, Westfield Court, Barns Ground, Kenn,
Clevedon, Bristol. BS21 6FQ.
Tel: 01275 876903
Email: mail@ground-investigation.com

SITE: The Kilns, Llangwm

CLIENT: Cotswold TP

PROJECT ID: P1511 **SCALE:** NTS

FILENAME: P1511.Fig1.dwg

FIGURE 1

Exploratory Hole Positions

ENCLOSURE A

T | E | www.ground-investigation.com

Ground Investigation

Trial Pit Record

Hole ID
TP1
Sheet 1 of 1 (0.00m-0.00m)
All dimensions in metres
Scale 1:20

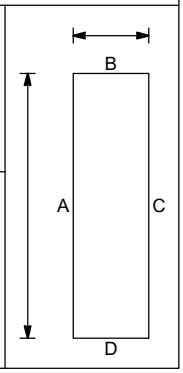
Site: The Kilns, Llangwm	**Method/Plant Used:** Terex wheeled		
Client: Cotswold TP	**Start date:** 06/05/21	**End Date:** 06/05/21	**Logged By:** RC
Job No: P1511	**Easting:**	**Northing:**	**Elevation:**

SAMPLES & IN-SITU TESTS			WATER	STRATA		
Depth	**Type / No**	**Results / Remarks**		**Legend**	**Depth**	**Description**
					(0.40) 0.40	Long meadow grass on soft to firm brown slightly sandy slightly gravelly clayey SILT with frequent thin roots. **TOPSOIL**
					(0.60) 1.00	Medium dense grey-brown slightly clayey/silty sandy slightly cobbly GRAVEL of fine to coarse subangular to angular often tabular siltstone. **SOUTH WALES LOWER COAL MEASURES FORMATION**
					(1.00) 2.00	Dense grey-brown slightly clayey/silty sandy slightly cobbly GRAVEL of fine to coarse subangular to angular often tabular siltstone. **SOUTH WALES LOWER COAL MEASURES FORMATION**
					(0.50) 2.50	Dense grey-brown slightly clayey/silty sandy GRAVEL and COBBLES of fine to coarse subangular to angular often tabular siltstone. **SOUTH WALES LOWER COAL MEASURES FORMATION**
					(0.50) 3.00	Very weak to weak highly fractured grey-brown SILTSTONE recovered as angular gravel and cobbles of weak siltstone. **SOUTH WALES LOWER COAL MEASURES FORMATION**
						NO GROUNDWATER ENCOUNTERED

Groundwater Observations

Strike Depth	Flow Rate Remarks

Shoring/Support: None.
Side Stability: Stable



General Remarks
1. Trial pit location approximate.
2. Descriptions of consistency and density are from field observations.
3. Trial pit backfilled upon completion and made safe at the surface.

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Ground Investigation

Trial Pit Record

Hole ID
TP2
Sheet 1 of 1 (0.00m-0.00m)
All dimensions in metres
Scale 1:20

Site: The Kilns, Llangwm	**Method/Plant Used:** Terex wheeled		
Client: Cotswold TP	**Start date:** 06/05/21	**End Date:** 06/05/21	**Logged By:** RC
Job No: P1511	**Easting:**	**Northing:**	**Elevation:**

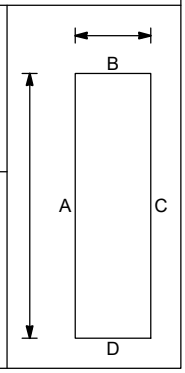
SAMPLES & IN-SITU TESTS			WATER	STRATA		
Depth	**Type / No**	**Results / Remarks**		**Legend**	**Depth**	**Description**
					(0.40) 0.40	Long meadow grass on soft to firm brown slightly sandy slightly gravelly clayey SILT with frequent thin roots. **TOPSOIL**
					(0.60) 1.00	Medium dense grey-brown slightly clayey/silty sandy slightly cobbly GRAVEL of fine to coarse subangular to angular often tabular siltstone. **SOUTH WALES LOWER COAL MEASURES FORMATION**
					(1.00) 2.00	Dense grey-brown slightly clayey/silty sandy slightly cobbly GRAVEL of fine to coarse subangular to angular often tabular siltstone. **SOUTH WALES LOWER COAL MEASURES FORMATION**
						NO GROUNDWATER ENCOUNTERED

Groundwater Observations

Strike Depth	Flow Rate Remarks

Shoring/Support: None.
Side Stability: Stable

General Remarks
1. Trial pit location approximate.
2. Descriptions of consistency and density are from field observations.
3. In-situ soakway test undertaken.
4. Trial pit backfilled upon completion and made safe at the surface.



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Ground Investigation

Trial Pit Record

Hole ID
TP3
Sheet 1 of 1 (0.00m-0.00m)
All dimensions in metres
Scale 1:20

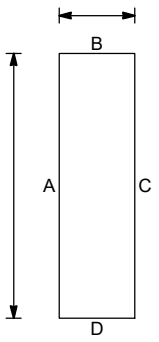
Site: The Kilns, Llangwm	**Method/Plant Used:** Terex wheeled		
Client: Cotswold TP	**Start date:** 06/05/21	**End Date:** 06/05/21	**Logged By:** RC
Job No: P1511	**Easting:**	**Northing:**	**Elevation:**

SAMPLES & IN-SITU TESTS			WATER	STRATA		
Depth	**Type / No**	**Results / Remarks**		**Legend**	**Depth**	**Description**
					(0.40) 0.40	Long meadow grass on soft to firm brown slightly sandy slightly gravelly clayey SILT with frequent thin roots. **TOPSOIL**
					(0.80) 1.20	Medium dense grey-brown slightly clayey/silty sandy slightly cobbly GRAVEL of fine to coarse subangular to angular often tabular siltstone. **SOUTH WALES LOWER COAL MEASURES FORMATION**
					(0.60) 1.80	Very weak to weak highly fractured grey-brown SILTSTONE recovered as angular gravel and cobbles of weak siltstone. **SOUTH WALES LOWER COAL MEASURES FORMATION**
						NO GROUNDWATER ENCOUNTERED

Groundwater Observations

Strike Depth	Flow Rate Remarks

Shoring/Support: None.
Side Stability: Stable



General Remarks
1. Trial pit location approximate.
2. Descriptions of consistency and density are from field observations.
3. In-situ soakway test undertaken.
4. Trial pit backfilled upon completion and made safe at the surface.

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Ground Investigation

Trial Pit Record

Hole ID
TP4

Sheet 1 of 1 (0.00m-0.00m)
All dimensions in metres
Scale 1:20

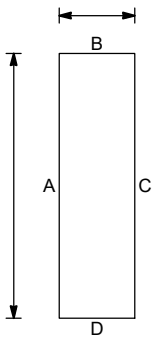
Site: The Kilns, Llangwm	**Method/Plant Used:** Terex wheeled		
Client: Cotswold TP	**Start date:** 06/05/21	**End Date:** 06/05/21	**Logged By:** RC
Job No: P1511	**Easting:**	**Northing:**	**Elevation:**

SAMPLES & IN-SITU TESTS			WATER	STRATA		
Depth	**Type / No**	**Results / Remarks**		**Legend**	**Depth**	**Description**
					(0.40) 0.40	Long meadow grass on soft to firm brown slightly sandy slightly gravelly clayey SILT with frequent thin roots. **TOPSOIL**
					(0.80) 1.20	Firm to stiff orange-brown and grey slightly sandy slightly gravelly slightly cobbly silty CLAY. Gravel and cobbles are fine to coarse subangular siltstone. **SOUTH WALES LOWER COAL MEASURES FORMATION**
					(0.50) 1.70	Stiff grey, orange-brown and red-brown sandy gravelly slightly cobbly CLAY/SILT. Gravel and cobbles are fine to coarse subangular to angular siltstone. **SOUTH WALES LOWER COAL MEASURES FORMATION**
					(0.30) 2.00	Extremely weak red-brown, orange-brown and grey silty SANDSTONE recovered as extremely weak, weakly cemented, gravel sized, very silty sand lumps, and medium strong, angular, gravel and cobble sized, silty sandstone fragments. **SOUTH WALES LOWER COAL MEASURES FORMATION**
						NO GROUNDWATER ENCOUNTERED

Groundwater Observations

Strike Depth	Flow Rate Remarks

Shoring/Support: None.
Side Stability: Stable



General Remarks
1. Trial pit location approximate.
2. Descriptions of consistency and density are from field observations.
3. In-situ soakway test undertaken.
4. Trial pit backfilled upon completion and made safe at the surface.

ENCLOSURE B

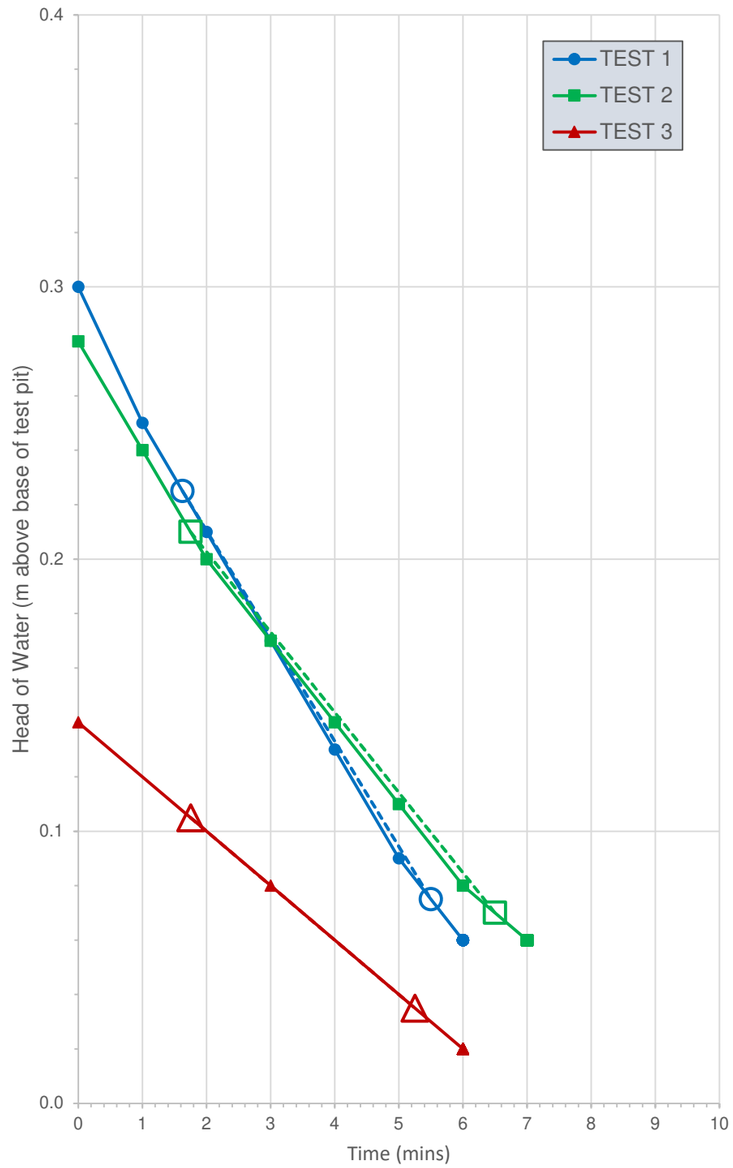
The Kilns, Llangwm — Test Location: TP2

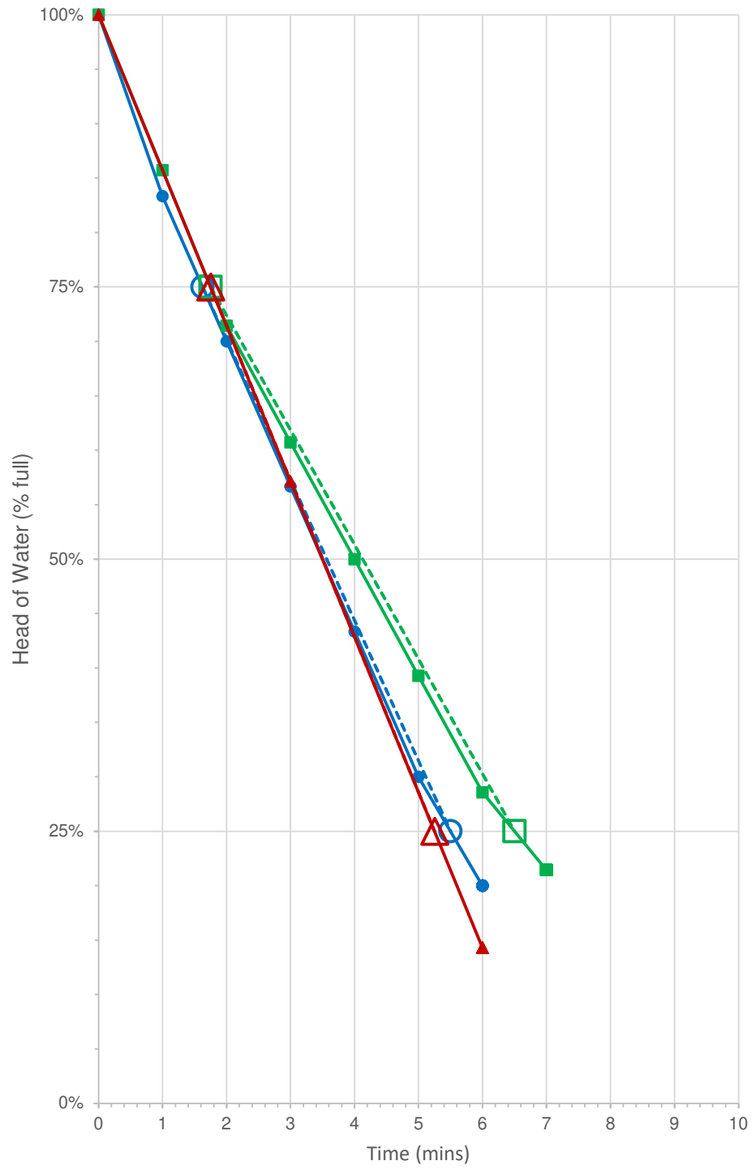
TEST PIT DIMENSIONS

Length	Width	Depth
1.60 m	0.70 m	2.00 m

Comments:

Observation No.	TEST 1 Time (min)	TEST 1 Head (m)	TEST 2 Time (min)	TEST 2 Head (m)	TEST 3 Time (min)	TEST 3 Head (m)
1	0.00	0.300	0.00	0.280	0.00	0.140
2	1.00	0.250	1.00	0.240	3.00	0.080
3	2.00	0.210	2.00	0.200	6.00	0.020
4	3.00	0.170	3.00	0.170	-	-
5	4.00	0.130	4.00	0.140	-	-
6	5.00	0.090	5.00	0.110	-	-
7	6.00	0.060	6.00	0.080	-	-
8	-	-	7.00	0.060	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	-	-	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	-	-	-	-	-	-
17	-	-	-	-	-	-
18	-	-	-	-	-	-
19	-	-	-	-	-	-
20	-	-	-	-	-	-
21	-	-	-	-	-	-
22	-	-	-	-	-	-
23	-	-	-	-	-	-
24	-	-	-	-	-	-
25	-	-	-	-	-	-
V_{p75-25} (m^3)	0.168		0.157		0.078	
a_{p50} (m^2)	1.810		1.764		1.442	
t_{p75-25} (sec)	233		285		210	
f (m/sec)	0.000399216 3.99E-04		0.000311891 3.12E-04		0.000258900 2.59E-04	





Soil infiltration rate, $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

Ground Investigation
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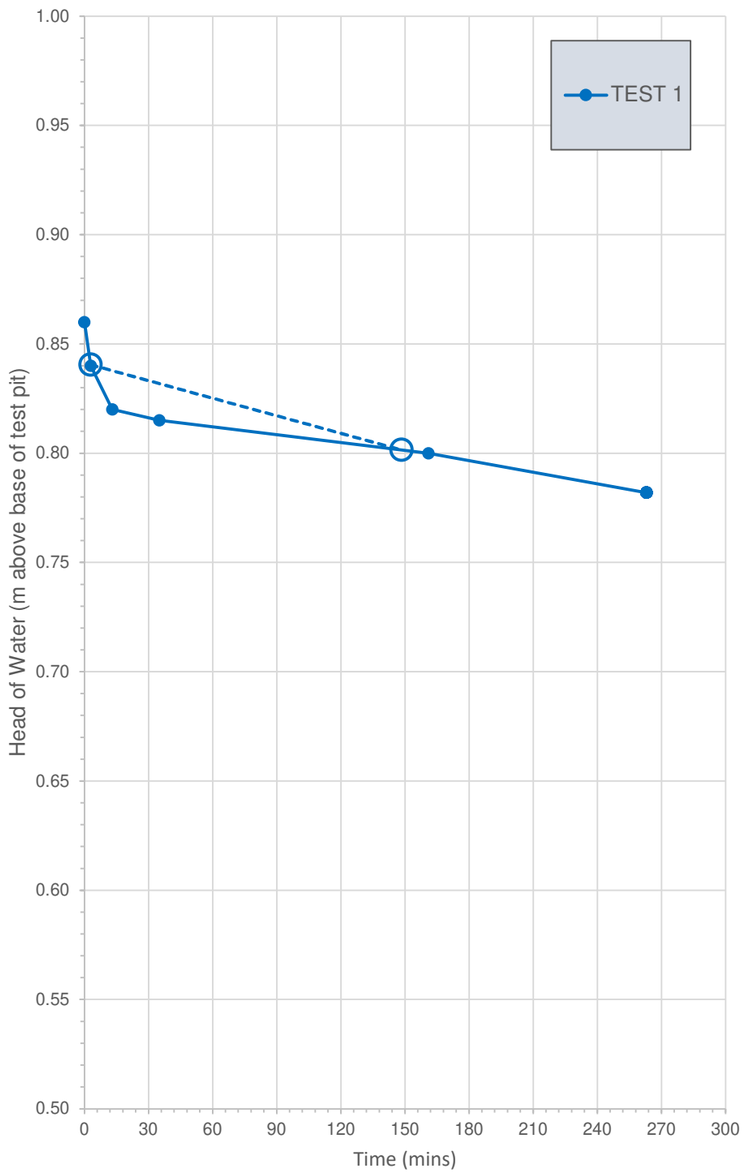
The Kilns, Llangwm — Test Location: TP3

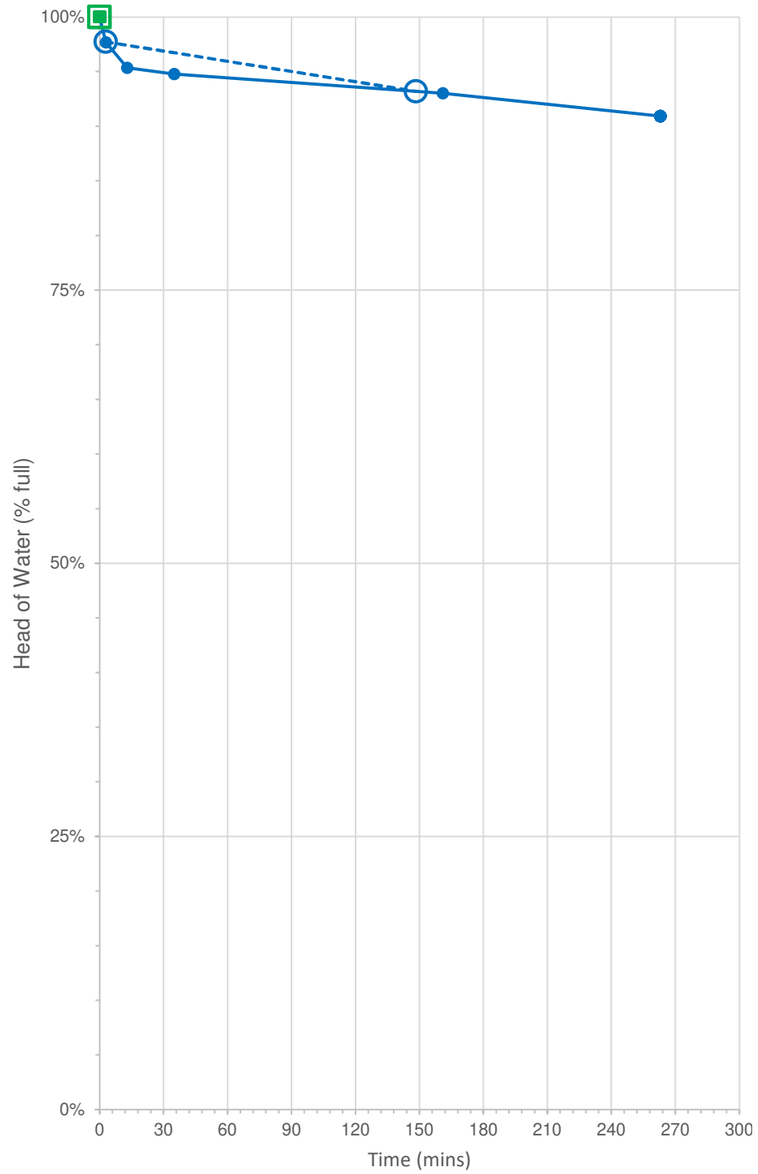
TEST PIT DIMENSIONS

Length	Width	Depth
1.40 m	0.70 m	1.80 m

Comments:

	TEST 1		TEST 2		TEST 3	
Observation No.	Time (min)	Head (m)	Time (min)	Head (m)	Time (min)	Head (m)
1	0.00	0.860	0.00	1.800	0.00	0.00
2	3.00	0.840	-	-	-	-
3	13.00	0.820	-	-	-	-
4	35.00	0.815	-	-	-	-
5	161.00	0.800	-	-	-	-
6	263.00	0.782	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	-	-	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	-	-	-	-	-	-
17	-	-	-	-	-	-
18	-	-	-	-	-	-
19	-	-	-	-	-	-
20	-	-	-	-	-	-
21	-	-	-	-	-	-
22	-	-	-	-	-	-
23	-	-	-	-	-	-
24	-	-	-	-	-	-
25	-	-	-	-	-	-
V_{p75-25} (m^3)	0.038		0.000		0.000	
a_{p50} (m^2)	4.428		8.540		8.540	
t_{p75-25} (sec)	8,729		#DIV/0!		-	
f (m/sec)	0.000000989		#DIV/0!		-	
	9.89E-07		#DIV/0!		-	





Soil infiltration rate, $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

Ground Investigation
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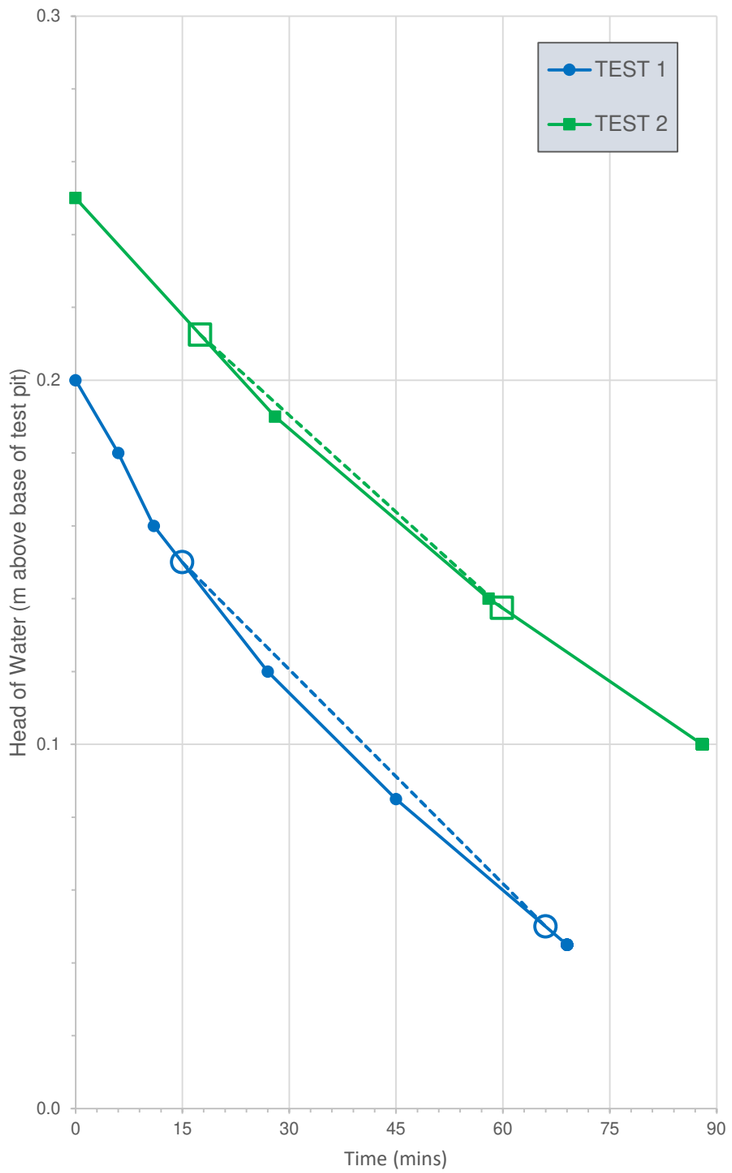
The Kilns, Llangwm — Test Location: TP4

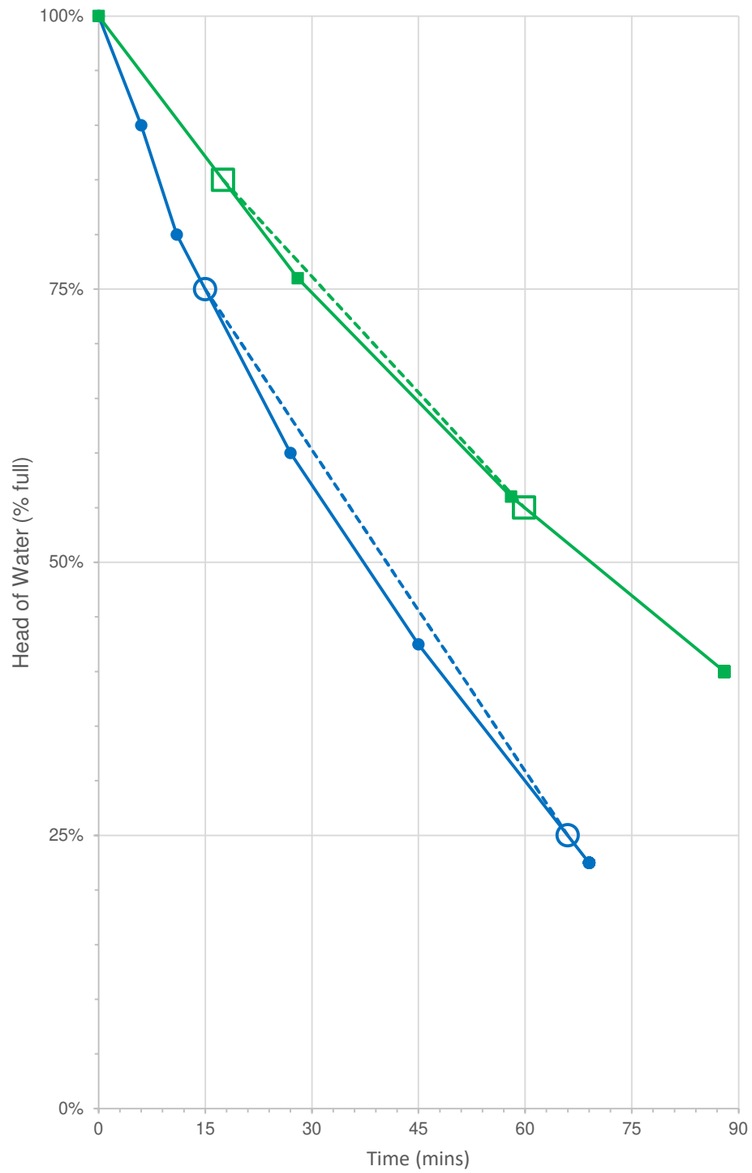
TEST PIT DIMENSIONS

Length	Width	Depth
1.60 m	0.70 m	2.00 m

Comments:

	TEST 1		TEST 2		TEST 3	
Observation No.	Time (min)	Head (m)	Time (min)	Head (m)	Time (min)	Head (m)
1	0.00	0.200	0.00	0.250	0.00	0.00
2	6.00	0.180	28.00	0.190	-	-
3	11.00	0.160	58.00	0.140	-	-
4	27.00	0.120	88.00	0.100	-	-
5	45.00	0.085	-	-	-	-
6	69.00	0.045	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	-	-	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	-	-	-	-	-	-
17	-	-	-	-	-	-
18	-	-	-	-	-	-
19	-	-	-	-	-	-
20	-	-	-	-	-	-
21	-	-	-	-	-	-
22	-	-	-	-	-	-
23	-	-	-	-	-	-
24	-	-	-	-	-	-
25	-	-	-	-	-	-
V_{p75-25} (m^3)	0.112		0.084		0.000	
a_{p50} (m^2)	1.580		1.925		10.320	
t_{p75-25} (sec)	3,060		2,543		-	
f (m/sec)	0.000023165		0.000017163		-	
	2.32E-05		1.72E-05		-	

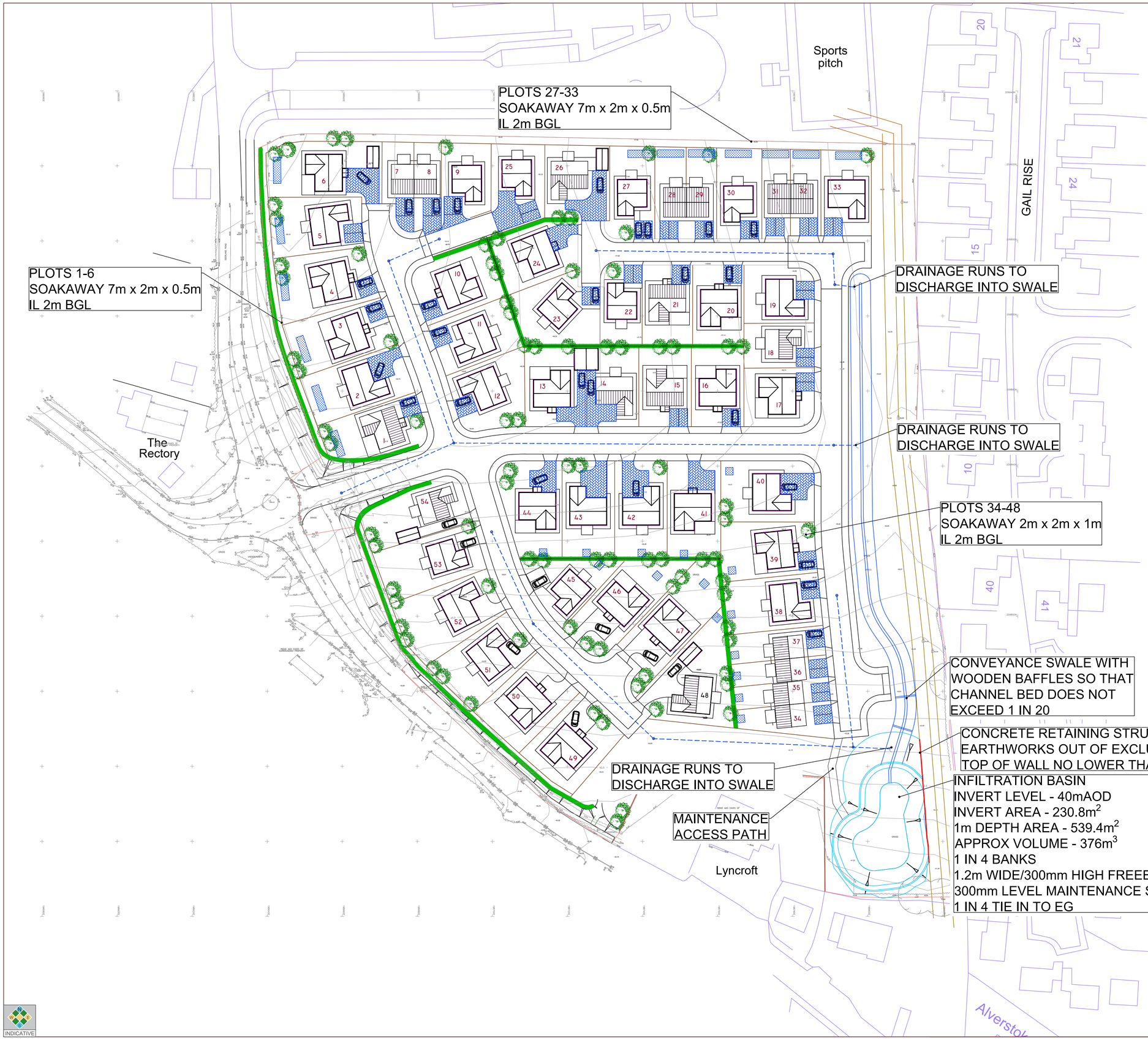




Soil infiltration rate, $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

Ground Investigation
www.ground-investigation.com

Appendix E



NOTES:

1. DO NOT SCALE FROM THIS DRAWING. ALL DIMENSIONS ARE IN METRES, UNLESS STATED OTHERWISE.
2. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
3. RAINWATER DOWNPIPE AND INTERNAL FOUL CONNECTION POSITIONS ARE TO BE CONFIRMED

KEY

- SURFACE WATER SEWER
- PLOT SOAKAWAY
- PERMEABLE PAVING
- RETAINING WALL

Rev	Date	Details	Drawn by	Checked by
P2	16.08.21	PLOT SOAKAWAYS AND PERMEABLE PAVING ADDED	PG	KT
P1	15/07/21	FIRST ISSUE	PG	KT

COTSWOLD TRANSPORT PLANNING

CLIENT: POWELLS RURAL

PROJECT: LAND AT LLANGWM

TITLE: DRAINAGE STRATEGY

STATUS: INFORMATION

SCALE @ A1:	DATE:	DRAWN:	CHECKED:	APPROVED:
1:500	JUL 21	PG	KT	KT

JOB NO:	DRAWING NO:	REVISION:
CTP-21-0221	C001	P2

INDICATIVE

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Appendix F

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Paul Graham
Site name:	Llangwm
Site location:	Llangwm

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be
the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.75116° N
Longitude:	4.91722° W
Reference:	952891888
Date:	Mar 31 2021 09:15

Runoff estimation approach FEH Statistical

Site characteristics

Total site area (ha):	2.75

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.442
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.08

Hydrological characteristics

	Default	Edited
SAAR (mm):	1119	1122
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):		28.09
1 in 1 year (l/s):		24.72
1 in 30 years (l/s):		50.01
1 in 100 year (l/s):		61.24
1 in 200 years (l/s):		69.11

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix G

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 259 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	39.535	0.535	10.3	161.6	O K
30 min Summer	39.682	0.682	11.5	221.1	O K
60 min Summer	39.820	0.820	12.6	283.1	O K
120 min Summer	39.874	0.874	13.0	309.3	O K
180 min Summer	39.888	0.888	13.1	316.4	O K
240 min Summer	39.891	0.891	13.1	317.7	O K
360 min Summer	39.887	0.887	13.1	315.9	O K
480 min Summer	39.876	0.876	13.0	310.2	O K
600 min Summer	39.861	0.861	12.9	302.9	O K
720 min Summer	39.845	0.845	12.8	295.1	O K
960 min Summer	39.813	0.813	12.5	279.7	O K
1440 min Summer	39.747	0.747	12.0	249.5	O K
2160 min Summer	39.655	0.655	11.3	209.7	O K
2880 min Summer	39.574	0.574	10.6	176.8	O K
4320 min Summer	39.439	0.439	9.5	126.5	O K
5760 min Summer	39.337	0.337	8.7	92.6	O K
7200 min Summer	39.264	0.264	8.1	69.7	O K
8640 min Summer	39.207	0.207	7.7	53.3	O K
10080 min Summer	39.166	0.166	7.3	41.8	O K
15 min Winter	39.587	0.587	10.7	181.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	123.380	0.0	25
30 min Summer	85.847	0.0	39
60 min Summer	57.108	0.0	68
120 min Summer	33.934	0.0	124
180 min Summer	25.105	0.0	180
240 min Summer	20.297	0.0	208
360 min Summer	15.059	0.0	270
480 min Summer	12.179	0.0	338
600 min Summer	10.327	0.0	408
720 min Summer	9.024	0.0	478
960 min Summer	7.291	0.0	616
1440 min Summer	5.387	0.0	884
2160 min Summer	3.981	0.0	1280
2880 min Summer	3.218	0.0	1652
4320 min Summer	2.388	0.0	2384
5760 min Summer	1.950	0.0	3120
7200 min Summer	1.686	0.0	3824
8640 min Summer	1.510	0.0	4576
10080 min Summer	1.386	0.0	5248
15 min Winter	123.380	0.0	25

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	39.747	0.747	12.0	249.5	O K
60 min Winter	39.897	0.897	13.2	320.8	O K
120 min Winter	39.961	0.961	13.7	353.7	O K
180 min Winter	39.983	0.983	13.9	365.3	O K
240 min Winter	39.987	0.987	13.9	367.5	O K
360 min Winter	39.981	0.981	13.9	364.2	O K
480 min Winter	39.967	0.967	13.8	356.6	O K
600 min Winter	39.946	0.946	13.6	345.6	O K
720 min Winter	39.922	0.922	13.4	333.2	O K
960 min Winter	39.872	0.872	13.0	308.4	O K
1440 min Winter	39.774	0.774	12.2	261.9	O K
2160 min Winter	39.640	0.640	11.1	203.4	O K
2880 min Winter	39.525	0.525	10.2	157.9	O K
4320 min Winter	39.341	0.341	8.7	93.8	O K
5760 min Winter	39.211	0.211	7.7	54.3	O K
7200 min Winter	39.121	0.121	7.0	29.8	O K
8640 min Winter	39.062	0.062	6.5	14.9	O K
10080 min Winter	39.048	0.048	6.1	11.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	85.847	0.0	39
60 min Winter	57.108	0.0	66
120 min Winter	33.934	0.0	122
180 min Winter	25.105	0.0	178
240 min Winter	20.297	0.0	230
360 min Winter	15.059	0.0	286
480 min Winter	12.179	0.0	364
600 min Winter	10.327	0.0	440
720 min Winter	9.024	0.0	516
960 min Winter	7.291	0.0	664
1440 min Winter	5.387	0.0	946
2160 min Winter	3.981	0.0	1348
2880 min Winter	3.218	0.0	1736
4320 min Winter	2.388	0.0	2468
5760 min Winter	1.950	0.0	3176
7200 min Winter	1.686	0.0	3888
8640 min Winter	1.510	0.0	4496
10080 min Winter	1.386	0.0	5136

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 198932 209732 SM 98932 09732
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.746

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.249	4	8	0.249	8	12	0.249

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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1523 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	98.137	0.137	0.0	1.8	O K
30 min Summer	98.190	0.190	0.0	2.5	O K
60 min Summer	98.251	0.251	0.0	3.3	O K
120 min Summer	98.293	0.293	0.0	3.9	O K
180 min Summer	98.319	0.319	0.0	4.2	O K
240 min Summer	98.339	0.339	0.0	4.5	O K
360 min Summer	98.366	0.366	0.0	4.9	O K
480 min Summer	98.383	0.383	0.0	5.1	O K
600 min Summer	98.394	0.394	0.0	5.2	O K
720 min Summer	98.402	0.402	0.0	5.3	O K
960 min Summer	98.410	0.410	0.0	5.5	O K
1440 min Summer	98.412	0.412	0.0	5.5	O K
2160 min Summer	98.408	0.408	0.0	5.4	O K
2880 min Summer	98.401	0.401	0.0	5.3	O K
4320 min Summer	98.383	0.383	0.0	5.1	O K
5760 min Summer	98.367	0.367	0.0	4.9	O K
7200 min Summer	98.357	0.357	0.0	4.7	O K
8640 min Summer	98.349	0.349	0.0	4.6	O K
10080 min Summer	98.344	0.344	0.0	4.6	O K
15 min Winter	98.154	0.154	0.0	2.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	123.380	0.0	27
30 min Summer	85.847	0.0	41
60 min Summer	57.108	0.0	70
120 min Summer	33.934	0.0	130
180 min Summer	25.105	0.0	190
240 min Summer	20.297	0.0	248
360 min Summer	15.059	0.0	366
480 min Summer	12.179	0.0	486
600 min Summer	10.327	0.0	604
720 min Summer	9.024	0.0	724
960 min Summer	7.291	0.0	960
1440 min Summer	5.387	0.0	1230
2160 min Summer	3.981	0.0	1608
2880 min Summer	3.218	0.0	2020
4320 min Summer	2.388	0.0	2856
5760 min Summer	1.950	0.0	3688
7200 min Summer	1.686	0.0	4480
8640 min Summer	1.510	0.0	5288
10080 min Summer	1.386	0.0	6152
15 min Winter	123.380	0.0	26

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	98.213	0.213	0.0	2.8	O K
60 min Winter	98.282	0.282	0.0	3.7	O K
120 min Winter	98.329	0.329	0.0	4.4	O K
180 min Winter	98.360	0.360	0.0	4.8	O K
240 min Winter	98.382	0.382	0.0	5.1	O K
360 min Winter	98.414	0.414	0.0	5.5	O K
480 min Winter	98.435	0.435	0.0	5.8	O K
600 min Winter	98.449	0.449	0.0	6.0	O K
720 min Winter	98.459	0.459	0.0	6.1	O K
960 min Winter	98.471	0.471	0.0	6.3	O K
1440 min Winter	98.476	0.476	0.0	6.3	O K
2160 min Winter	98.469	0.469	0.0	6.2	O K
2880 min Winter	98.459	0.459	0.0	6.1	O K
4320 min Winter	98.431	0.431	0.0	5.7	O K
5760 min Winter	98.404	0.404	0.0	5.4	O K
7200 min Winter	98.383	0.383	0.0	5.1	O K
8640 min Winter	98.366	0.366	0.0	4.9	O K
10080 min Winter	98.353	0.353	0.0	4.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	85.847	0.0	41
60 min Winter	57.108	0.0	70
120 min Winter	33.934	0.0	128
180 min Winter	25.105	0.0	186
240 min Winter	20.297	0.0	244
360 min Winter	15.059	0.0	360
480 min Winter	12.179	0.0	476
600 min Winter	10.327	0.0	592
720 min Winter	9.024	0.0	706
960 min Winter	7.291	0.0	930
1440 min Winter	5.387	0.0	1358
2160 min Winter	3.981	0.0	1696
2880 min Winter	3.218	0.0	2164
4320 min Winter	2.388	0.0	3076
5760 min Winter	1.950	0.0	3984
7200 min Winter	1.686	0.0	4840
8640 min Winter	1.510	0.0	5712
10080 min Winter	1.386	0.0	6560

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 198932 209732 SM 98932 09732
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.008

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.003	4	8	0.003	8	12	0.003

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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 121 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	98.437	0.437	0.2	1.7	O K
30 min Summer	98.590	0.590	0.2	2.2	O K
60 min Summer	98.729	0.729	0.3	2.8	O K
120 min Summer	98.747	0.747	0.3	2.8	O K
180 min Summer	98.744	0.744	0.3	2.8	O K
240 min Summer	98.733	0.733	0.3	2.8	O K
360 min Summer	98.701	0.701	0.2	2.7	O K
480 min Summer	98.666	0.666	0.2	2.5	O K
600 min Summer	98.632	0.632	0.2	2.4	O K
720 min Summer	98.599	0.599	0.2	2.3	O K
960 min Summer	98.539	0.539	0.2	2.0	O K
1440 min Summer	98.437	0.437	0.2	1.7	O K
2160 min Summer	98.322	0.322	0.2	1.2	O K
2880 min Summer	98.239	0.239	0.2	0.9	O K
4320 min Summer	98.129	0.129	0.1	0.5	O K
5760 min Summer	98.070	0.070	0.1	0.3	O K
7200 min Summer	98.048	0.048	0.1	0.2	O K
8640 min Summer	98.043	0.043	0.1	0.2	O K
10080 min Summer	98.040	0.040	0.1	0.2	O K
15 min Winter	98.493	0.493	0.2	1.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	123.380	0.0	24
30 min Summer	85.847	0.0	37
60 min Summer	57.108	0.0	64
120 min Summer	33.934	0.0	102
180 min Summer	25.105	0.0	134
240 min Summer	20.297	0.0	170
360 min Summer	15.059	0.0	238
480 min Summer	12.179	0.0	308
600 min Summer	10.327	0.0	374
720 min Summer	9.024	0.0	442
960 min Summer	7.291	0.0	574
1440 min Summer	5.387	0.0	828
2160 min Summer	3.981	0.0	1196
2880 min Summer	3.218	0.0	1560
4320 min Summer	2.388	0.0	2260
5760 min Summer	1.950	0.0	2952
7200 min Summer	1.686	0.0	3656
8640 min Summer	1.510	0.0	4368
10080 min Summer	1.386	0.0	5056
15 min Winter	123.380	0.0	24

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	98.667	0.667	0.2	2.5	O K
60 min Winter	98.829	0.829	0.3	3.2	O K
120 min Winter	98.854	0.854	0.3	3.2	O K
180 min Winter	98.848	0.848	0.3	3.2	O K
240 min Winter	98.830	0.830	0.3	3.2	O K
360 min Winter	98.779	0.779	0.3	3.0	O K
480 min Winter	98.724	0.724	0.3	2.8	O K
600 min Winter	98.672	0.672	0.2	2.6	O K
720 min Winter	98.623	0.623	0.2	2.4	O K
960 min Winter	98.535	0.535	0.2	2.0	O K
1440 min Winter	98.395	0.395	0.2	1.5	O K
2160 min Winter	98.249	0.249	0.2	0.9	O K
2880 min Winter	98.151	0.151	0.1	0.6	O K
4320 min Winter	98.049	0.049	0.1	0.2	O K
5760 min Winter	98.040	0.040	0.1	0.2	O K
7200 min Winter	98.035	0.035	0.1	0.1	O K
8640 min Winter	98.031	0.031	0.1	0.1	O K
10080 min Winter	98.029	0.029	0.1	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	85.847	0.0	37
60 min Winter	57.108	0.0	64
120 min Winter	33.934	0.0	110
180 min Winter	25.105	0.0	142
240 min Winter	20.297	0.0	182
360 min Winter	15.059	0.0	256
480 min Winter	12.179	0.0	330
600 min Winter	10.327	0.0	400
720 min Winter	9.024	0.0	470
960 min Winter	7.291	0.0	606
1440 min Winter	5.387	0.0	868
2160 min Winter	3.981	0.0	1240
2880 min Winter	3.218	0.0	1596
4320 min Winter	2.388	0.0	2204
5760 min Winter	1.950	0.0	2864
7200 min Winter	1.686	0.0	3672
8640 min Winter	1.510	0.0	4368
10080 min Winter	1.386	0.0	5000

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 198932 209732 SM 98932 09732
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.008

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.003	4	8	0.003	8	12	0.003

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