PAP/2023/0071

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ENVIRONMENT

Enviromena Project Management UK Limited
Nailcote Farm
Warwickshire
Drainage Strategy

NORTH WARWICKSHIRE
BOROUGH COUNCIL
RECEIVED
29/11/2023
PLANNING & DEVELOPMENT DIVISION

November 2023

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1. INTRODUCTION

1.1 This Drainage Strategy (DS) has been produced by BWB Consulting on behalf of Enviromena Project Management UK Limited in respect of a planning application for a proposed temporary solar farm at Nailcote Farm, Warwickshire.

1.2 A Flood Risk Assessment (FRA) has been developed for the Site (reference NFW-BWB-ZZ-XX-RP-YE-0001_FRA) and this DS accompanies this overarching document.

1.3 This DS is intended to support a full planning application (PAP/2023/0071) and as such the level of detail included is relevant for the type of application and type of development proposed.

1.4 It is understood that this SDS (dated November 2023) will be resubmitted to the live planning application "PAP/2023/0071". Therefore, the drainage guidance at the time of the planning application validation (24/02/2023) will be used for the latest drainage strategy.

1.5 The Lead Local Flood Authority (LLFA) initially raised an objection to the proposed drainage strategy, outlined within the DS (reference: NFW-BWB-ZZ-XX-RP-CD-0001_DS_S2-P05), which was previously submitted as part of the planning application (PAP/2023/0071). BWB provided a response outlining further information following consultation with the LLFA (reference: NFW-BWB-ZZ-XX-RP-CD-0002_LLFA Letter_S2-P01, dated 26/10/2023), which resulted in the LLFA removing their objection, with conditions. The letter produced by BWB has been provided as **Appendix 1**.

1.6 The Site is bound to the north by agricultural fields, to the east by agricultural fields and an unnamed ordinary watercourse (UOW). The south boundary of the Site is bound by the M6 motorway and Fillongley Shooting Club, the west of the Site is bound by Meriden Road (B4102).

1.7 The Proposed Development is for the construction of a temporary Solar Farm, to include the installation of ground-mounted solar panels together with associated works, equipment, and necessary infrastructure. The existing Site access is via a dirt track off Meriden Road (B4102) and is proposed to be retained as part of the development. A proposed Site development plan and sections of the associated structures are included as **Appendix 2**.

1.8 The location of the Site is illustrated within **Figure 1.1**, with contextual information provided within **Table 1.1**.

Table 1.1: Site Details

Site Name	Nailcote Farm
Location	Warwickshire
NGR (approx.)	SP 276 860
Application Site Area (ha)	62.2 (Approx.)
Development Type	Solar Farm
Anticipated Lifespan	40 years
Lead Local Flood Authority	Warwickshire County Council
Local Planning Authority	North Warwickshire Borough Council
Environment Agency Area	West Midlands
Planning Application	PAP/2023/0071

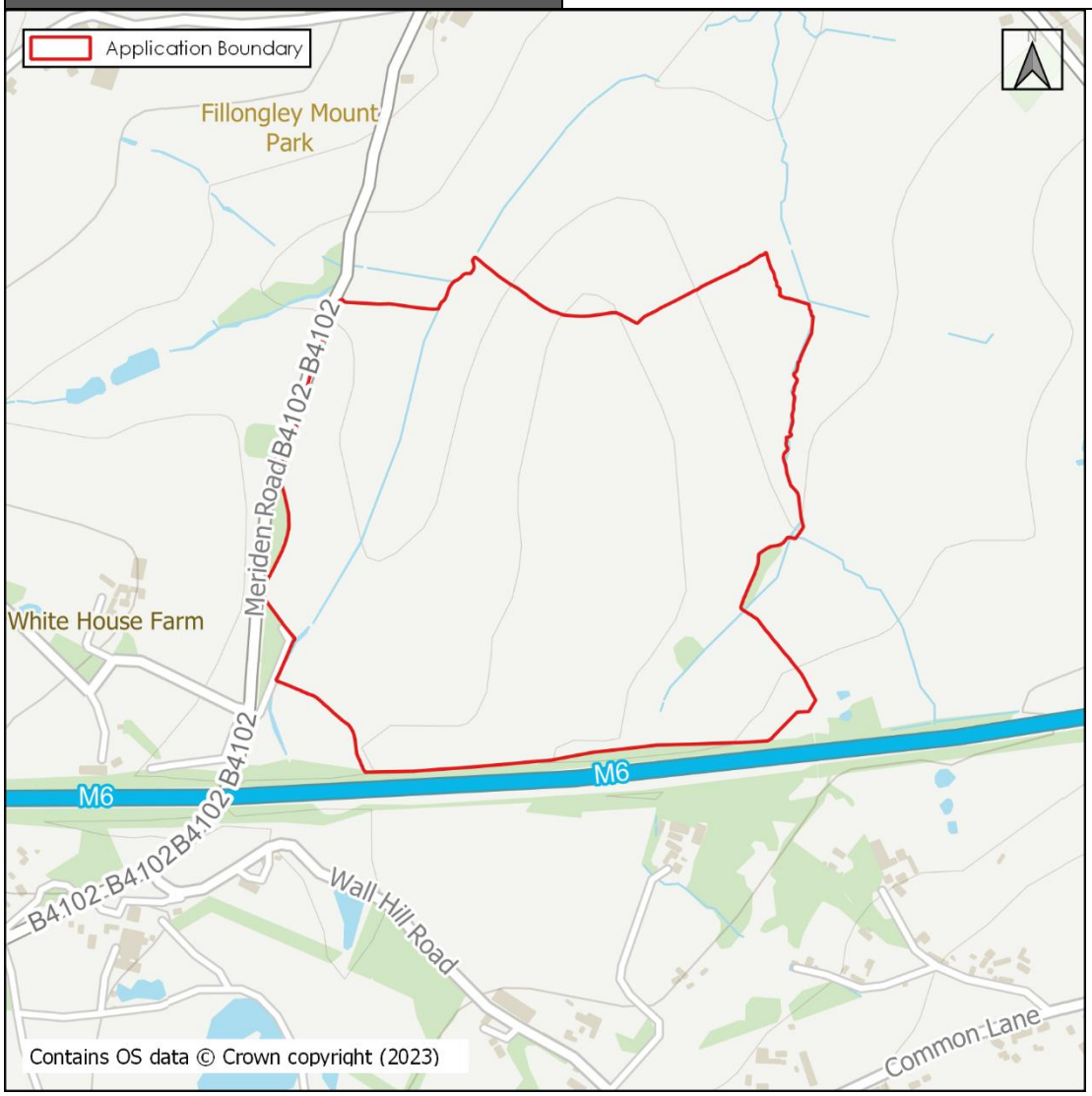

Figure 1.1: Site Location

Relevant Drainage Guidance

'Flood Risk & Sustainable Drainage Local guidance for developers'[1]

1.9 Warwickshire County Council's 'Flood Risk & Sustainable Drainage Local guidance for developers' has been reviewed in the development of this report. The key points from this document are as follows:

i. Restrict vehicular movements on Site to designated access tracks. In doing so, the risk of soil compaction is minimised and limited to specific locations. The applicant is to design the vehicular access tracks to be permeable.

ii. Specify what type of vegetation will be planted across the Site and how will it be managed/ maintained in perpetuity. The ideal situation is that vegetation is grassed and is kept reasonably high or grazed by livestock. Good vegetation cover will limit the transfer of sediments and slow the flow of water.

iii. Incorporate above- or below- ground surface water attenuation features to capture runoff from the panels. There are two basic ways as follows:

a. IDEAL - Gravel filter trenches positioned under the drip line of each solar panel. Typically, these are French drains 300mm x 300mm filled with a granular material to capture and store runoff from the panels. These will encourage infiltration and provide betterment in terms of reducing surface water runoff.

b. MINIMUM - Above ground swales positioned strategically around the development to capture surface water runoff from the panels as water flows downslope. The exact dimensions and number of swales required will depend upon the situation but are likely to be acceptable where designed in accordance with CIRIA SuDS Manual. Excavated material should be deposited on the downslope bank.

iv. Provide attenuation measures for the areas of hardstanding (i.e. electrical infrastructure or kiosks). This should be done in the normal way (i.e. calculate greenfield runoff rate, calculate increase in impermeable area, conduct storage estimate to work out storage volume).

1.10 Within the 'Flood Risk Recommendations' section of the SFRA it states that 'An appropriate buffer strip must be maintained along fluvial corridors respectively, to ensure that maintenance of the channel can be undertaken;'.

[1] Flood Risk & Sustainable Drainage Local guidance for developers available at: https://api.warwickshire.gov.uk/documents/WCCC-1039-95

Peak Rainfall

1.11 Predicted future changes in peak rainfall intensity caused by climate change are provided by the EA[2], with a range of projections applied to River Basin District Management Catchments.

1.12 The Site falls within the Tame Anker and Mease Management Catchment. **Table 1.2** identifies the relevant peak rainfall climate change allowances from this Management Catchment.

Table 1.2: Peak Rainfall Climate Change Allowances for the Tame Anker and Mease Management Catchment

Tame Anker and Mease Management Catchment Allowance	Total Potential Change Anticipated for the '2050s' (Lifetime up to 2060)	Total Potential Change Anticipated for the '2070s' (2061 to 2125)
1 in 30-Year Rainfall Event		
Upper End	35%	35%
Central	20%	25%
1 in 100-Year Rainfall Event		
Upper End	40%	40%
Central	20%	25%

1.13 The future increase in rainfall will need to be considered when designing a development to ensure its drainage system is sufficient for its lifetime and that it does not increase flood risk elsewhere. When determining the appropriate allowance(s) the anticipated lifespan of the development should be considered.

1.14 **Table 1.3** provides a summary of the EA's guidance on determining the appropriate allowance(s).

[2] Environment Agency, Flood risk assessments: climate change allowances: Environment Agency, Flood risk assessments: climate change allowances: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances. Last Accessed January 2023.

Table 1.3: Application of Appropriate Peak Rainfall Climate Change Allowances

<table>
<tr><th rowspan="2">Area Assessed</th><th colspan="3">Anticipated Development Life Span</th></tr>
<tr><th>up to 2060</th><th>between 2061 and 2100</th><th>up to or beyond 2100*</th></tr>
<tr><td>Development Sites^

Assess the 1 in 30-year and 1 in 100-year storm events with the respective climate change allowance(s) applied.

Development to be designed so that with the climate change allowance applied to the 1 in 100-year storm:
• there is no increase in flood risk elsewhere.
the development will be safe from surface water flooding</td><td rowspan="3">Use the Central Allowance for the 2050s</td><td rowspan="3">Use the Central Allowance for the 2070s+</td><td rowspan="3">Use the Upper End Allowance for the 2070s+</td></tr>
<tr><td>Urban Catchments

Assess the flood risk at the 1 in 30-year and 1 in 100-year storm events with the respective allowance(s) applied.</td></tr>
<tr><td>Rural Catchments <5km^2

Assess the flood risk at the 1 in 30-year and 1 in 100-year storm events with the respective central climate change allowances applied.</td></tr>
<tr><td>Rural Catchments >5km^2</td><td colspan="3">Direct rainfall analysis is not appropriate, use flood flow estimation methods.</td></tr>
</table>

**Includes all residential developments*
^the Lead Local Flood Authority may have local standards that also need to be considered.
+unless the 2050s allowance is greater.

1.15 The development Site has an anticipated lifespan of 40 years. Therefore, the Central allowance for the '2070s' epoch will need to be considered in the design of the associated drainage infrastructure. Although the 2070s epoch central allowance should be used for the climate change calculations in line with national guidance, to provide a conservative assessment for this scheme, the upper end allowance has been used. At the discharge of conditions design stage, the use of the 2070s epoch central allowance may be discussed for use with the LLFA and Local Planning Authority.

2. EXISTING CONDITIONS

Site location and land use

2.1 The Site is bound to the north by agricultural fields, to the east by agricultural fields and an unnamed ordinary watercourse (UOW). The south boundary of the Site is bound by the M6 motorway and Fillongley Shooting Club, Meriden Road (B4102) binds the west of the Site.

2.2 The site currently comprises agricultural land.

Topography

2.3 A topographical Survey (**Appendix 3**) shows the levels within the Site to undulate; however, the Site generally falls from the high points located at the centre of the Site towards the southern boundary and the ditches located within the Site to the east and west. The levels at the Site range from the highest point at approximately 148.7m Above Ordnance Datum (AOD) in the southern centre of the Site to approximately 122.3m AOD in the northeast Site corner.

2.4 The existing Site access levels range from 132.7m AOD to 133.6m AOD.

Existing watercourses / ditches within and adjacent to site

2.5 There are several watercourses and ditches within the Site, as shown on **Figure 2.1**.

2.6 The main watercourse on the Site is the Bourne Brook, which enters in the southwestern corner and exits along the northern boundary. There is also an Unnamed Ordinary Watercourse (UOW) within the Site, which enters in the southeast and follows the eastern Site boundary.

2.7 Several ditches can be found across the Site. One of these, located in the centre of the Site, seems to have no connection to the surrounding ditches. Another ditch, within the southern portion of the Site, connects to the some of the ditches found on the western Site boundary.

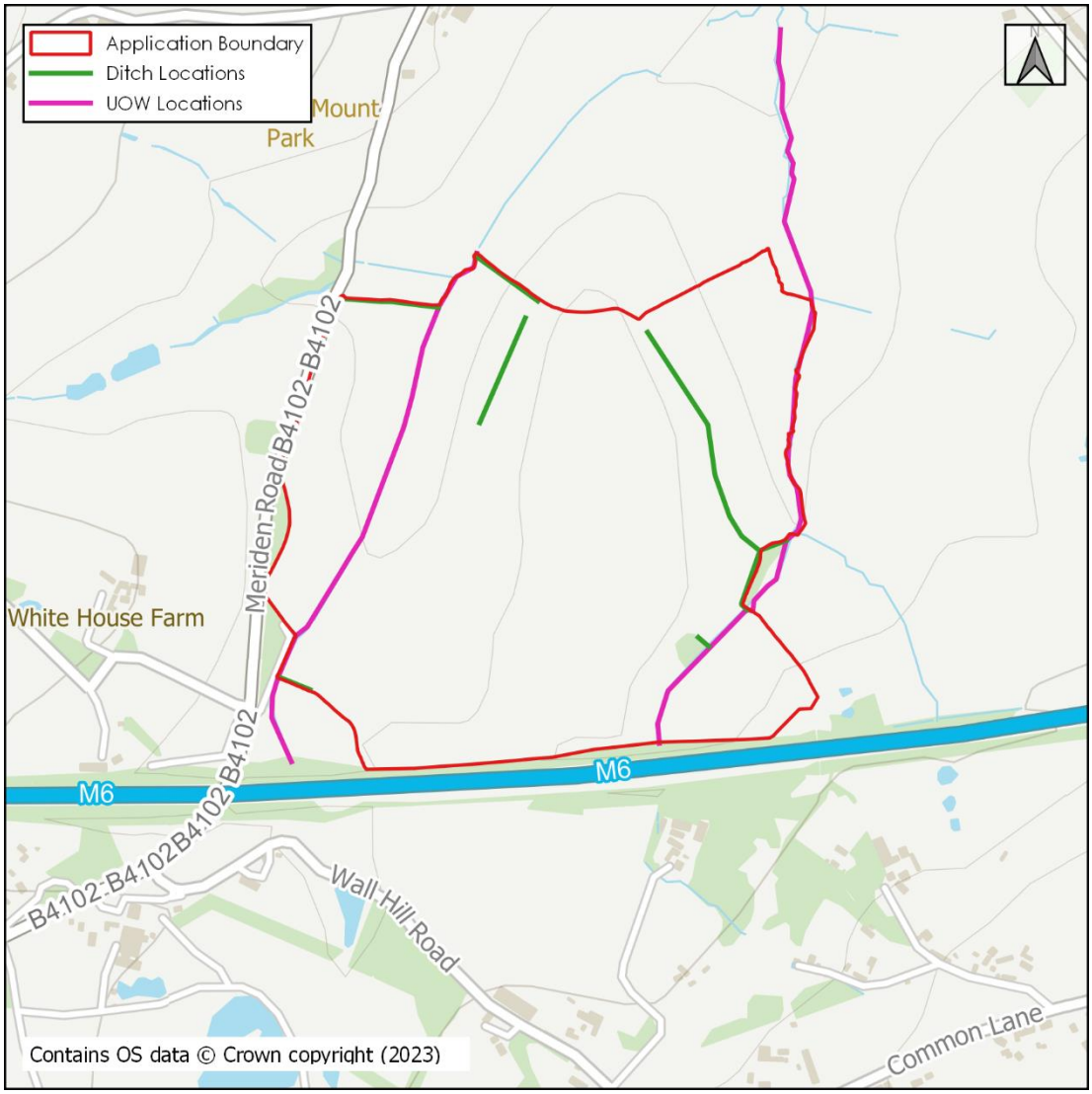

Figure 2.1 Location of ditches and UOW's

Geology

2.8 British Geological Survey (BGS) mapping shows the Site predominantly to be underlain by Keresley Member - Sandstone, a small pocket along the eastern UOW is underlain by Keresley Member – Argillaceous rocks and sandstone and conglomerate, interbedded.

2.9 Within the Site there are three superficial deposits. Along the north-western boundary there are deposits of Alluvium – clay, silt sand and gravel. A large area of Thrussington Member – Diamicton is located in the middle of the Site from the south boundary to the northern boundary. Along the UOW to the south of the Site there are traces of glaciolacustrine deposits, mid Pleistocene, clay, and silt. Rest of the Site has no recorded superficial deposits.

2.10 The geology is also supported by the report published by DUNELM Geotechnical & Environmental (report number: D10836).

2.11 Details on the bedrock geology and superficial deposits is included within **Figure 2.2**.

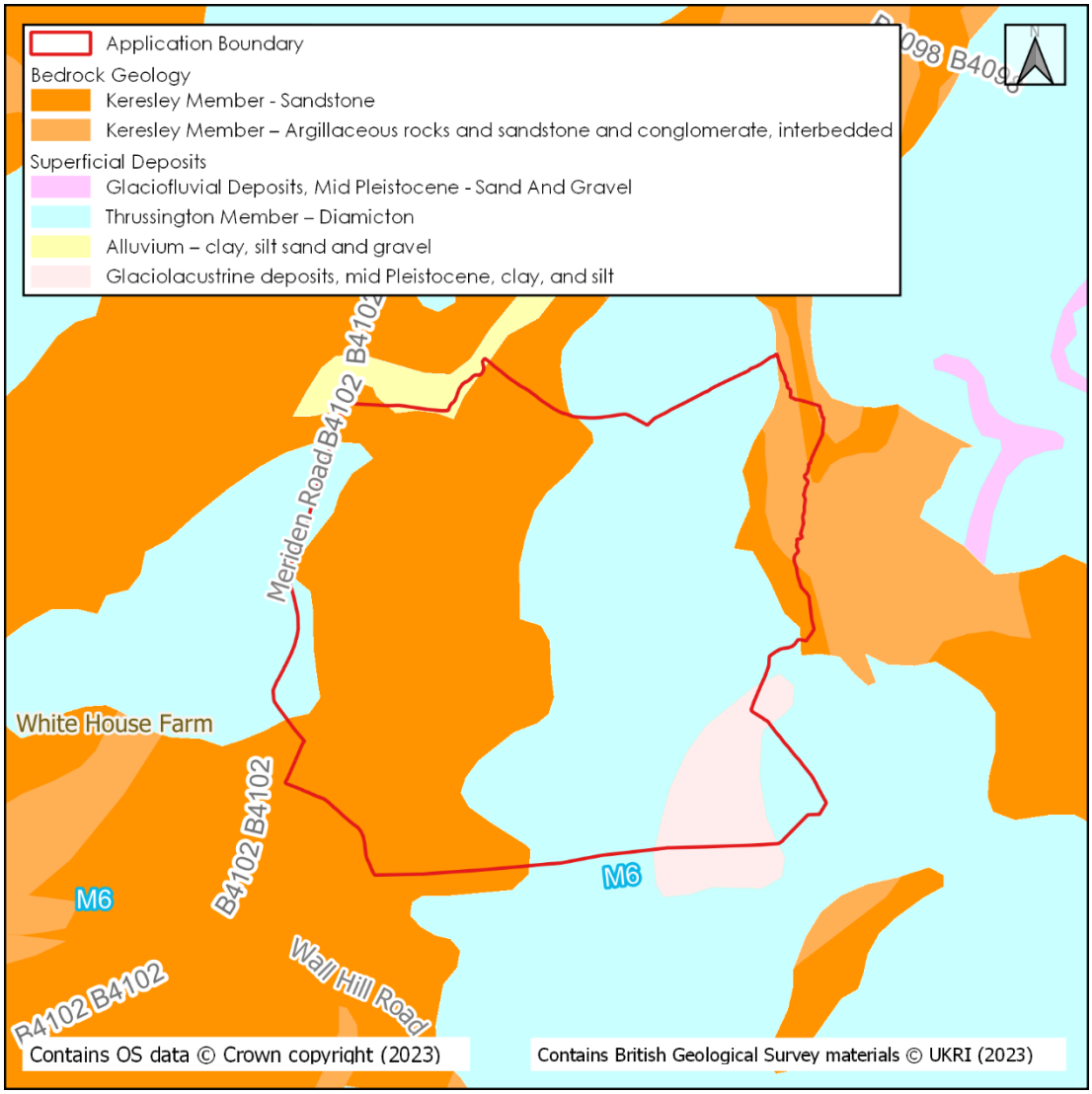

Figure 2.2: Bedrock Geology and Superficial Deposits

2.12 The EA designates the bedrock to be a principal aquifer, this means the bedrock holds a significant amount of groundwater that is used to support water supply, base flows to rivers, lakes, and wetlands on a strategic scale.

2.13 Areas of superficial deposits are classed as unproductive strata. There are several areas within the Site (mainly the central area of the Site) which is classed as a Secondary (undifferentiated) Aquifer, this means that the superficial deposit contains both characteristic traits of Secondary A and Secondary B Aquifers. There is also an area which seems to align with the area of Alluvium which is classed as a Secondary A Aquifer which is defined as a permeable layer which can support local water supplies and may form a base flow of a river.

2.14 A review of BGS borehole logs identifies records of two previous boreholes located within the Site, these are SP28NE128 and SP28NE68, which were excavated to depths of 705.24m and 716.57m, respectively. These show no recorded of ground water being struck. The Site is located in a Groundwater Source Protection Zone III.

3. DRAINAGE PROPOSALS

Surface Water Drainage

Solar Farm Research

3.1 The proposed surface water drainage strategy is based upon research on 'Hydrologic Response of Solar Farms'[3] (Cook and McCuen, 2013) and is supported by guidance published on 'Biodiversity Guidance for Solar Developments'[4] (BRE, 2014) and 'Technical Information Note TIN101: Solar Parks: Maximising Environmental Benefits'[5] (Natural England, 2011).

3.2 In summary, Cook and McCuen identify that the development of solar panels over a grassy field does not have a significant effect on the volume of runoff, the peak discharge, nor the time to peak. During the study, the runoff volume was found to increase slightly but not enough to require storm-water management facilities.

3.3 However, Cook and McCuen found that if the ground cover under the panels is gravel or bare ground, owing to design decisions or lack of maintenance, the peak discharge may increase significantly with storm water management needed. Additionally, the kinetic energy of water draining from the panels was found to be greater than that of typical rainfall, which increases the risk of erosion of soil at the base of panels.

3.4 Cook and McCuen recommend that the grass beneath the panels be well maintained or that a buffer strip (i.e., interception swale) be placed after the most downgradient row of panels, in order to maintain a drainage regime as close to existing conditions as possible.

3.5 BRE recognise that in most solar farms "*because panels are raised above the ground on posts, greater than 95% of a field utilised for solar farm development is still accessible for plant growth*". Therefore, it is considered that the majority of the site will remain as 'soft'/permeable surface post-development, with grassland around and underneath the solar arrays.

3.6 Natural England have stated in reference to solar developments that "*the key to avoiding increased run-off and soil into watercourses is to maintain soil permeability and vegetation cover. Permeable land surfaces underneath and between panels should be able to absorb rainfall as long as they are not compacted and there is some vegetation to bind the soil surface*."

[3] Hydrologic Response of Solar Farms, Journal of Hydrologic Engineering (Cook and McCuen, 2013)
[4] Biodiversity Guidance for Solar Development (BRE, 2014)
[5] TIN101: Solar Parks: Maximising Environmental Benefits (Natural England, 2011)

3.7 Based on the above research, the proposed surface water drainage strategy for the proposed solar arrays aims to minimise the compaction of soil during the construction and operation of the proposed development and incorporate a robust landscaping strategy to keep the areas beneath the panels as 'grassy' as possible during the lifetime of the development. These mitigation measures should be detailed within a Construction Environmental Management Plan (CEMP) and landscape strategy for the proposed development.

3.8 As an additional resilience measure, it is proposed that interception swales are constructed at the most downgradient row of panels to act as a form of mitigation and betterment, should the ground beneath the panels become patchy or bare during the lifetime of the development.

Construction and Operational Mitigation Measures

3.9 In order to minimise the compaction of soil during the construction phase, the temporary construction Site compound will be positioned as close as possible to the Site access to minimise the number of Heavy Goods Vehicles (HGVs) driving through the Site.

3.10 It is recommended that during construction only light machinery is used to install the solar arrays and ancillary equipment where possible. Vehicle movements should be minimised, and low ground pressure vehicles are recommended during wet weather working.

3.11 If necessary, to alleviate the effects of any compaction during the construction process, any affected areas should be chisel ploughed or harrowed and seeded prior to the solar farm becoming active.

3.12 During the operation of the solar farm, maintenance of the panels will be infrequent, minimal and will only require light machinery. Therefore, the operation of the Site is unlikely to significantly decrease the infiltration potential of the soil compared to its pre-development condition.

3.13 During the first few years of the solar farm becoming live, it is recommended that regular inspections of the planting and soil are undertaken to confirm that the grass is growing properly and is not bare or compacted. Any required remedial work should be completed as soon as possible.

Additional Resilience Mitigation Measures

3.14 Based on the mitigation proposed above, no formal surface water drainage system is necessary to manage the surface water flows emanating from the solar panels.

3.15 However, as an additional resilience measure, it is proposed to construct interception swales at the most downgradient row of solar panels to interrupt and slow potential channelised flows, enhance and promote the infiltration and interception capacity of the development, and help convey surface water over a greater surface area.

3.16 The location of the proposed swales is provided on the Conceptual Drainage Strategy provided as **Appendix 4**. Further details on the proposed swales are also provided further on within this section.

3.17 In the event of exceedance of the proposed swales, exceedance flows will follow the existing topography either into nearby watercourses or off Site onto third-party land. However, it should be noted that these exceedance flows will provide a degree of betterment on flooding on the existing scenario.

Ancillary Equipment and Roads

3.18 Although the solar panel arrays can be managed without the need for formal surface water drainage management, the ancillary equipment and roads should be assessed for their impact on the surface water runoff rates and volumes post-development.

3.19 New roads should be constructed using either Type 1 gravel, grass tracks or permeable materials so that the roads do not have an adverse impact on post-development surface water runoff rates and volumes.

3.20 If any new roads are proposed with typical impermeable surfacing, the runoff from the roads will need to me managed by a suitable surface water drainage system.

3.21 There is an existing informal parking area at the site entrance that is proposed to be retained. If the parking area is to be formalised, it should be re-surfaced with a permeable surface type, such as plastic reinforced type 1 aggregate. If the parking area is proposed to be surfaced with impermeable surfacing, a surface water drainage strategy will be required for this portion of the development.

3.22 Based on a review of the proposed masterplan, it is anticipated that the impermeable footprint of the ancillary equipment associated with the development will cover approximately 387m^2 (0.04ha), which is approximately 0.1% of the total proposed development area (62.2ha).

3.23 An assessment of the pre and post development runoff rates for the Site has been undertaken using the IH-124 method in MicroDrainage and are outlined in **Table 3.1**, with supporting calculations provided in **Appendix 5**.

Table 3.1: Existing & Proposed Runoff Rates

Return Period (Yr.)	Existing Greenfield Runoff Rate (l/s)	Post-Development Unmitigated Runoff Rate (l/s)	Post-Development Increase	
			l/s	%
1	20.4	20.5	0.1	0.5
QBAR	24.6	24.7	0.1	0.4
30	48.2	48.3	0.1	0.2
100	63.2	63.4	0.2	0.3
100 + 40%*	93.7	93.9	0.2	0.2

* Calculated by multiplying Standard Annual Average Rainfall (SAAR) by 1.4 to simulate a 40% climate change uplift on rainfall intensity

3.24 As shown within **Table 3.1**, the post-development runoff rate, when factoring in the increased impermeable area from the ancillary equipment is anticipated to increase the QBAR rate by 0.1l/s (0.4%), the 1 in 100-year runoff rate by 0.2l/s (0.3%) and the 1 in 100-year plus 40% climate change by 0.2l/s (0.2%). Therefore, the impact of developing the Site is considered to have a negligible impact on the existing runoff rate.

3.25 An assessment of the impacts the proposed ancillary equipment will have on the 1 in 100-year 6-hour runoff volume post-development has been undertaken. The pre- and post-development runoff volumes are compared in **Table 3.2**, with the supporting calculations provided within **Appendix 6**.

3.26 As the proposed development area is currently entirely greenfield, the existing runoff volume has been calculated using MicroDrainage to be 12,907m^3.

3.27 The runoff volume from the new impermeable area (i.e., 0.04ha associated with the ancillary equipment has been calculated using an average rainfall intensity of 10.7mm/hr as calculated using FEH rainfall data within Micro Drainage, and multiplied by the impermeable area, as described within **Figure 3.1**. The 100-year, 6-hour rainfall profile is presented within **Appendix 7**.

Av. Rainfall (m/hr) x 6 (hours) x Impermeable Area (m^2) = Runoff Volume (m^3)

0.0107 x 6 x 387 = 25m^3

Figure 3.1: 1 in 100-Year, 6 Hour Runoff Volume

3.28 As shown in **Figure 3.1**, the runoff volume from the newly introduced impermeable area is 25m^3. The runoff volume from the remaining permeable portion of the proposed development area (62.16ha) has been calculated using MicroDrainage to be 12,899m^3. As a result, the total post-development runoff volume is calculated to be 12,924m^3.

Table 3.2: Runoff Volume Comparison

Existing Volume (m^3)	Proposed Volume (m^3)		Difference (m^3)
	Permeable	Impermeable	
12,907	12,899	25	17

3.29 As shown within **Table 3.2**, the proposed introduction of the ancillary equipment will result in an increase of surface water runoff volume during the 1 in 100-year 6-hour event by 17m^3. This an increase of approximately 0.1% of the existing conditions within the Site.

3.30 It is anticipated that any increase in surface water runoff volume leaving the site will be intercepted within the interception swales located across the site.

Interception Swales

3.31 It is proposed that the interception swales will have 1:4 internal side slopes with a maximum design water depth of 300mm. The material excavated to install the swales will be applied to the downstream edge of the features to create an earth bund. A typical cross section of the proposed interception swales is provided within **Appendix 4**.

3.32 The proposed swales have been positioned outside of Flood Zone 3 and are also not anticipated to adversely displace any existing floodplains within the Site as no level raising will be associated with the construction of the swales.

3.33 Based on the proposed dimensions of the interception swales, it is anticipated that the maximum storage capacity of the swales is approximately 0.4m^3/m.

3.34 The interception storage capacity of the swales is such that in increase in runoff volume associated with the ancillary equipment will be intercepted by the proposed swales. Additionally, the inclusion of the swales within the development will act to provide a betterment to the existing surface water runoff rate and volume that will leave the Site onto surrounding land and Bourne Brook and the UOW post-development.

3.35 The inclusion of the interception swales across the development will also function as a mitigation measure to reduce the likelihood of any pollution incidents leaving the Site. As the risk of pollution incidents is more likely to occur during the construction phase as opposed to the operation of the Site, it is recommended that the swales are constructed early on during the construction phase and silt fences are utilised on the swales during the entire construction phase.

3.36 The proposed swales should be maintained throughout the lifetime of the development to reduce the risk of the features becoming less effective due to silt accumulation, litter accumulation or vegetation issues.

3.37 The final operations and maintenance plan should be developed during the construction design stage prior to the development becoming live; however, a basic maintenance schedule based off guidance provided within the CIRIA SuDS Manual[6] is provided within **Section 4**.

Infiltration Trenches

3.38 Gravel infiltration trenches can be installed alongside ancillary equipment in order to provide residual attenuation and land drainage, as well as intercepting exceedance flows. Illustrative locations of where the trenches are proposed to be installed are shown within **Appendix 4**.

3.39 The infiltration trench dimensions can vary; however, a 300mm wide and 300mm deep trench with a 30% void aggregate ratio would provide approximately 0.03m^3/m of attenuation.

3.40 An indicative cross section of an arrangement of utilising infiltration trenches surrounding the ancillary equipment is presented as **Figure 3.2**.

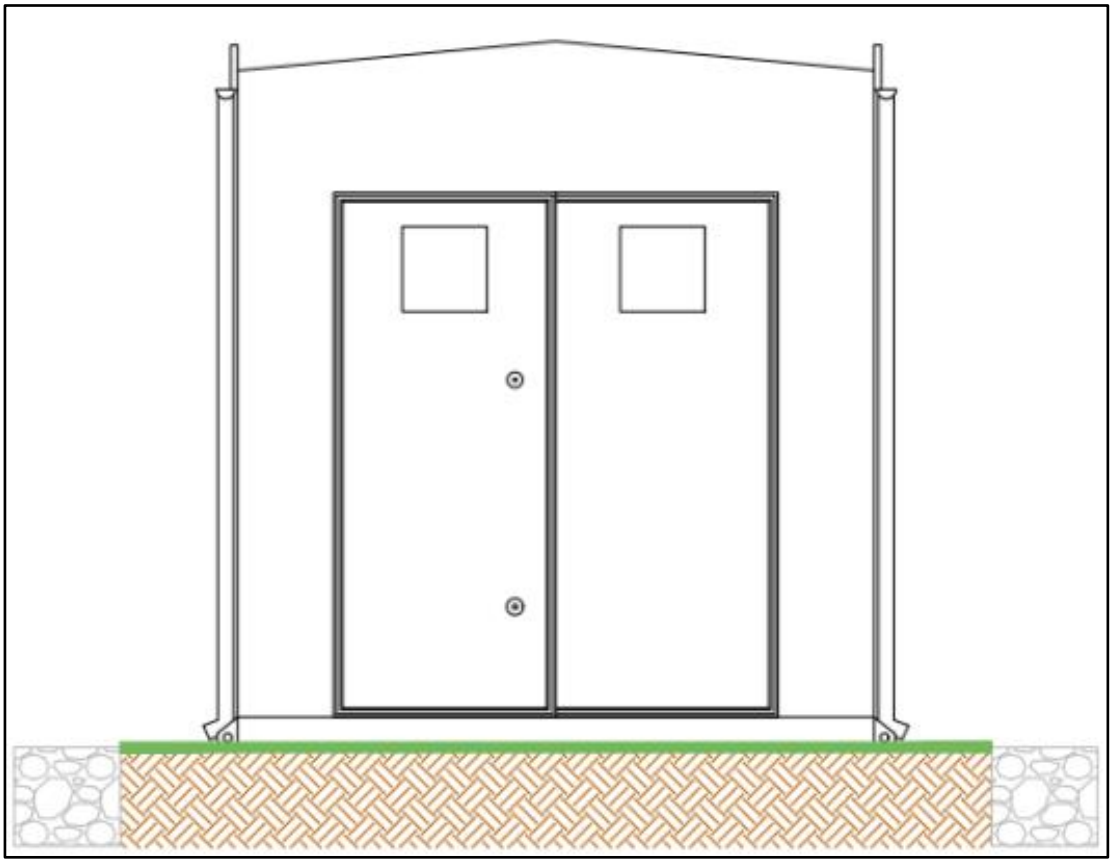

Figure 3.2: Indicative Filter Drain and Ancillary Equipment Arrangement

[6] The SuDS Manual C753 -Version 6 (CIRIA, 2019)

Foul Water Drainage

3.41 No foul water flows will be produced as a result of the proposed development. Therefore, no foul water drainage provision is required.

4. MAINTENANCE

4.1 The SuDS Manual maintenance schedule for swales, is shown in **Table 4.1**.

Table 4.1: The SuDS Manual Typical Maintenance Schedule for Swales

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly	• Inspect inlets, outlets, and overflows for blockages, and clear if required.
	Monthly (or as required)	• Remove litter and debris; and • Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours.
	Monthly (during growing season), or as required	• Cut grass – to retain grass height within specified design range.
	Monthly for first year then as required	• Manage other vegetation and remove nuisance plants.
	Monthly for 6 months, quarterly for 2 years, then half yearly	• Inspect vegetation coverage.
	Half yearly	• Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies.
Occasional Maintenance	As required or if bare soil is exposed over > 10% of the swale treatment area	• Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required.
Remedial Action	As required	• Repair erosion or other damage by re-turfing or reseeding; • Relevel uneven surfaces and reinstate design levels; • Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface; • Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip; and • Remove and dispose of oils or petrol residues using safe standard practices.

4.2 The SuDS Manual maintenance schedule for filter drains, is shown in **Table 4.2**.

Table 4.2: The SuDS Manual Typical Maintenance Schedule for Filter Drains

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly (or as required)	• Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices.
	Monthly	• Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage.
	Six monthly (or as required)	• Remove sediment from pre-treatment devices.
	Six monthly	• Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies.
Occasional Maintenance	Five yearly, or as required	• At locations with high pollution loads, remove surface geotextiles and replace, and wash or replace overlying filter medium.
	As required	• Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (e.g., NJUG, 2007 or BS 3998:2010); and • Clear perforated pipework of blockages.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 This DS has been written in accordance with the latest relevant local and national guidance and the latest accepted research on solar farm developments at the time of initial validation of planning application "PAP/2023/0071".

5.2 This DS is intended to be read in conjunction with the accompanying FRA (reference: NFW-BWB-ZZ-XX-RP-YE-0001_FRA).

5.3 The findings of this DS are that the proposed solar development will have negligible impact on the post-development surface water runoff rates and volumes.

5.4 Whilst the proposed development will have negligible impact on the surface water runoff regime, in accordance with the LLFA requirements it is proposed that interception swales are used within the development to mitigate against the potential risk of surface water runoff rates and volumes increasing as a result of the development.

5.5 A suitably qualified maintenance company should be appointed to undertake the required maintenance of the proposed interception swales for the proposed lifespan of the development. General best practice maintenance activities and schedules are provided within this report.

APPENDICES

Appendix 1: Letter to LLFA to Address their Comments (Reference:NFW-BWB-ZZ-XX-RP-CD-0002_LLFA Letter_S2-P01)

Warwickshire Count Council,
Flood Risk Management Team,
Planning Delivery,
Environmental Services.

Our Ref: NFW-BWB-ZZ-XX-RP-CD-0002_LLFA Letter_S2-P01
Contact: Matthew Bailey
Direct Dial: 07436 031863

Date: 26th October 2023

Dear Scarlett

SUBMISSION OF ADDITIONAL INFORMATION FOLLOWING LEAD LOCAL FLOOD AUTHROITY OBJECTION TO PLANNING APPLICATION PAP/2023/0071

I am writing to formally summarise consultation that has taken place with Warwickshire County Council Flood Risk Management Team and to submit new information following these discussions, in response to the Lead Local Flood Authority's (LLFA) objection to the proposed solar development at Fillongley (planning application reference: PAP/2023/0071). The LLFA's objection is dated 29th March 2023 and has been attached to this letter as **Appendix 1** for reference.

Following receipt of the objection, consultation has taken place both via email and a teleconference meeting on the 15th June 2023. The email correspondence undertaken with the LLFA has been attached to this letter as **Appendix 2**.

Although the objection states that BRE365 infiltration testing should be undertaken within the site, it was agreed with the LLFA that falling head tests would be acceptable (**Appendix 2**).

Falling head permeability testing was undertaken by BWB Consulting between 13th and 18th September 2023. The ground investigation findings (reference: NFW-BWB-ZZ-XX-RP-YE-0003) are presented as **Appendix 3** to this letter. A summary of the testing findings and their implications for the proposed development is provided below.

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Summary of falling head test results and implications for the proposed development

Falling head tests were undertaken at seven Test locations across the site.

The testing demonstrated that the site has good drainage characteristics in the granular strata and poor drainage characteristics in the cohesive strata within the site. Although the drainage characteristics were poor in the cohesive strata, there was evidence of infiltration in these locations and we have calculated a rate for each test location. The infiltration rates calculated across the site range between 3.09×10^{-6} m/s to 2.58×10^{-9} m/s and generally the western region of the site showed better infiltration potential than the eastern portion.

Based on the findings of the infiltration testing, it is considered that surface water naturally drains from the site via infiltration at varying rates.

On the eastern region of the development, the only impermeable area proposed is associated with three transformer units, totalling 75m^2 of impermeable area across approximately 24.7ha (or, 247,000m^2) of land, which is the natural drainage catchment area within the east of the site. Therefore, although the infiltration rates are poor in the east of the site, the low rate and minimal impermeable area associated with the transformer units will have a negligible impact on the rate and volume of surface water leaving the site.

The use of any sort of restriction device to enable a restriction to greenfield rates from this area, would not be practical and/or feasible, based upon the significantly low calculated runoff rate. It would not be possible to physically restrict to such a low rate, whilst ensuring that any orifice/restriction device, does not become blocked with sediment etc.

Additionally, the runoff from these impermeable areas will be captured by the proposed cut off swales located upstream from any offsite receptors of surface water runoff. Surface water captured by runoff swales can slowly infiltrate into the ground.

Based on the above summary and attached ground investigation findings, it is considered that the proposed drainage strategy submitted in support of planning application PAP/2023/0071 (reference: NFW-BWB-ZZ-XX-RP-CD-0001_S2-P04) is suitable to ensure that there is no downstream detriment, based upon the surface water runoff rates and runoff volume, associated with the proposals.

In addition to the above, it is proposed that additional residual mitigation will be proposed for the isolated transformer units across the site, to reduce the likelihood of ground surrounding this infrastructure becoming 'boggy' following rainfall. This additional resilience is outlined below and will provide further attenuation to surface water running off the impermeable surfaces.

Additional Mitigation for Transformer Units

As a general resilience measure to reduce the ground becoming 'boggy' around the transformer units, we are proposing that the units will be raised 150mm above the external ground level.

Additionally, it is proposed that each transformer unit will be surrounded by infiltration trenches to capture, attenuate and discharge surface water runoff from the transformers.

The infiltration trench for each individual transformer can be sized up ahead of construction using the nearest infiltration test location for the relevant transformer. However, for the planning stage a Quick Storage Estimate (QSE) has been undertaken in MicroDrainage using the upper and lower infiltration range found during the permeability testing.

Based on the QSE outputs, the required attenuation volume for the infiltration trenches to manage the 1 in 100-year plus climate change return period ranged between 1.2m^3 – 4.3m^3 per transformer. It is expected that the volume required at detailed design will be in the middle of this range. The QSE outputs are provided as **Appendix 4**.

Maintenance Contact Details

Within their objection the LLFA ask for details of the party responsible for undertaking the future operations and maintenance of the Sustainable Drainage Systems within the proposed development.

It is understood that the ongoing maintenance of the proposed development will be undertaken by the developer of the site, as per the approach they have taken for their other operational solar sites. Their details are provided below:

- O&M provider - Enviromena Asset Manager UK Ltd
- Contact number – 03301071415
- Adress – 15 Diddenham Court, Grazeley, Reading, RG7 1JQ

Next Steps

I trust the above summary and information attached is suitable to allow the LLFA to reassess the proposed development and provide new comments on planning application PAP/2023/0071.

Yours sincerely,

Matthew Bailey
Environmental Engineer

Enc:

- Appendix 1 – LLFA Objection (reference: WCC002749/FRM/SR/001)
- Appendix 2 – LLFA Email Correspondence
- Appendix 3 – Ground Investigation Findings (reference: NFW-BWB-ZZ-XX-RP-YE-0003)
- Appendix 4 – MicroDrainage Quick Storage Estimate Outputs

Appendix 1 – LLFA Objection (reference: WCC002749/FRM/SR/001)

Your ref: PAP/2023/0071
Our ref: WCC002749/FRM/SR/001
Your letter received: 03/10/2023

SENT BY EMAIL

Mr Jeff Brown
Head of Development Control
North Warwickshire Borough Council
The Council House
South Street
Atherstone CV9 1DE

Flood Risk Management
Warwickshire County Council
Shire Hall
Warwick
Warwickshire
CV34 4RL
Tel: 01926 412982
FRMPlanning@warwickshire.gov.uk
www.warwickshire.gov.uk

FAO Jeff Brown

29 March 2023

Dear Mr Brown

PROPOSAL: **Construction of a temporary Solar Farm providing 47.7 MW output, to include the installation of ground-mounted solar panels together with associated works, equipment and necessary infrastructure**

LOCATION: **Land 800 Metres South Of Park House Farm, Meriden Road, Fillongley**

Warwickshire County Council as the Lead Local Flood Authority (LLFA) has reviewed the application which was received on the 03 October 2023. Based on the information submitted the LLFA currently recommends refusal of planning permission and **objects** to the development based on the following reasons.

Reason
The information submitted with this application does not comply with the requirements set out in the National Planning Policy Framework[i] (NPPF) and supporting Flood Risk & Coastal Change guidance[ii]. Specifically:

- The details relating to the surface water drainage are insufficient.

The submitted information does not therefore allow a suitable assessment of the proposed development, considering flood risk and surface water drainage matters.

Overcoming our objection

You can overcome our objection by submitting further information which is detailed below. This information should provide details of the proposed surface water drainage considering the scale and nature of the development to ensure the site will not increase risk elsewhere and where possible reduces flood risk overall. If this cannot be achieved we are likely to maintain our objection to the application.

At the 'full' planning stage proposals for surface water drainage should be well developed and this should be reflected in the level of detail provided. A surface water drainage scheme should be provided based on SuDS principles demonstrating how the development attenuates surface water runoff,

improves water quality and provides amenity and biodiversity. This should be supported by network level calculations demonstrating the performance of the system.

Given the above, the following comments are made and further information required is outlined. This forms the basis of our current objection:

1. As no formal outfall has been provided; therefore it is assumed that surface water is being managed on site via an infiltration-led drainage method. As the development proposes extensive use of swales, the performance of such features must be proven to be viable through appropriate testing in accordance with BRE Digest 365 Soakaway Guidance. The drainage system should be adequately sized to reflect the results of the testing.
2. Further information is required demonstrating that the proposed swales will effectively manage run-off from the impermeable areas. Supporting evidence should demonstrate how discharge from the proposed swales will be appropriately restricted to the greenfield run off rate.
3. The LLFA acknowledges that solar arrays should have a limited impact on run off rates, however this is reliant on well-maintained vegetation below the panels. Acknowledge that the concentration of runoff along the drip-edge of panels can lead to erosion issues and detail mitigation measures as appropriate, including:
    - The importance of maintaining site vegetation and how this will be achieved for the lifetime of the development.
    - Gaps between each individual cell of the solar panels to allow water to fall to the ground at multiple points and avoid concentrating run-off.
4. A site specific maintenance has been provided. Such maintenance plan should provide the name of the party responsible, including contact name, address, email address and phone number.

We ask to be re-consulted with the results of any additional information. We will provide you with bespoke comments within 21 days of receiving formal reconsultation..

Informative

a) Surface water run-off should be controlled as near to its source as possible through a sustainable drainage approach to surface water management. Sustainable Drainage Systems (SuDS) are an approach to managing surface water run-off which seeks to mimic natural drainage systems and retain water on-site as opposed to traditional drainage approaches which involve piping water off-site as quickly as possible.
b) The LLFA does not consider oversized pipes or box culverts as sustainable drainage. Where such attenuation is considered necessary, this should be supplemented with suitable above ground features such as green roofs, rain-gardens and tree pits to provide water quality, amenity and bio-diversity benefits.
c) Reference is made to the LLFA's *Flood Risk & Sustainable Drainage Local guidance for developers*[iii] which provides further advice and guidance as to how surface water drainage proposals should be designed.

Yours sincerely

Scarlett Robertson

Scarlett Robertson
Flood Risk Management Officer

Documents Reviewed:

- 11370 Land at Nailcote Farm LVA Rev B.pdf
- 11370 Land at Nailcote Farm LVA Rev B_Part2.pdf
- Application Form.pdf
- Covering Letter_Redacted..pdf
- Drainage Strategy_S2-P05_Part1.pdf
- Drainage Strategy_S2-P05_Part2.pdf
- Flood Risk Assessment_S2_P05_Part1.pdf
- Flood Risk Assessment_S2_P05_Part2.pdf
- General Layout RevF - 09-03-23.pdf
- Landscape Strategy Plan- 09-03-23.pdf
- Planning Statement Feb 23.pdf
- Site location plan.pdf

N.B. On 10th January 2023, the Defra published[iv] "the Review for implementation of Schedule 3 to the Flood & Water Management Act 2010;" this recommended implementation of Schedule 3 which the government has accepted. Warwickshire County Council will take on the role of the SuDS Approval Body (SAB), you can read more about this on our website which we will be updating periodically.

https://www.warwickshire.gov.uk/severe-weather/planning-and-sustainable-drainage/2

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[i] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf

[ii] https://www.gov.uk/guidance/flood-risk-and-coastal-change

[iii] https://api.warwickshire.gov.uk/documents/WCCC-1039-95

[iv] https://www.gov.uk/government/publications/sustainable-drainage-systems-review

Appendix 2 - LLFA Email Correspondence

Matthew Bailey

From: FRM Planning <frmplanning@warwickshire.gov.uk>
Sent: 04 July 2023 10:49
To: Matthew Bailey
Subject: Re: 221748_Nailcote Farm, Fillongley, Warwickshire (Planning ref: PAP/2023/0071)

This email originated from outside of our organisation. Please exercise caution with content, links and attachments.

OFFICIAL

Good Morning Matthew,

As previously stated, infiltration testing compliant with BRE Digest 365 Soakaway Design Guide would be our preference however, given the nature of the development we could accept a series of failing head tests across the proposed development site. We expect a minimum of 3 repeated failing head tests for each point showing the suitability of ground conditions for repeated rainfall events.

I hope this addressess your concerns.

Best regards,
Scarlett
Flood Risk Management

Please send responses to FRMplanning@warwickshire.gov.uk

Our updated Flood Risk Guidance for Development was published in June 2023. The new guidance is available here and our website details the changes within this update.

Flood Risk Management
Planning Delivery
Environment Services
Warwickshire County Council

[redacted]
Email: FRMplanning@warwickshire.gov.uk
www.warwickshire.gov.uk

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From: Matthew Bailey <Matthew.Bailey@bwbconsulting.com>
Sent: 21 June 2023 16:54
To: FRM Planning <frmplanning@warwickshire.gov.uk>
Cc: Keith Alger <Keith.Alger@bwbconsulting.com>
Subject: RE: 221748_Nailcote Farm, Fillongley, Warwickshire (Planning ref: PAP/2023/0071)

OFFICIAL

Hi Scarlett,

Thank you for your time last week to discuss this site / application.

Following our discussion we have put together an indicative test location plan for falling head tests across the site (see attached markup plan).

We are looking at seven total falling head tests across the site. Would this be acceptable to confirm there is infiltration within the site and address your concerns about the runoff from the ancillary equipment?

Thanks,

Matt

Matthew Bailey
Engineer | Environmental Engineering | BWB Consulting Limited

[redacted]

From: FRM Planning <frmplanning@warwickshire.gov.uk>
Sent: 12 May 2023 10:01
To: Matthew Bailey <Matthew.Bailey@bwbconsulting.com>
Subject: Re: 221748_Nailcote Farm, Fillongley, Warwickshire (Planning ref: PAP/2023/0071)

This email originated from outside of our organisation. Please exercise caution with content, links and attachments.

OFFICIAL

Good Morning Matthew,

We expect to see infiltration testing across this site compliant with BRE Digest 365 Soakaway Design Guide given the shallow nature of the swales. Providing the location points are within close proximity to the proposed swales we can confirm that 4 points would be sufficient, however more would be favourable.

I hope this addresses your concerns

Best regards,
Flood Risk Management
Please send responses to FRMplanning@warwickshire.gov.uk

Flood Risk Management
Planning Delivery
Environment Services
Warwickshire County Council

[redacted]
Email: FRMplanning@warwickshire.gov.uk
www.warwickshire.gov.uk
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From: Matthew Bailey <Matthew.Bailey@bwbconsulting.com>
Sent: 05 May 2023 14:27
To: FRM Planning <frmplanning@warwickshire.gov.uk>
Cc: Keith Alger <Keith.Alger@bwbconsulting.com>
Subject: 221748_Nailcote Farm, Fillongley, Warwickshire (Planning ref: PAP/2023/0071)

F.A.O Scarlett Robertson

Hi Scarlett,

I am writing in respect of your consultee comments (dated 29/03/2023) relating to the proposed Solar Farm development at Fillongley (Planning ref: PAP/2023/0071). I have attached your comments for ease of reference.

We are in the process of preparing a response to your objection with the additional information requested. As part of this we are looking into getting soakaway testing commissioned within the site.

Please can you confirm if falling head infiltration testing would be sufficient to inform the infiltration potential of the proposed interception swales? Given the size of the development and potential logistical difficulties associated with transporting a water bowser across the site, BRE365 Digest testing may be difficult to undertake across the whole site.

The size of the site at approximately 61.5 hectares is such that we would look to have 4 test locations spread across the site. **Would you deem this sufficient?**

As the swales are only intended to be utilised as a buffer to reduce soil erosion from runoff from the solar panels and there only being approximately 2,000m^2 of impermeable area associated with the ancillary equipment, the swales provided across the site will likely be sufficient to manage any additional runoff post-development even if the infiltration rate is extremely low, which we do not expect to be the case given the Sandstone bedrock indicated on British Geological Survey mapping.

I am awaiting confirmation on the exact details on the approach to maintenance, but am expecting a detailed maintenance scope from the client, based upon other sites they operate. We will send this over to you in due course, as part of our formal response.

Your input would be appreciated as it will reduce the likelihood of undertaking abortive work and/or submit insufficient information again, in turn leading to a delay in the application process.

Many thanks,

Matt

Matthew Bailey
Engineer | Environmental Engineering | BWB Consulting Limited

[redacted]

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Appendix 3 - Ground Investigation Findings (reference: NFW-BWB-ZZ-XX-RP-YE-0003)

Nailcote Farm, September 2023

Project Name:	Land at Nailcote Farm, Warwickshire
Project No:	221748
Revision:	P02
Reference:	NFW-BWB-ZZ-XX-RP-YE-0003
Author:	Thomas Flame
Approver:	Chris Rhodes

BWB Consulting Ltd (BWB) was instructed by Environmena Project Management UK Ltd (the Client) to carry out a ground investigation and permeability testing at the above site. The testing was required to obtain information regarding the suitability of the underlying geology at the site to support soakaway drainage for a proposed solar farm development.

The site currently comprises a series of large fields adjacent to Meriden Lane, near Filongley, Coventry.

Scope of Works

BWB undertook permeability testing at the site between 13th and 18th September 2023 which comprised the drilling of seven boreholes across the site and infiltration testing to assess the permeability characteristics of the underlying soils . Investigation locations are presented on **Drawing 1**, labelled FH01 – FH07.

Published geology indicates ground conditions to comprise superficial Thrussington Member deposits in the east and west of the site overlying Bedrock of the Keresley Member (sandstone). Superficial deposits are absent in the central areas of the site.

Ground Conditions

Ground conditions encountered during this investigation comprised Topsoil across the entire site comprising dark brown clayey sand with rootlets and occasional sandstone gravel.

The Thrussington Member was identified below the topsoil in FH03, FH04 and FH05 and typically comprised slightly clayey or slightly gravelly sand. Gravels consisted of sandstone and quartzite.

The Keresley Member bedrock was encountered as reddish brown clayey sand in FH01, FH03 and FH05. Cohesive strata, inferred to be weathered mudstone units of the Keresley member, or cohesive Glacial Till deposits of the Thrussington member, was encountered as a red sandy clay in FH02, FH04 and FH07. Exploratory hole logs are presented in **Appendix 1**.

Groundwater was not encountered during the drilling, however it was observed in FH06 prior to the commencement of the permeability testing. The level was recorded at 1.20m bgl on the first day of testing, and 0.90m bgl on the second day.

Soakaway Test Results

Results of the infiltration tests are presented within **Appendix 2** and a summary of the results are presented below in **Table 1**.

In FH01, FH05 and FH06, 3 full test runs were completed, wherein the water level was raised and allowed to drain at least 75% before refilling. FH02, FH03, FH04 and FH07 were filled and monitored for 24 hours without draining 75% of the way back to their original level.

Table 1: Summary of Soakaway Test Results

Location	Test No.	Permeability Rate (m/s) – Basic Time Lag Method	Permeability Rate (m/s) – General Method
FH01	A	2.57×10^{-06}	3.89×10^{-07}
	B	2.44×10^{-06}	3.13×10^{-07}
	C	3.09×10^{-06}	2.03×10^{-06}
FH02	A	N/A	7.46×10^{-08}
FH03	A	2.97×10^{-07}	3.14×10^{-08}
FH04	A	N/A	2.58×10^{-09}
FH05	A	8.73×10^{-08}	1.08×10^{-07}
	B	1.45×10^{-07}	2.15×10^{-07}
	C	1.78×10^{-07}	2.69×10^{-07}
FH06	A	1.16×10^{-07}	1.37×10^{-07}
	B	1.25×10^{-07}	1.14×10^{-07}
	C	1.54×10^{-07}	4.10×10^{-07}
FH07	A	N/A	1.01×10^{-08}

Conclusions

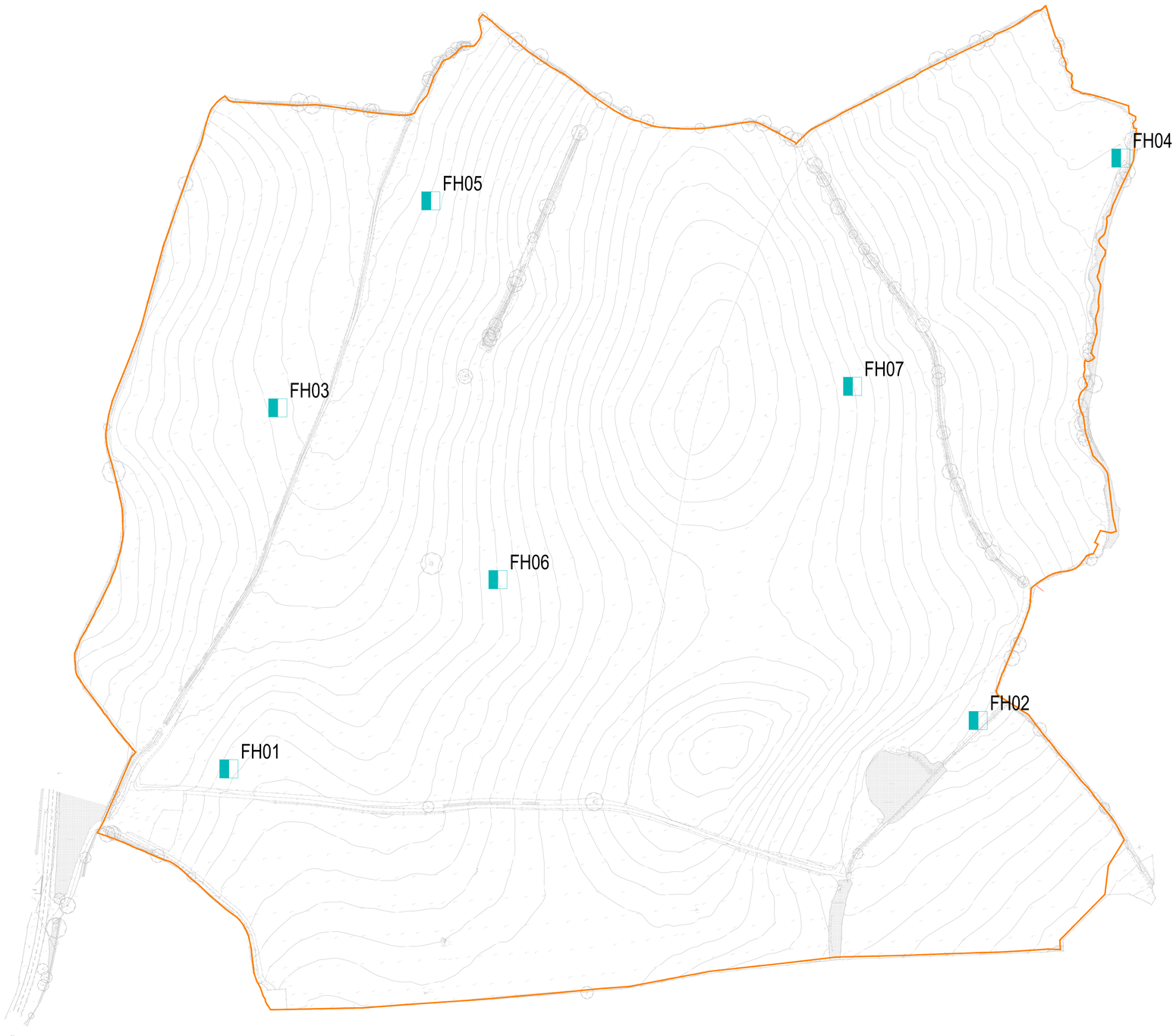
Falling head permeability testing has been conducted at the site, which has demonstrated good drainage characteristics in granular strata, and poor drainage characteristics in cohesive strata.

Yours Sincerely

[redacted]

Thomas Flame
Geo-Environmental Consultant
M.Sci (Hons), FGS

DRAWING 1: EXPLORATORY HOLE LOCATION PLAN



Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Enclosed topographical survey based on BWB Consulting drawing (Dwg No:NFW-BWB-00-ZZ-M2-G-0001) dated 15.12.22
6. Enclosed masterplan based on Enviromena Project Management UK Limited (Dwg No.P.NailcoteFarm_01_GeneralLayout_RevF)
7. This report should be read in conjunction with BWB Consulting Drainage Strategy 'NFW-BWB-ZZ-XX-RP-CD-0001'.
8. This drawing is a proof of concept only, do not consider costing from this drawing.

Legend

Rev	Date	Details of issue / revision	Drw	Rev

Issues & Revisions

BWB A CAF GROUP COMPANY

- Birmingham | 0121 233 3322
- Leeds | 0113 233 8000
- London | 020 7407 3879
- Manchester | 0161 233 4260
- Nottingham | 0115 924 1100

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Client

Enviromena Project Management UK Limited

Project Title

Nailcote Farm, Warwickshire

Drawing Title

Investigation Location Plan

Drawn:	T		Reviewed:	CR	
BWB Ref:	221748	Date:	27.01.23	Scale@A1:	1:2000

Drawing Status

Final

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NFW-BWB-ZZ-XX-DR-YE-0001	**S2**	**P05**

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APPENDIX 1: EXPLORATORY HOLE LOGS

BOREHOLE LOG

Scale 1:50

LOCATION ID				
FH01	**Project Name:** Nailcote Farm, Warwickshire		**Ground Level (m AOD):** 134.48	
	Project Number: 221748		**Eastings:** 427294.27	
	Client: Environmena Project Management UK Ltd		**Northings:** 285815.87	
Hole Type: WLS	**Rig:** Premier 110	**Start & End Date:** 13/09/2023	**Engineer:** TF	**Checker:** CR

Boring		Strata				Samples			In-Situ Tests			
Strike	Well	Level (m AOD) & [Thickness (m)]	Description	Legend	Depth (m bgl)	Type (Ublows)	From (m)	To (m)	Type	Depth (m)	Result	Casing Depth & (Water Level)
		[0.10] 134.38 [2.40]	Dark brown clayey SAND.()		0.10							
			Weathered SANDSTONE recovered as reddish brown clayey SAND.()									
		131.98	Hole Terminated at 2.50m bgl.		2.50							

Chiseling		
From (m bgl)	To (m bgl)	Time (hh:mm)

Water Added		
From (m bgl)	To (m bgl)	Volume (l)

Remarks

Reason for Termination:

Target depth reached.

Groundwater Remarks:

No groundwater encountered.

Other Remarks:

Location cleared of buried services. Borehole advanced to enable installation of standpipe for falling head infiltration test.

BWB A CAF GROUP COMPANY

AGS REGISTERED USER 2023

BOREHOLE LOG

Scale 1:50

LOCATION ID				
FH02	**Project Name:** Nailcote Farm, Warwickshire		**Ground Level (m AOD):**	132.98
	Project Number: 221748		**Eastings:**	427939.06
	Client: Environmena Project Management UK Ltd		**Northings:**	285857.47
Hole Type: WLS	**Rig:** Premier 110	**Start & End Date:** 14/09/2023	**Engineer:** TF	**Checker:** CR

Boring		Strata				Samples			In-Situ Tests			
Strike	Well	Level (m AOD) & [Thickness (m)]	Description	Legend	Depth (m bgl)	Type (U/blows)	From (m)	To (m)	Type	Depth (m)	Result	Casing Depth & (Water Level)
		[1.00]	Grass over dark brown clayey SAND with moderate rootlet content.()									
		131.98 [1.00]	Soft reddish brown sandy CLAY.()		1.00							
		130.98	Hole Terminated at 2.00m bgl.		2.00							

Chiseling		
From (m bgl)	To (m bgl)	Time (hh:mm)

Water Added		
From (m bgl)	To (m bgl)	Volume (l)

Remarks

Reason for Termination:

Target depth reached.

Groundwater Remarks:

No groundwater encountered.

Other Remarks:

Location cleared of buried services. Borehole advanced to enable installation of standpipe for falling head infiltration test.

BWB A CAF GROUP COMPANY

AGS REGISTERED USER 2023

BOREHOLE LOG

Scale 1:50

LOCATION ID				
FH03	**Project Name:** Nailcote Farm, Warwickshire		**Ground Level (m AOD):**	126.52
	Project Number: 221748		**Eastings:**	427336.36
	Client: Environmena Project Management UK Ltd		**Northings:**	286126.41
Hole Type: WLS	**Rig:** Premier 110	**Start & End Date:** 13/09/2023	**Engineer:** TF	**Checker:** CR

Boring		Strata				Samples			In-Situ Tests			
Strike	Well	Level (m AOD) & [Thickness (m)]	Description	Legend	Depth (m bgl)	Type (U/blows)	From (m)	To (m)	Type	Depth (m)	Result	Casing Depth & (Water Level)
		[1.50]	Crops over light brown clayey SAND.()									
		125.02 [0.50]	Reddish brown very clayey SAND.()		1.50							
		124.52	Hole Terminated at 2.00m bgl.		2.00							

Chiseling		
From (m bgl)	To (m bgl)	Time (hh:mm)

Water Added		
From (m bgl)	To (m bgl)	Volume (l)

Remarks

Reason for Termination:

Target depth reached.

Groundwater Remarks:

No groundwater encountered.

Other Remarks:

Location cleared of buried services. Borehole advanced to enable installation of standpipe for falling head infiltration test.

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BOREHOLE LOG

Scale 1:50

LOCATION ID				
FH04	**Project Name:** Nailcote Farm, Warwickshire		**Ground Level (m AOD):** 123.99	
	Project Number: 221748		**Eastings:** 428061.88	
	Client: Environmena Project Management UK Ltd		**Northings:** 286341.30	
Hole Type: WLS	**Rig:** Premier 110	**Start & End Date:** 14/09/2023	**Engineer:** TF	**Checker:** CR

Boring		Strata				Samples			In-Situ Tests			
Strike	Well	Level (m AOD) & [Thickness (m)]	Description	Legend	Depth (m bgl)	Type (U/blows)	From (m)	To (m)	Type	Depth (m)	Result	Casing Depth & (Water Level)
		[0.40]	Dark brown very clayey SAND with moderate rootlet content.()									
		123.59 [0.20]			0.40							
		123.39 [1.40]	Light brown gravelly SAND. Gravel is subangular to rounded, fine to coarse of sandstone and quartzite.()		0.60							
			Firm red sandy CLAY()									
		121.99	Hole Terminated at 2.00m bgl.		2.00							

Chiseling		
From (m bgl)	To (m bgl)	Time (hh:mm)

Water Added		
From (m bgl)	To (m bgl)	Volume (l)

Remarks

Reason for Termination:

Target depth reached.

Groundwater Remarks:

No groundwater encountered.

Other Remarks:

Location cleared of buried services. Borehole advanced to enable installation of standpipe for falling head infiltration test.

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BOREHOLE LOG

Scale 1:50

LOCATION ID				
FH05	**Project Name:** Nailcote Farm, Warwickshire		**Ground Level (m AOD):** 125.08	
	Project Number: 221748		**Eastings:** 427468.06	
	Client: Environmena Project Management UK Ltd		**Northings:** 286304.46	
Hole Type: WLS	**Rig:** Premier 110	**Start & End Date:** 13/09/2023	**Engineer:** TF	**Checker:** CR

Boring		Strata				Samples			In-Situ Tests			
Strike	Well	Level (m AOD) & [Thickness (m)]	Description	Legend	Depth (m bgl)	Type (U/blows)	From (m)	To (m)	Type	Depth (m)	Result	Casing Depth & (Water Level)
		[0.40]	Brown clayey SAND.()									
		124.68 [0.20]	Orangish brown clayey SAND.()		0.40							
		124.48 [1.40]	Weathered SANDSTONE recovered as redish brown clayey SAND.()		0.60							
		123.08	Hole Terminated at 2.00m bgl.		2.00							

Chiseling		
From (m bgl)	To (m bgl)	Time (hh:mm)

Water Added		
From (m bgl)	To (m bgl)	Volume (l)

Remarks

Reason for Termination:

Target depth reached.

Groundwater Remarks:

No groundwater encountered.

Other Remarks:

Location cleared of buried services. Borehole advanced to enable installation of standpipe for falling head infiltration test.

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BOREHOLE LOG

Scale 1:50

LOCATION ID				
FH06	**Project Name:** Nailcote Farm, Warwickshire		**Ground Level (m AOD):** 134.85	
	Project Number: 221748		**Eastings:** 427525.77	
	Client: Environmena Project Management UK Ltd		**Northings:** 285978.70	
Hole Type: WLS	**Rig:** Premier 110	**Start & End Date:** 13/09/2023	**Engineer:** TF	**Checker:** CR

Boring		Strata				Samples			In-Situ Tests			
Strike	Well	Level (m AOD) & [Thickness (m)]	Description	Legend	Depth (m bgl)	Type (U/blows)	From (m)	To (m)	Type	Depth (m)	Result	Casing Depth & (Water Level)
		[0.10] 134.75 [1.90]	Brown slightly clayey slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse fo sandstone.()		0.10							
			Firm red slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse of quartzite.()									
		132.85	Hole Terminated at 2.00m bgl.		2.00							

Chiseling		
From (m bgl)	To (m bgl)	Time (hh:mm)

Water Added		
From (m bgl)	To (m bgl)	Volume (l)

Remarks

Reason for Termination:

Target depth reached.

Groundwater Remarks:

No groundwater encountered.

Other Remarks:

Location cleared of buried services. Borehole advanced to enable installation of standpipe for falling head infiltration test.

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BOREHOLE LOG

Scale 1:50

LOCATION ID				
FH07	**Project Name:** Nailcote Farm, Warwickshire		**Ground Level (m AOD):** 140.99	
	Project Number: 221748		**Eastings:** 427831.03	
	Client: Environmena Project Management UK Ltd		**Northings:** 286144.97	
Hole Type: WLS	**Rig:** Premier 110	**Start & End Date:** 14/09/2023	**Engineer:** TF	**Checker:** CR

Boring		Strata				Samples			In-Situ Tests			
Strike	Well	Level (m AOD) & [Thickness (m)]	Description	Legend	Depth (m bgl)	Type (U/blows)	From (m)	To (m)	Type	Depth (m)	Result	Casing Depth & (Water Level)
		[0.30]	Crops over dark brown very clayey SAND with moderate rootlet content.()									
		140.69 [1.70]	Firm reddish brown sandy CLAY.()		0.30							
		138.99	Hole Terminated at 2.00m bgl.		2.00							

Chiseling		
From (m bgl)	To (m bgl)	Time (hh:mm)

Water Added		
From (m bgl)	To (m bgl)	Volume (l)

Remarks

Reason for Termination:

Target depth reached.

Groundwater Remarks:

No groundwater encountered.

Other Remarks:

Location cleared of buried services. Borehole advanced to enable installation of standpipe for falling head infiltration test.

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APPENDIX 2: INFILTRATION TEST RESULTS

PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

BWB
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Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH01
Date:	13-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	2.20
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.20
Geology:	Sandstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.300	1.900	1.000
0.25	0.400	1.800	0.947
0.50	0.500	1.700	0.895
0.75	0.600	1.600	0.842
1.00	0.720	1.480	0.779
2.00	0.810	1.390	0.732
4.00	1.100	1.100	0.579
6.00	1.350	0.850	0.447
8.00	1.440	0.760	0.400
10.00	1.530	0.670	0.353
12.00	1.640	0.560	0.295
15.00	1.740	0.460	0.242
20.00	1.850	0.350	0.184
25.00	1.880	0.320	0.1684
30.00	1.900	0.300	0.158
35.00	1.920	0.280	0.147
40.00	1.950	0.250	0.132

Basic Time Lag Method (after BS5930:1999)

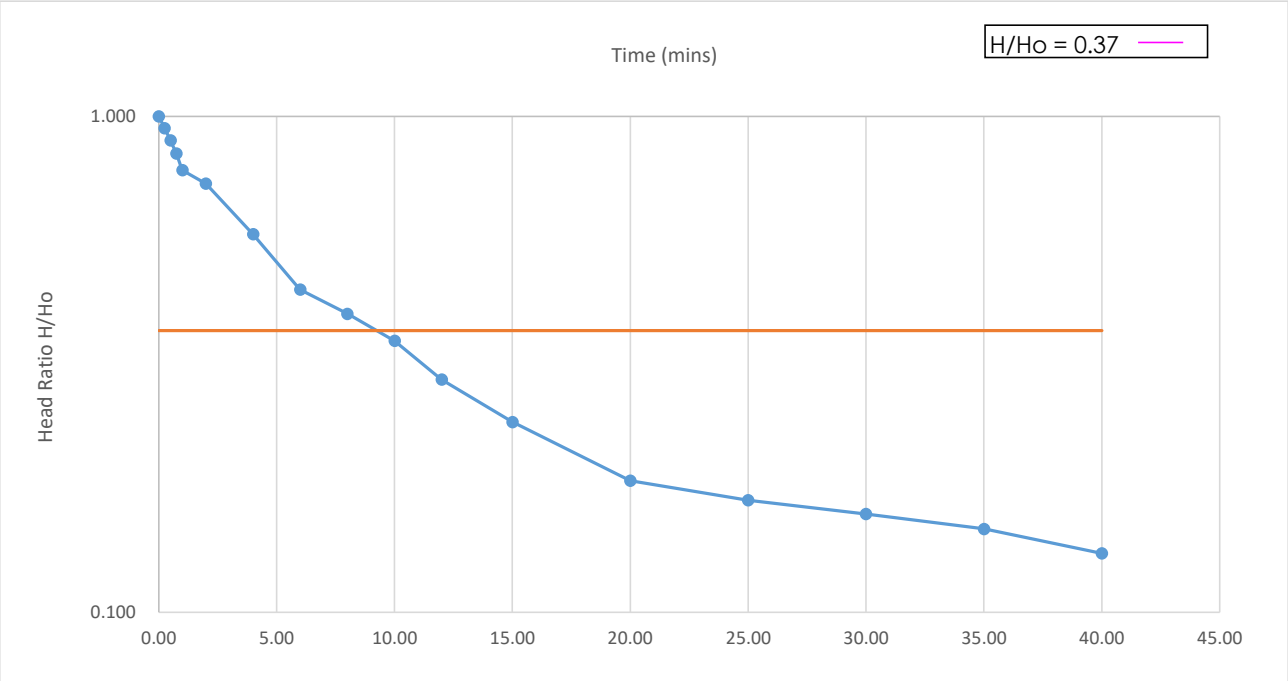
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=	9.00	(min)
T=	540.00	(sec)
K=	**2.57E-06**	**(m/s)**
K=	**0.222**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	20.00	(min)
t2=	40.00	(min)
H(head)1=	0.35	(m)
H(head)2=	0.25	(m)
K=	**3.89E-07**	**(m/s)**
K=	**0.034**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

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Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH01
Date:	13-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	2.20
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Sandstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.300	1.900	1.000
0.25	0.410	1.790	0.942
0.50	0.520	1.680	0.884
0.75	0.550	1.650	0.868
1.00	0.570	1.630	0.858
2.00	0.720	1.480	0.779
4.00	1.060	1.140	0.600
6.00	1.210	0.990	0.521
8.00	1.400	0.800	0.421
10.00	1.530	0.670	0.353
12.00	1.620	0.580	0.305
15.00	1.740	0.460	0.242
20.00	1.840	0.360	0.189
25.00	1.860	0.340	0.1789
30.00	1.880	0.320	0.168
35.00	1.890	0.310	0.163
40.00	1.910	0.290	0.153
45.00	1.930	0.270	0.142
50.00	1.960	0.240	0.126

Basic Time Lag Method (after BS5930:1999)

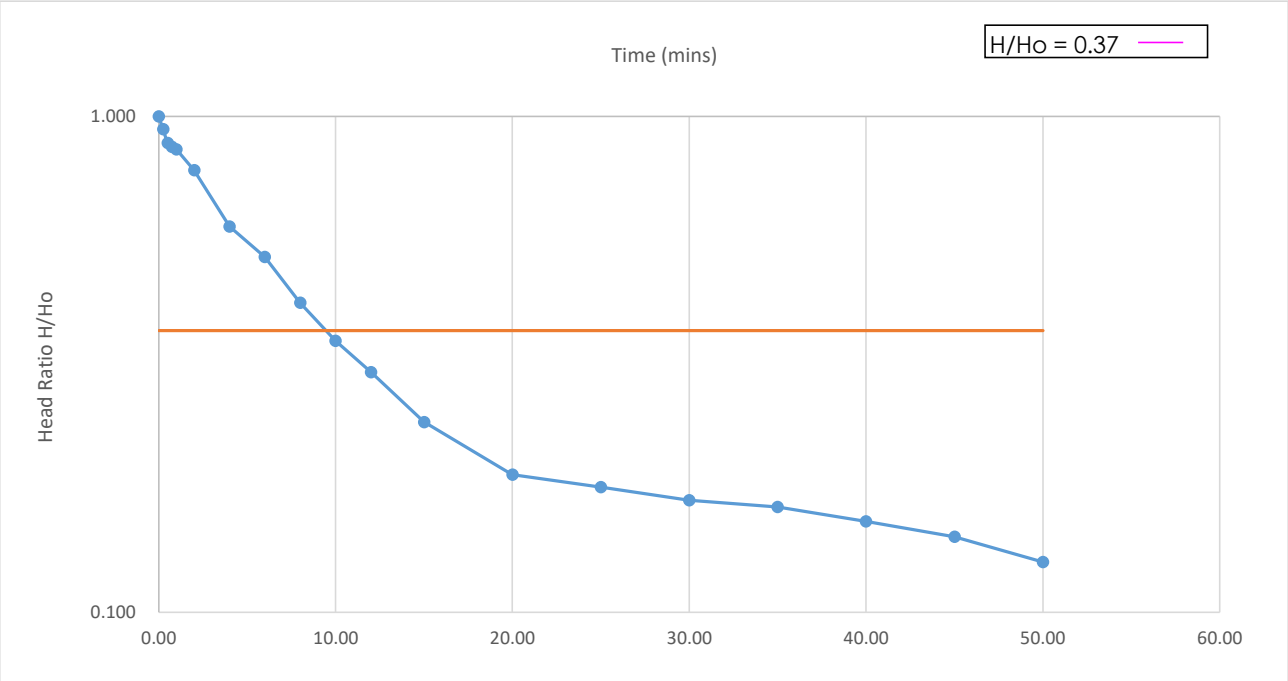
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=	9.50	(min)
T=	570.00	(sec)
K=	**2.44E-06**	**(m/s)**
K=	**0.210**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	20.00	(min)
t2=	50.00	(min)
H(head)1=	0.36	(m)
H(head)2=	0.24	(m)
K=	**3.13E-07**	**(m/s)**
K=	**0.027**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

BWB
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Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH01-C
Date:	13-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	2.20
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.20
Geology:	Sandstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

Time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.300	1.900	1.000
0.25	0.320	1.880	0.989
0.50	0.450	1.750	0.921
0.75	0.500	1.700	0.895
1.00	0.650	1.550	0.816
2.00	0.820	1.380	0.726
4.00	1.100	1.100	0.579
6.00	1.400	0.800	0.421
8.00	1.540	0.660	0.347
10.00	1.680	0.520	0.274
12.00	1.750	0.450	0.237
15.00	1.820	0.380	0.200
20.00	1.850	0.350	0.184
25.00	1.900	0.300	0.1579
30.00	1.910	0.290	0.153
35.00	1.980	0.220	0.116
40.00	2.050	0.150	0.079
45.00	2.090	0.110	0.058
50.00	2.150	0.050	0.026

Basic Time Lag Method (after BS5930:1999)

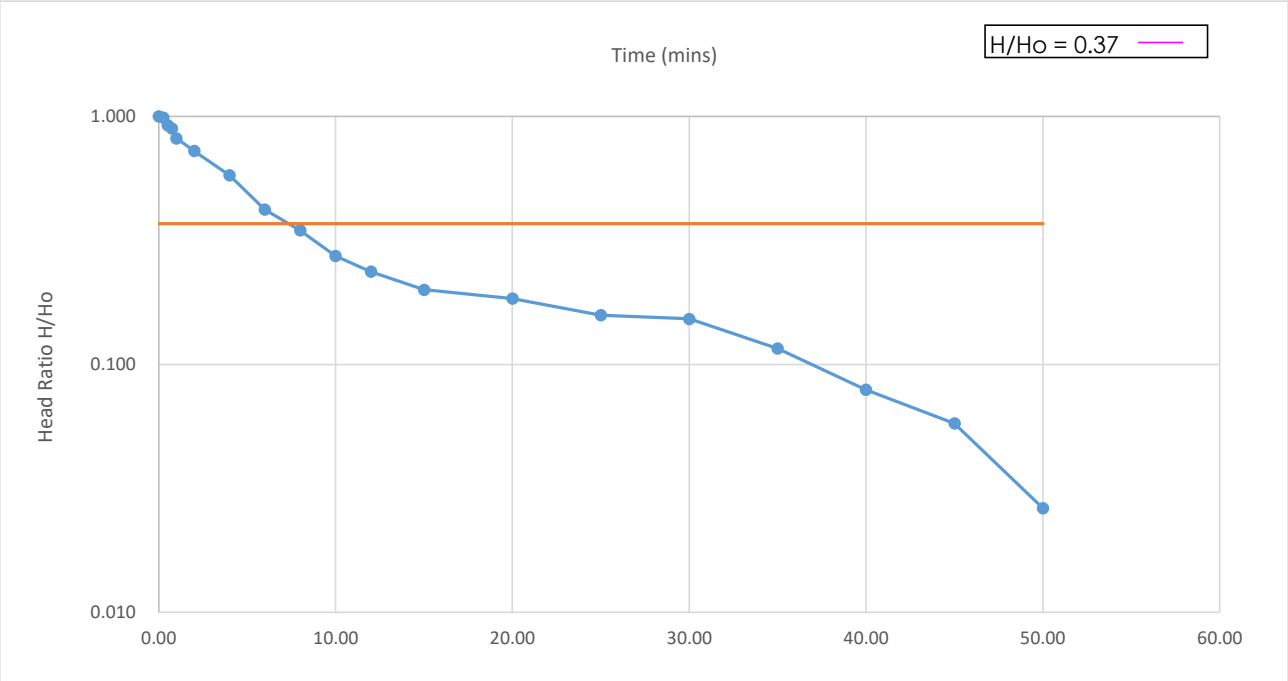
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=	7.50	(min)
T=	450.00	(sec)
K=	**3.09E-06**	**(m/s)**
K=	**0.267**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	30.00	(min)
t2=	50.00	(min)
H(head)1=	0.29	(m)
H(head)2=	0.05	(m)
K=	**2.03E-06**	**(m/s)**
K=	**0.176**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

BWB
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Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH02
Date:	14-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	2.00
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Mudstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	b
F Value	1.65E-01
Area (A) of Borehole (m^2)	2.83E-03

time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.000	2.000	1.000
0.25	0.200	1.800	0.900
0.50	0.230	1.770	0.885
0.75	0.270	1.730	0.865
1.00	0.320	1.680	0.840
2.00	0.450	1.550	0.775
4.00	0.500	1.500	0.750
6.00	0.570	1.430	0.715
8.00	0.600	1.400	0.700
12.00	0.690	1.310	0.655
16.00	0.710	1.290	0.645
60.00	0.750	1.250	0.625
120.00	0.800	1.200	0.600
240.00	0.880	1.120	0.5600
1440.00	1.150	0.850	0.425
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000

Basic Time Lag Method (after BS5930:1999)

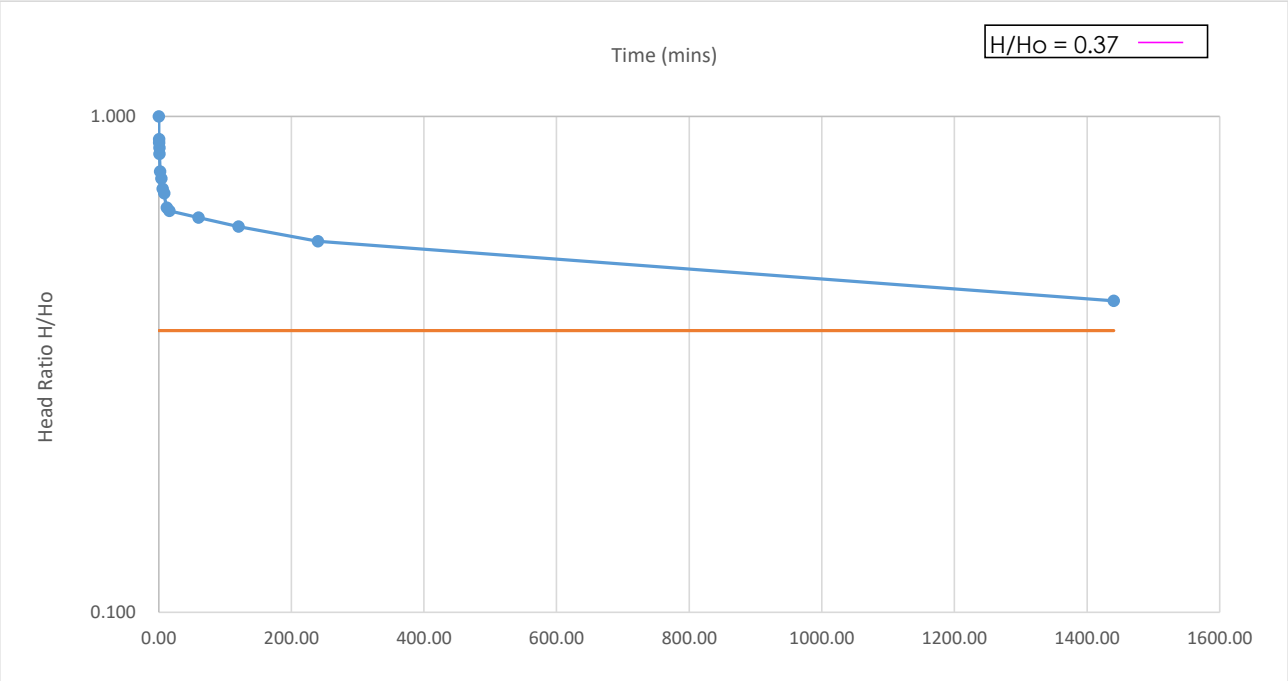
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=		(min)
T=	0.00	(sec)
K=	**#DIV/0!**	**(m/s)**
K=	**#DIV/0!**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	120.00	(min)
t2=	1440.00	(min)
H(head)1=	1.20	(m)
H(head)2=	0.85	(m)
K=	**7.46E-08**	**(m/s)**
K=	**0.006**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

BWB
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INFRASTRUCTURE | BUILDINGS

Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH03
Date:	13-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	2.00
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Mudstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

Time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.000	2.000	1.000
0.25	0.010	1.990	0.995
0.50	0.010	1.990	0.995
0.75	0.010	1.990	0.995
1.00	0.010	1.990	0.995
2.00	0.010	1.990	0.995
10.00	0.020	1.980	0.990
20.00	0.050	1.950	0.975
60.00	0.100	1.900	0.950
120.00	0.200	1.800	0.900
240.00	0.450	1.550	0.775
1440.00	1.700	0.300	0.150
		2.000	1.000
		2.000	1.0000
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000

Basic Time Lag Method (after BS5930:1999)

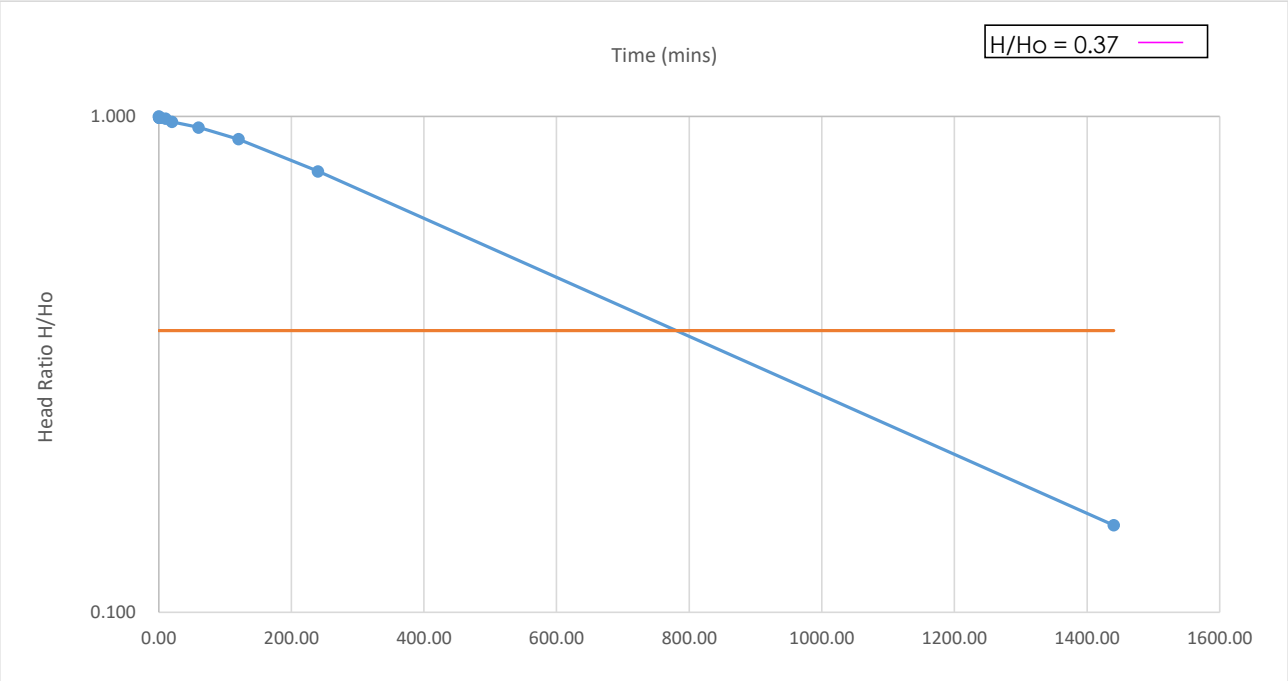
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=	78.00	(min)
T=	4680.00	(sec)
K=	**2.97E-07**	**(m/s)**
K=	**0.026**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	120.00	(min)
t2=	1440.00	(min)
H(head)1=	1.80	(m)
H(head)2=	0.30	(m)
K=	**3.14E-08**	**(m/s)**
K=	**0.003**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

BWB
CONSULTANCY | ENVIRONMENT
INFRASTRUCTURE | BUILDINGS

Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH04
Date:	14-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	2.00
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Mudstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.000	2.000	1.000
0.25	0.000	2.000	1.000
0.50	0.000	2.000	1.000
0.75	0.000	2.000	1.000
1.00	0.000	2.000	1.000
2.00	0.000	2.000	1.000
4.00	0.000	2.000	1.000
6.00	0.000	2.000	1.000
8.00	0.000	2.000	1.000
12.00	0.000	2.000	1.000
16.00	0.000	2.000	1.000
60.00	0.000	2.000	1.000
120.00	0.000	2.000	1.000
240.00	0.000	2.000	1.0000
1440.00	0.250	1.750	0.875
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000

Basic Time Lag Method (after BS5930:1999)

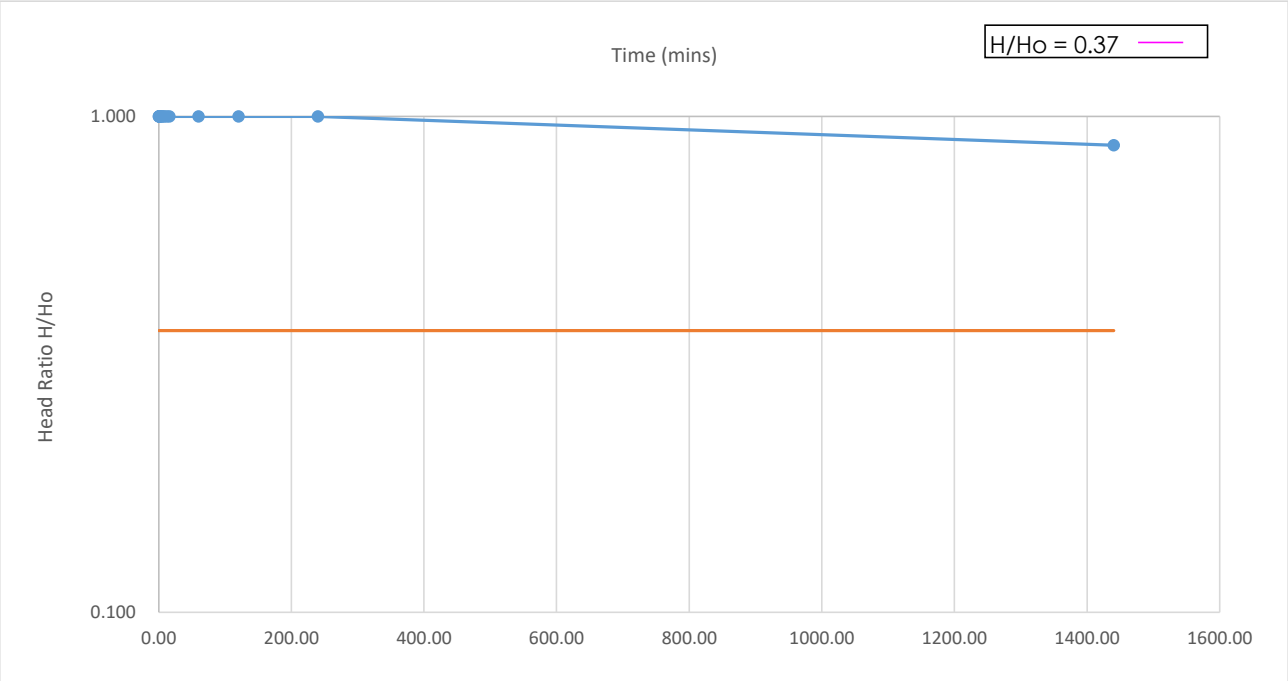
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=		(min)
T=	0.00	(sec)
K=	**#DIV/0!**	**(m/s)**
K=	**#DIV/0!**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	240.00	(min)
t2=	1440.00	(min)
H(head)1=	2.00	(m)
H(head)2=	1.75	(m)
K=	**2.58E-09**	**(m/s)**
K=	**0.000**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

BWB
CONSULTANCY | ENVIRONMENT
INFRASTRUCTURE | BUILDINGS

Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH05
Date:	14-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	2.00
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Sandstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

Time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.000	2.000	1.000
0.25	0.150	1.850	0.925
0.50	0.170	1.830	0.915
0.75	0.180	1.820	0.910
1.00	0.210	1.790	0.895
2.00	0.220	1.780	0.890
4.00	0.270	1.730	0.865
6.00	0.310	1.690	0.845
8.00	0.360	1.640	0.820
20.00	0.580	1.420	0.710
30.00	0.660	1.340	0.670
90.00	1.000	1.000	0.500
240.00	1.200	0.800	0.400
1080.00	1.990	0.010	0.0050

Basic Time Lag Method (after BS5930:1999)

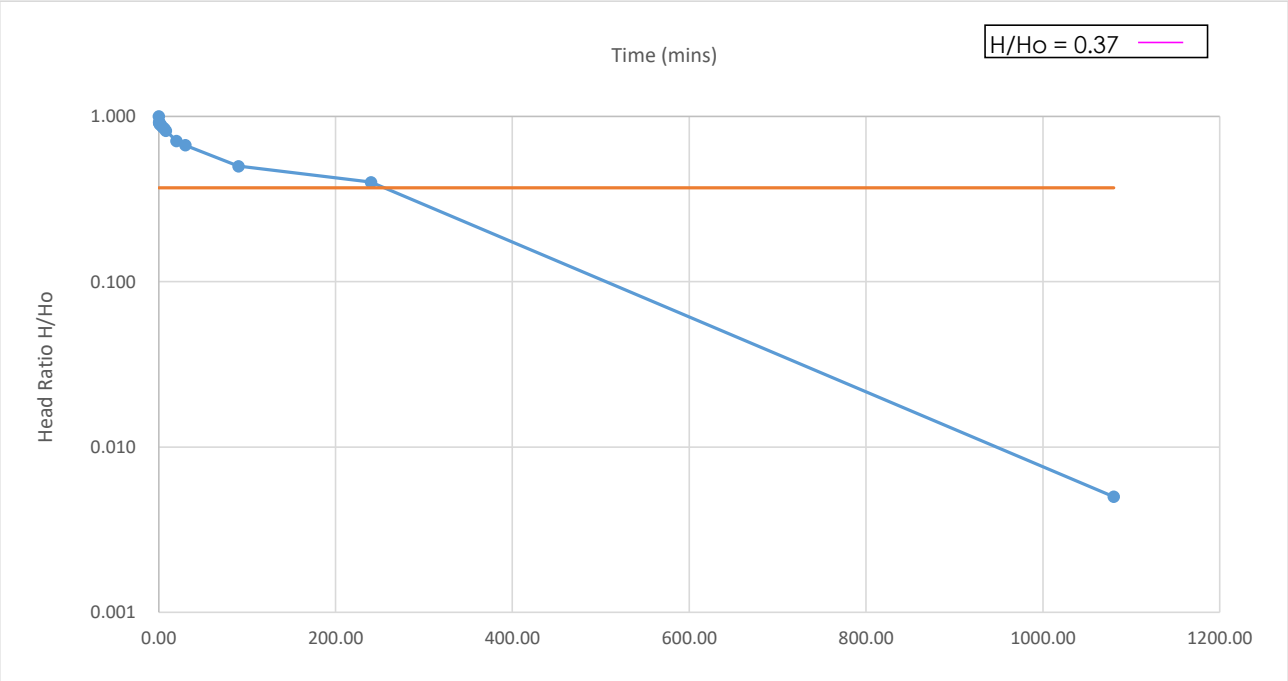
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=	265.00	(min)
T=	15900.00	(sec)
K=	**8.73E-08**	**(m/s)**
K=	**0.008**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	90.00	(min)
t2=	1080.00	(min)
H(head)1=	1.00	(m)
H(head)2=	0.01	(m)
K=	**1.08E-07**	**(m/s)**
K=	**0.009**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

BWB
CONSULTANCY | ENVIRONMENT
INFRASTRUCTURE | BUILDINGS

Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH05 B
Date:	14-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	2.00
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Sandstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

Time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.000	2.000	1.000
0.25	0.170	1.830	0.915
0.50	0.180	1.820	0.910
0.75	0.180	1.820	0.910
1.00	0.190	1.810	0.905
2.00	0.210	1.790	0.895
4.00	0.240	1.760	0.880
6.00	0.280	1.720	0.860
8.00	0.280	1.720	0.860
10.00	0.300	1.700	0.850
20.00	0.400	1.600	0.800
90.00	0.930	1.070	0.535
240.00	1.510	0.490	0.245
420.00	1.950	0.050	0.0250
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000

Basic Time Lag Method (after BS5930:1999)

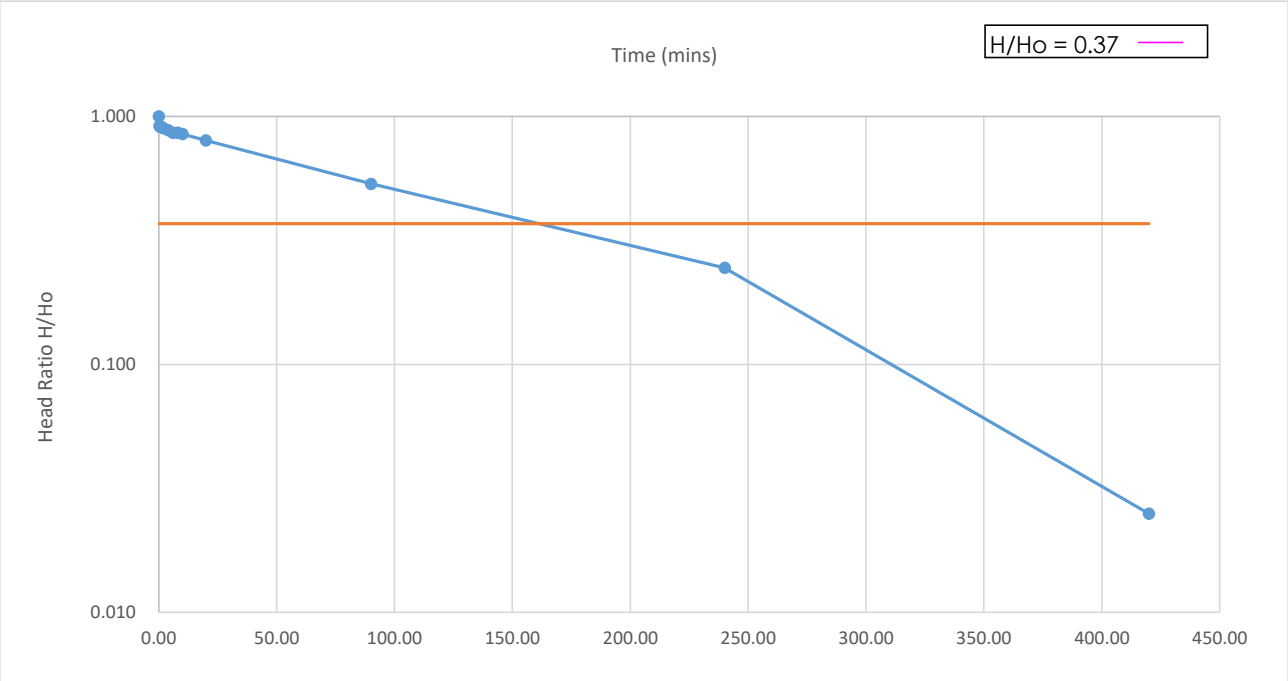
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=	160.00	(min)
T=	9600.00	(sec)
K=	**1.45E-07**	**(m/s)**
K=	**0.012**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	90.00	(min)
t2=	420.00	(min)
H(head)1=	1.07	(m)
H(head)2=	0.05	(m)
K=	**2.15E-07**	**(m/s)**
K=	**0.019**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

BWB
CONSULTANCY | ENVIRONMENT
INFRASTRUCTURE | BUILDINGS

Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH05 C
Date:	14-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	2.00
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Sandstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

Time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.000	2.000	1.000
0.25	0.020	1.980	0.990
0.50	0.030	1.970	0.985
0.75	0.040	1.960	0.980
1.00	0.050	1.950	0.975
2.00	0.100	1.900	0.950
4.00	0.150	1.850	0.925
6.00	0.180	1.820	0.910
8.00	0.220	1.780	0.890
10.00	0.260	1.740	0.870
20.00	0.370	1.630	0.815
60.00	0.680	1.320	0.660
180.00	1.510	0.490	0.245
420.00	1.980	0.020	0.0100

Basic Time Lag Method (after BS5930:1999)

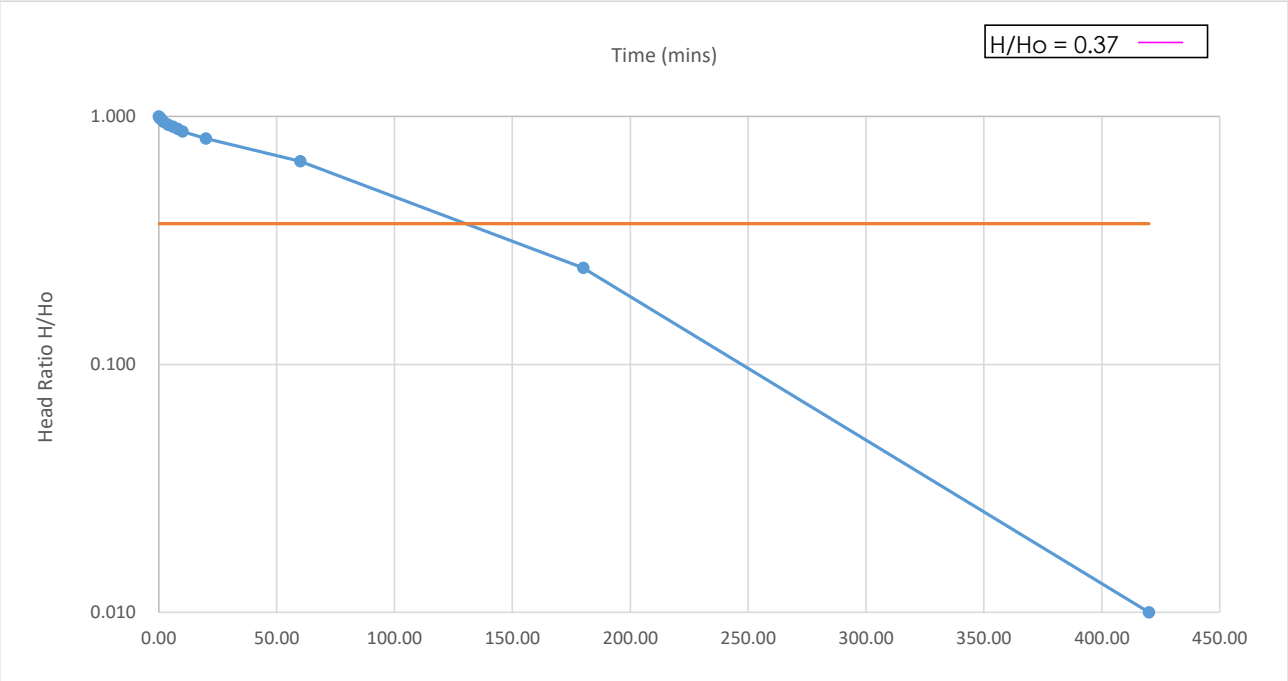
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=	130.00	(min)
T=	7800.00	(sec)
K=	**1.78E-07**	**(m/s)**
K=	**0.015**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	60.00	(min)
t2=	420.00	(min)
H(head)1=	1.32	(m)
H(head)2=	0.02	(m)
K=	**2.69E-07**	**(m/s)**
K=	**0.023**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

BWB
CONSULTANCY | ENVIRONMENT
INFRASTRUCTURE | BUILDINGS

Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH06
Date:	14-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	1.20
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Sandstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.000	1.200	1.000
0.25	0.000	1.200	1.000
0.50	0.000	1.200	1.000
0.75	0.010	1.190	0.992
1.00	0.020	1.180	0.983
2.00	0.040	1.160	0.967
4.00	0.060	1.140	0.950
10.00	0.120	1.080	0.900
15.00	0.170	1.030	0.858
20.00	0.230	0.970	0.808
25.00	0.250	0.950	0.792
30.00	0.290	0.910	0.758
60.00	0.460	0.740	0.617
120.00	0.650	0.550	0.4583
150.00	0.700	0.500	0.417
300.00	0.860	0.340	0.283
360.00	1.010	0.190	0.158
		1.200	1.000
		1.200	1.000
		1.200	1.000

Basic Time Lag Method (after BS5930:1999)

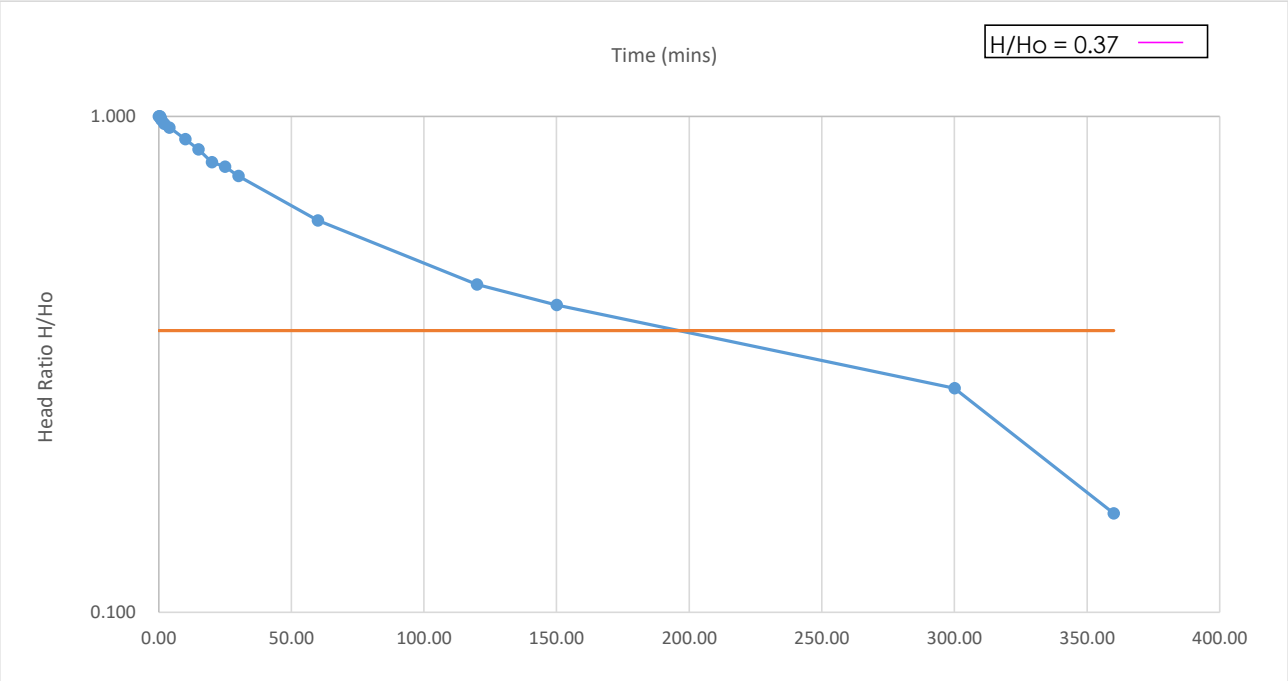
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=	200.00	(min)
T=	12000.00	(sec)
K=	**1.16E-07**	**(m/s)**
K=	**0.010**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	120.00	(min)
t2=	300.00	(min)
H(head)1=	0.55	(m)
H(head)2=	0.19	(m)
K=	**1.37E-07**	**(m/s)**
K=	**0.012**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

BWB
CONSULTANCY | ENVIRONMENT
INFRASTRUCTURE | BUILDINGS

Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH06
Date:	14-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	1.20
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Sandstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

Time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.000	1.200	1.000
0.25	0.000	1.200	1.000
0.50	0.000	1.200	1.000
0.75	0.010	1.190	0.992
1.00	0.030	1.170	0.975
2.00	0.050	1.150	0.958
4.00	0.070	1.130	0.942
10.00	0.090	1.110	0.925
15.00	0.120	1.080	0.900
20.00	0.140	1.060	0.883
25.00	0.170	1.030	0.858
30.00	0.270	0.930	0.775
60.00	0.410	0.790	0.658
120.00	0.620	0.580	0.4833
150.00	0.650	0.550	0.458
360.00	1.020	0.180	0.150

Basic Time Lag Method (after BS5930:1999)

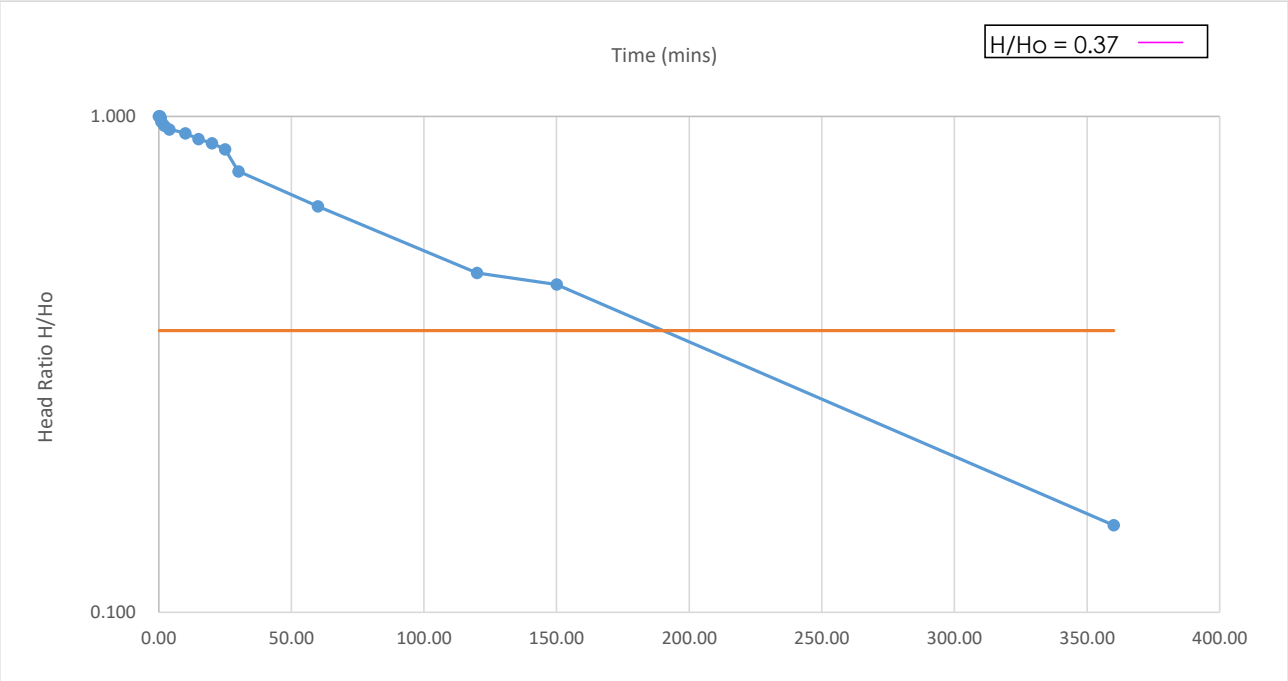
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=	185.00	(min)
T=	11100.00	(sec)
K=	**1.25E-07**	**(m/s)**
K=	**0.011**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	60.00	(min)
t2=	360.00	(min)
H(head)1=	0.79	(m)
H(head)2=	0.18	(m)
K=	**1.14E-07**	**(m/s)**
K=	**0.010**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

BWB
CONSULTANCY | ENVIRONMENT
INFRASTRUCTURE | BUILDINGS

Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH06
Date:	18-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	0.90
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Sandstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

Time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.000	0.900	1.000
0.25	0.000	0.900	1.000
0.50	0.000	0.900	1.000
0.75	0.000	0.900	1.000
1.00	0.010	0.890	0.989
2.00	0.020	0.880	0.978
4.00	0.030	0.870	0.967
6.00	0.050	0.850	0.944
8.00	0.050	0.850	0.944
10.00	0.060	0.840	0.933
15.00	0.090	0.810	0.900
20.00	0.120	0.780	0.867
25.00	0.140	0.760	0.844
30.00	0.180	0.720	0.8000
60.00	0.260	0.640	0.711
150.00	0.530	0.370	0.411
1000.00	0.899	0.001	0.001

Basic Time Lag Method (after BS5930:1999)

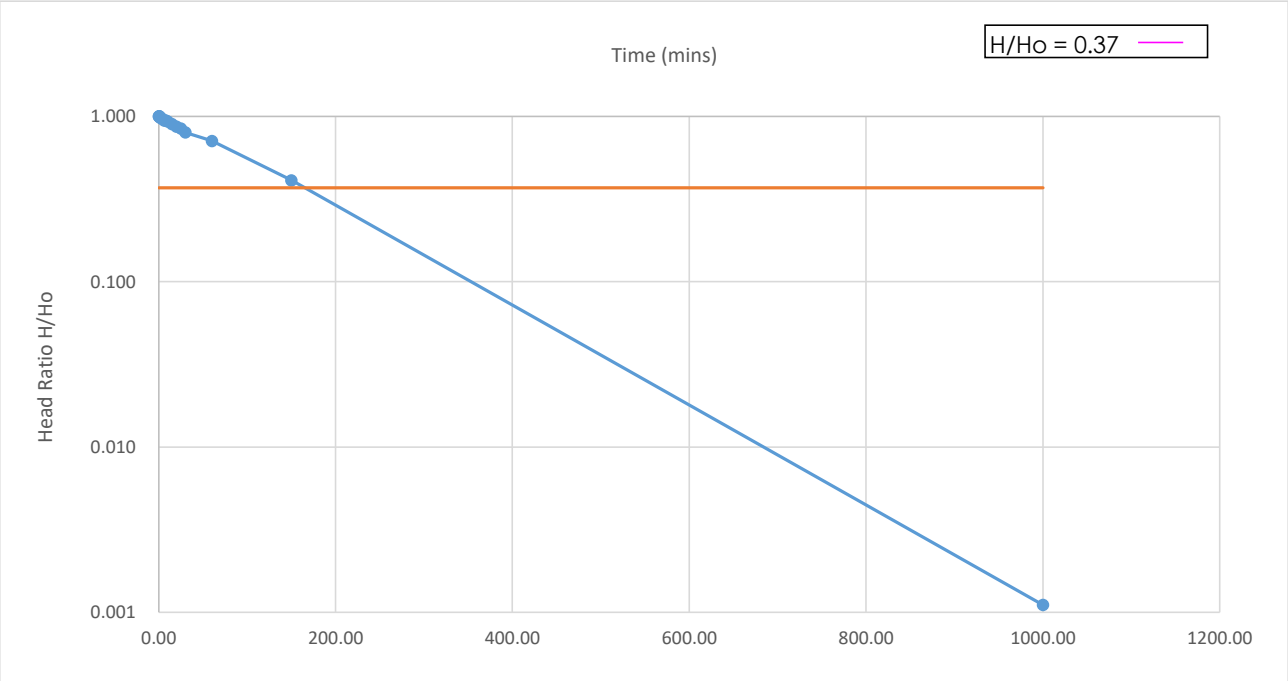
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=	150.00	(min)
T=	9000.00	(sec)
K=	**1.54E-07**	**(m/s)**
K=	**0.013**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	1.00	(min)
t2=	300.00	(min)
H(head)1=	1.99	(m)
H(head)2=	0.01	(m)
K=	**4.10E-07**	**(m/s)**
K=	**0.035**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

BWB
CONSULTANCY | ENVIRONMENT
INFRASTRUCTURE | BUILDINGS

Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH07
Date:	14-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	2.00
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Mudstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

time (mins)	Hi(mbd)	H(head)	H/Ho
0.00	0.000	2.000	1.000
0.25	0.150	1.850	0.925
0.50	0.200	1.800	0.900
0.75	0.200	1.800	0.900
1.00	0.200	1.800	0.900
2.00	0.200	1.800	0.900
4.00	0.200	1.800	0.900
6.00	0.200	1.800	0.900
8.00	0.200	1.800	0.900
12.00	0.200	1.800	0.900
16.00	0.200	1.800	0.900
60.00	0.200	1.800	0.900
120.00	0.220	1.780	0.890
240.00	0.250	1.750	0.8750
1440.00	1.000	1.000	0.500
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000

Basic Time Lag Method (after BS5930:1999)

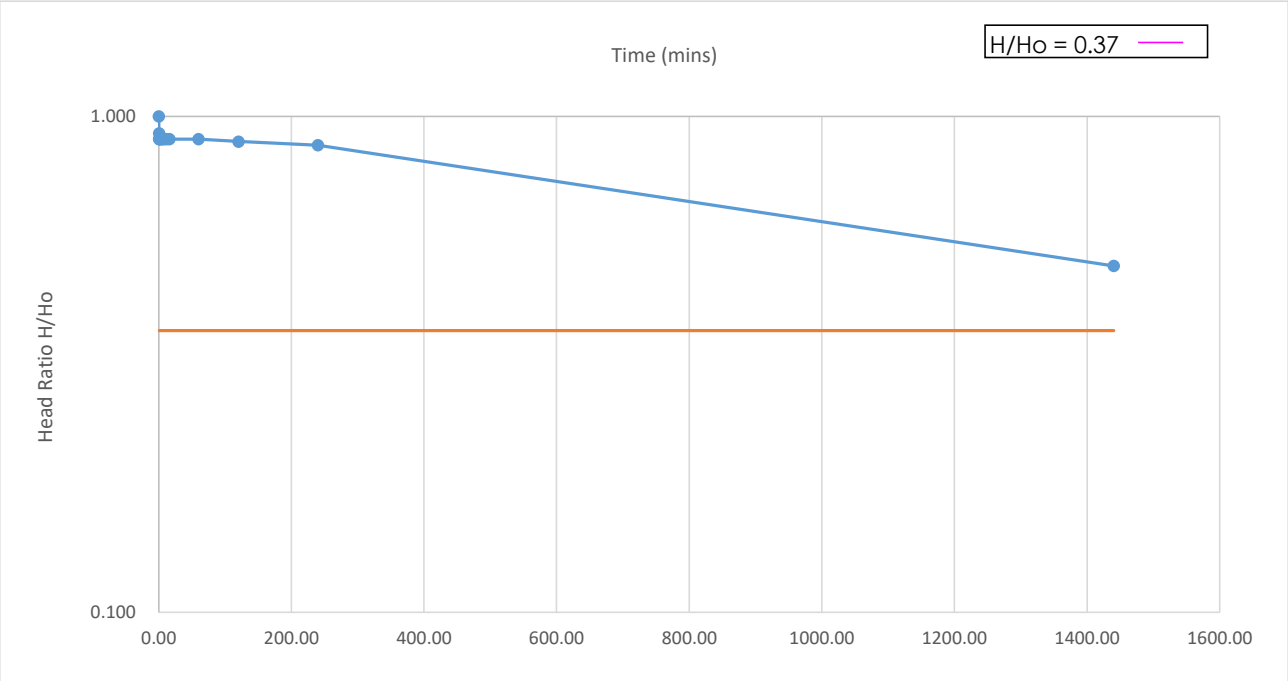
K= A/(F*T)
T= TIME FOR H/Ho:0.37

T=		(min)
T=	0.00	(sec)
K=	**#DIV/0!**	**(m/s)**
K=	**#DIV/0!**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	120.00	(min)
t2=	1440.00	(min)
H(head)1=	1.78	(m)
H(head)2=	1.00	(m)
K=	**1.01E-08**	**(m/s)**
K=	**0.001**	**(m/d)**

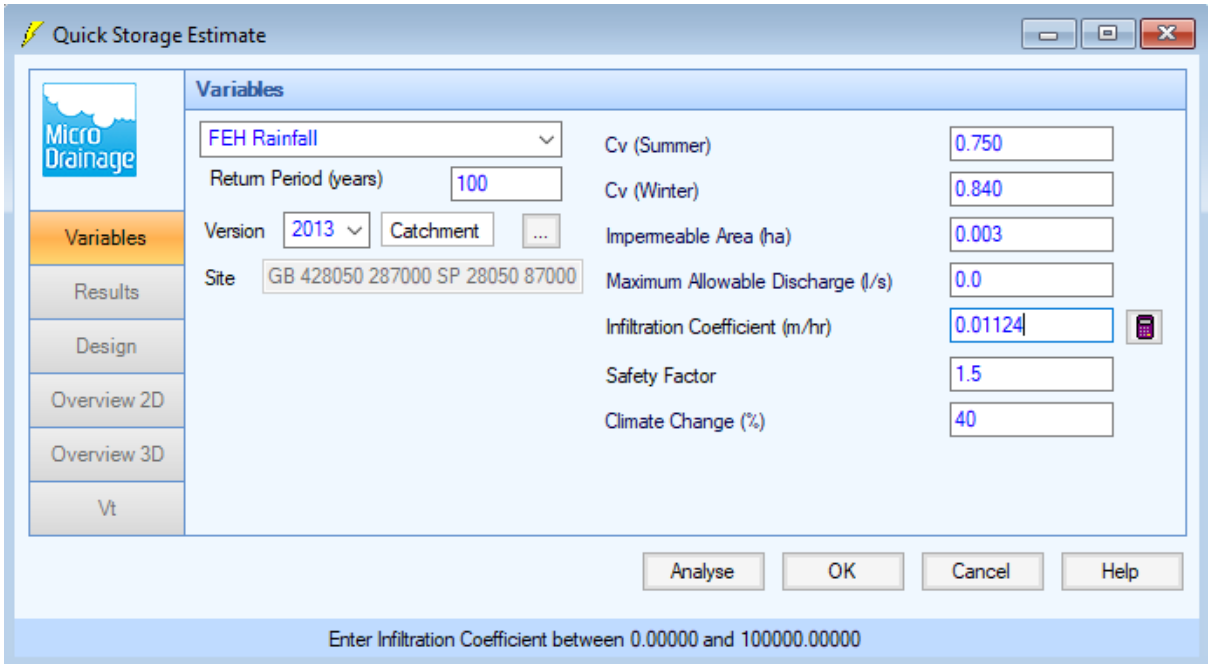


Appendix 4 - MicroDrainage Quick Storage Estimate Outputs

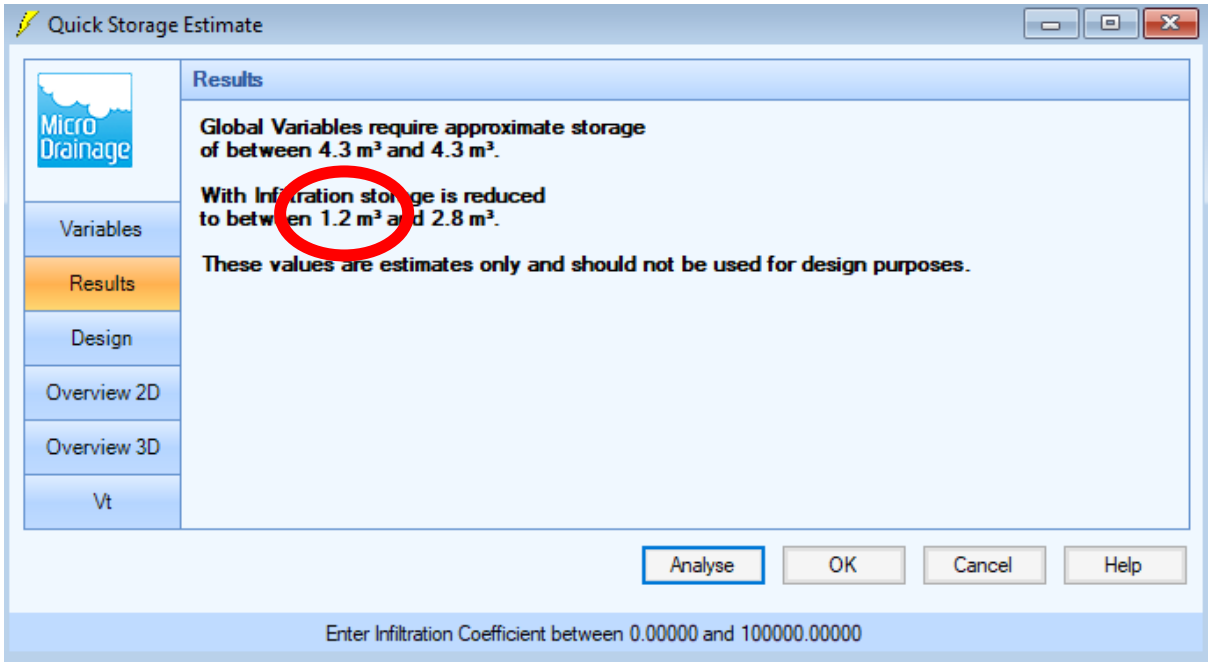
Quick Storage Estimate Outputs

Upper Band Infiltration Rate (3.09×10^{-6} m/s)

Inputs

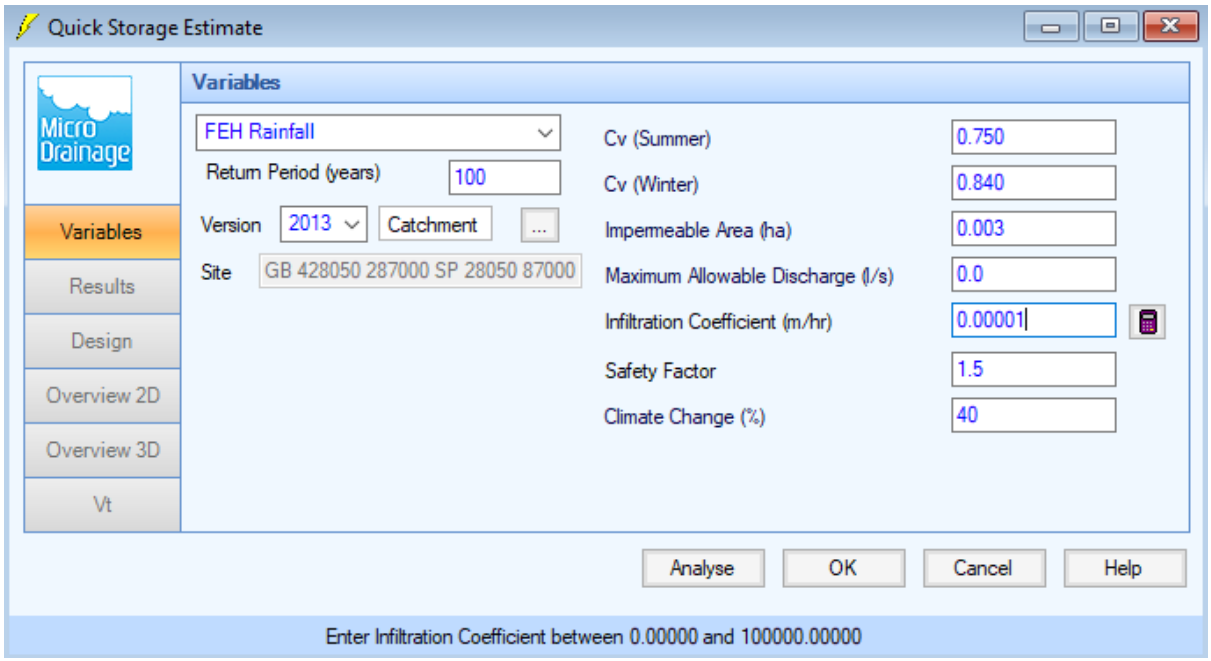


Outputs

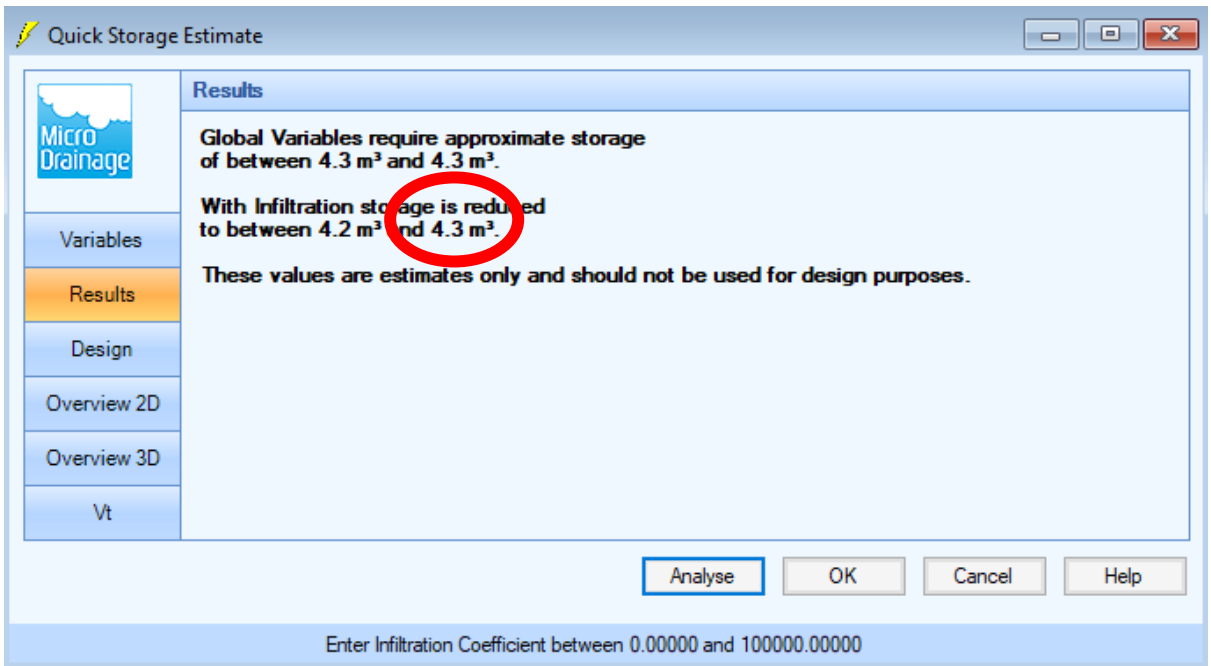


Lower Band Infiltration Rate (2.58×10^{-9} m/s)

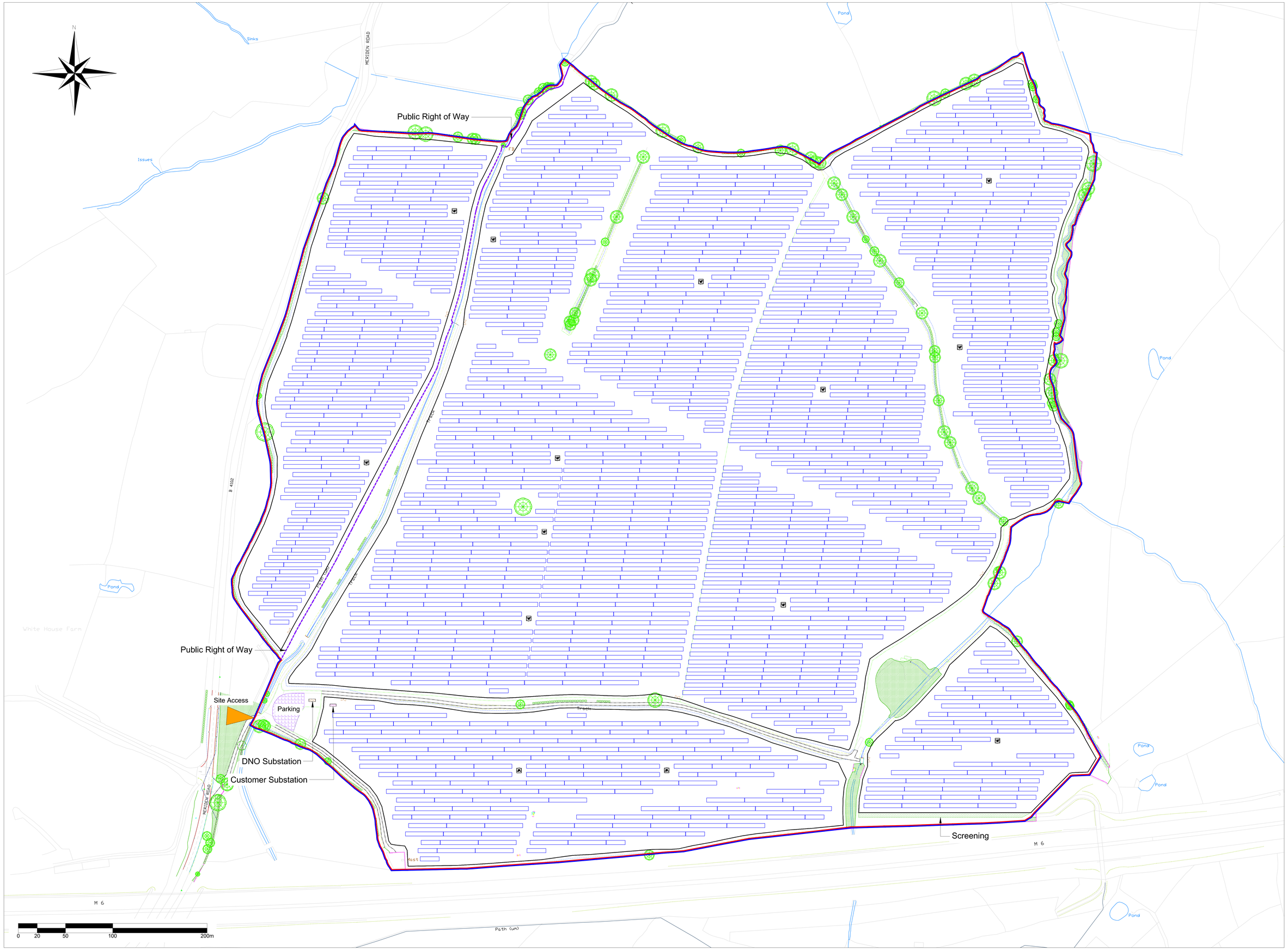
Inputs



Outputs



Appendix 2: Proposed Development Layout and Sections



LEGEND

- Landlord Boundary
- Site Boundary
- Site Access
- Fence
- PV Array
- Transformer Station
- DNO Substation
- Customer Substation
- Public Right of Way

REV	DESCRIPTION	BY	DATE
B	Drawing created using General Layout RevN	AMS	06/11/23
A	Drawing created using General Layout RevM	CC	20/10/23

ENVIROMENA

COMPANY DETAILS
Environmena Project Management UK Ltd,
15 Diddenham Court, Grazeley,
Reading, RG7 1JQ
T: +44 330 107 1415

SITE ADDRESS
Nailcote Farm
Nailcote Lane
Berkswell
Coventry
CV7 7DE

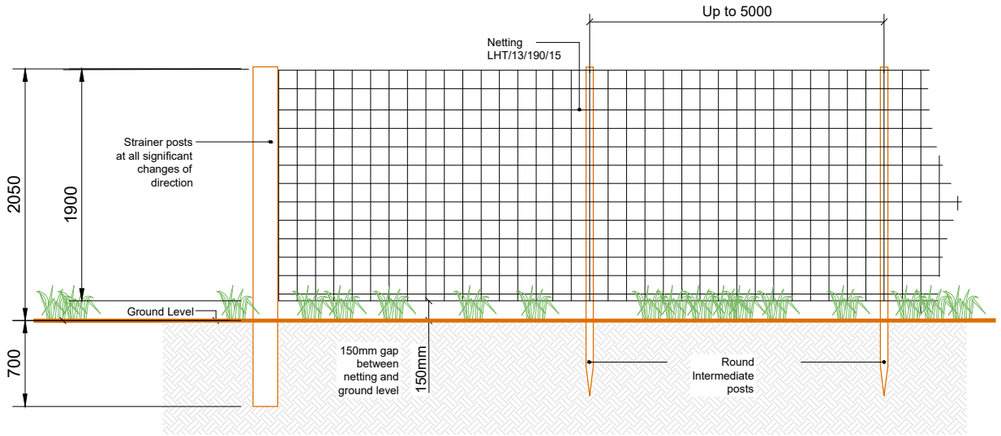
PROJECT
Fillongley Solar

TITLE
Planning Layout

NUMBER	REVISION
P.NailcoteFarm. (B_Planning)Layout	A

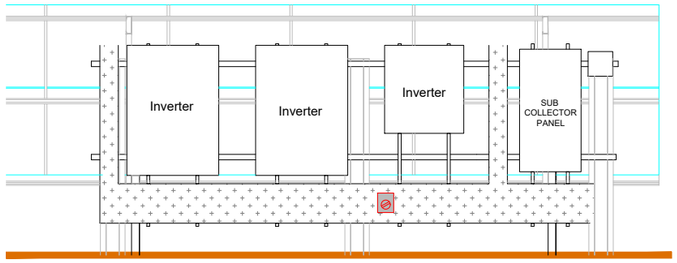
SCALE (A0)	SHEET	DRAWN	APPROVED
1:1250	1 OF 1	CC	AMS

SECURITY FENCE DETAIL
(DEER FENCE)



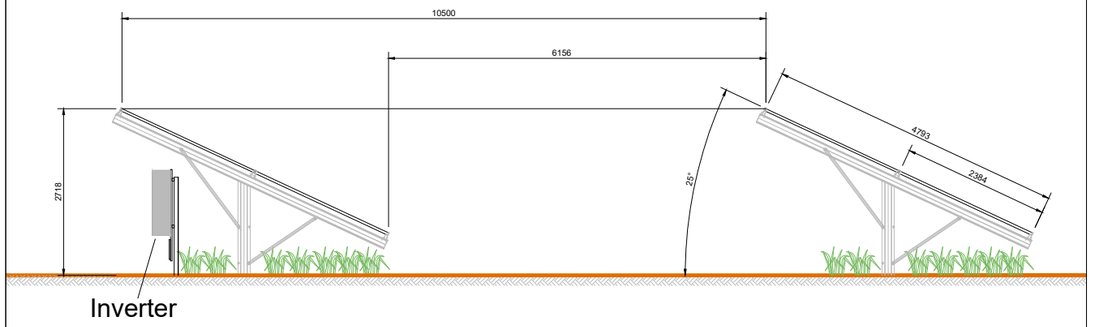
Scale 1:50 @A3

NORTH ELEVATION
(rear - showing typical inverter arrangement)



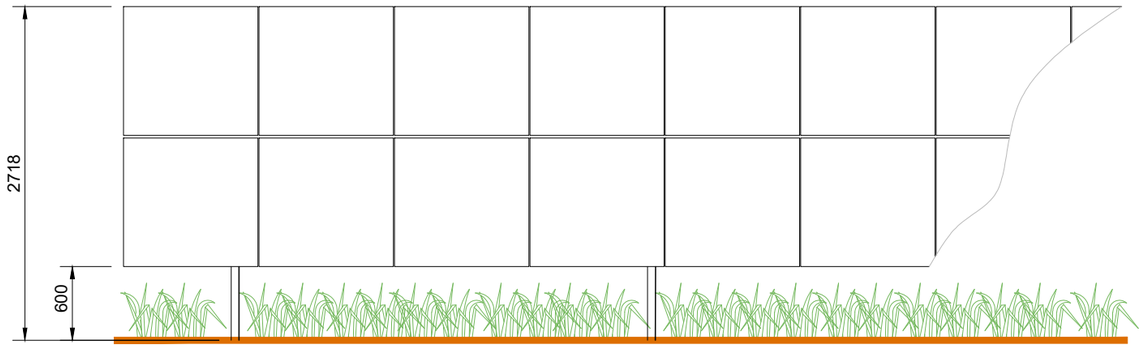
Scale 1:50 @A3

TYPICAL SECTION THROUGH ARRAY



Scale 1:100 @A3

SOUTH ELEVATION
(Front)



Scale 1:50 @A3

COMMENTS:
Units in mm.

REVISION:	DESCRIPTION:	REVISED BY:	APPROVED BY:	DATE:
RevA		AMS		05/12/2022

REVISION:	DESCRIPTION:	REVISED BY:	APPROVED BY:	DATE:

Scale:	Drawn by:	Checked by:	Signed by PM:	Date checked:	Page:	Sheet size:
N/A	AMS				1 of 1	A3

SITE ADDRESS:
Nailcote Farm
Nialcote Lane
Berkswell, Coventry

CV7 7DE

PROJECT NAME:
Nailcote Farm

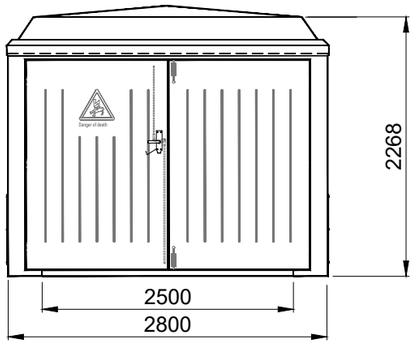
TITLE:
Section views

DRAWING No.:
P.NailcoteFarm_06_SectionViews

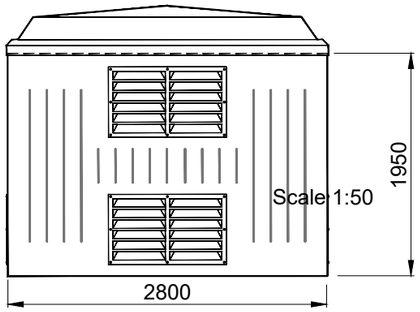
REV:
Rev A

ENVIROMENA

ADDRESS:
Enviromena Project Management UK Ltd
Tel: +44 330 107 1415
15 Diddenham Court, Grazeley
Reading, RG7 1JQ, United Kingdom



FRONT ELEVATION



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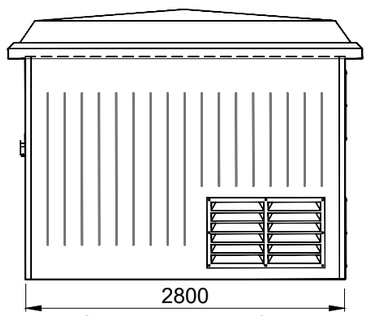
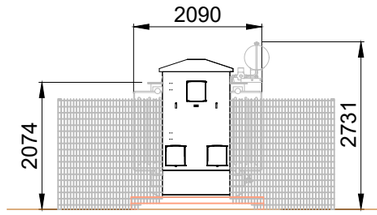
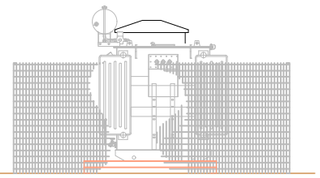


SIDE ELEVATION

CUSTOMER SWITCHGEAR ENCLOSURE



SIDE ELEVATION



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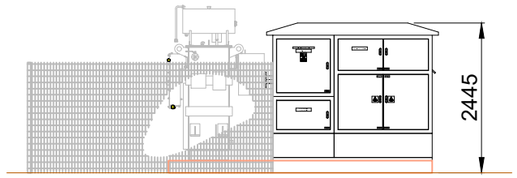

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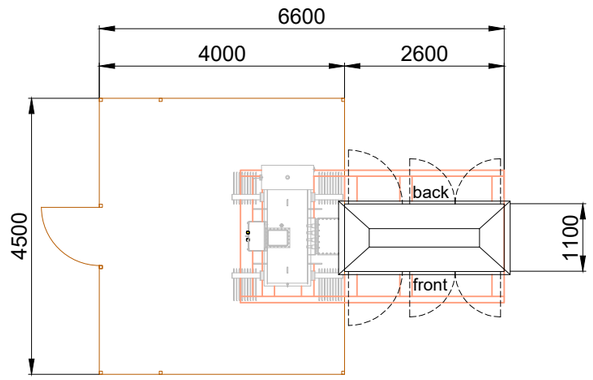
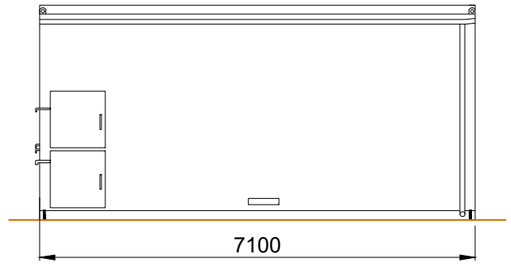
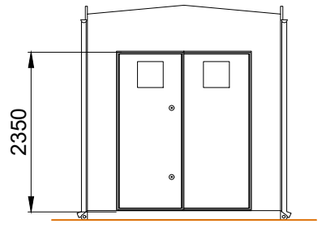


PLAN

TYPICAL LV STATION



BACK ELEVATION



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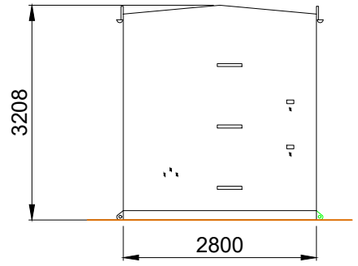
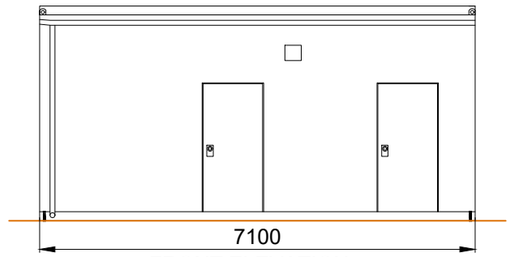
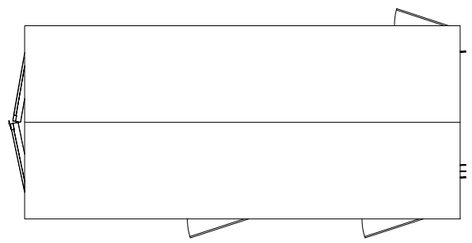


SIDE ELEVATION



FRONT ELEVATION



PLAN

TYPICAL DNO SUBSTATION ENCLOSURE

COMMENTS:
Units in mm.

REVISION:	DESCRIPTION:	REVISED BY:	APPROVED BY:	DATE:
RevA		AMS		05/12/2022

REVISION:	DESCRIPTION:	REVISED BY:	APPROVED BY:	DATE:

Scale:	Drawn by:	Checked by:	Signed by PM:	Date checked:	Page:	Sheet size:
N/A	AMS				1 of 1	A3

SITE ADDRESS:
Nailcote Farm
Nialcote Lane
Berkswell, Coventry

CV7 7DE

PROJECT NAME:
Nailcote Farm

TITLE:
Building Sections view

DRAWING No.: P.NailcoteFarm_07_BuildingSectionViews

REV: Rev A

ENVIROMENA

ADDRESS:
Enviromena Project Management UK Ltd
Tel: +44 330 107 1415
15 Diddenham Court, Grazeley
Reading, RG7 1JQ, United Kingdom

Appendix 3: Topographical Survey

Station Coordinates			
Station Name	Eastings (m)	Northings (m)	Height (m)
BWB01	427107.293	285586.147	137.020
BWB02	427131.275	285593.351	133.907
BWB03	427147.832	285812.084	136.132

Notes

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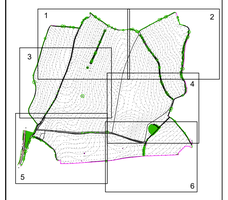
8. OS license number: 100022432

Key Plan



Legend

OS Buildings
Surveyed Buildings
Building
Wall
Kerb Channel Line
Top of Kerb
Edge of Surface
Top of Bank
Bottom of Bank
Canopy / Overhang
Line Marking
Centre Line
Watercourse Centre Line
Barrier
Fence
Gate
Overhead Powerline
Overhead Utilities
Contour Lines
Inspection Chamber
0.25 Flow direction and pipe diameter
1 Station and Name
BH 1 Monitoring Borehole
Tree / Bush / Sapling
Area of Vegetation/ Extent of Tree Canopy
Hedge
Body of Water
Body of Water from OS
50.00 Spot Level
Assumed Surface Water Drainage Line
Surface Water Drainage Line

AP	Anchor Point	FBW	Fence Barbed Wire	LB	Litter Bin
BG	Back Gully	FCB	Fence Closed Board	LP	Lamp Post
BO	Bollard	FCL	Fence Chain Link	MH	Manhole
BS	Bus Stop	FEL	Fence Electric	Mkr	Service Marker
BT	British Telecom	FMP	Fence Metal Panel	PB	Post Box
C	Crest	FMR	Fence Metal Railing	PT	Post
CL	Cover Level	FOB	Fence Open Board	RE	Rodding Eye
CMP	Cable Marker Post	FPW	Fence Post & Wire	SP	Sign Post
		FSP	Fence Steel Palisade	ST	Stop Tap
CCTV	Security Camera	FWM	Fence Wire Mesh	SV	Stop Valve
CTV	Cable TV	FFL	Finished Floor Level	TCB	Telephone Call Box
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		Gas	Gas	THL	Threshold Level
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Elec	Electric	Ht	Height	TS	Traffic Signal
EP	Electricity Post	IC	Inspection Chamber	UTS	Unable to Survey
ER	Earth Rod	IFL	Internal Floor Level	WL	Water Level
FH	Fire Hydrant	IL	Invert Level (as a reduced level)	WM	Water Meter
FL	Floodlight			WO	Wash Out

Rev	Date	Details of issue / revision	Drw	Rev
P1	15.12.22	First Issue	BC	DS

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Client

Enviromena Project Management UK Limited

Project Title

Nailcote Farm, Warwickshire

Drawing Title

Existing Site Plan Sheet 1 of 6

Drawn:	B. Connelly		Reviewed:	D.Smith	
BWB Ref:	221748.00	Date:	15.12.22	Scale@A0:	1:500

Drawing Status

Information

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NFW-BWB-00-01-DR-G-001	S2	P1

Station Coordinates			
Station Name	Eastings (m)	Northings (m)	Height (m)
BWB01	427107.293	285086.147	137.020
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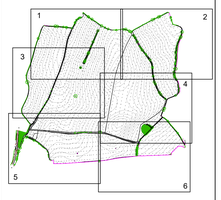

Legend

OS Buildings
Surveyed Buildings
Building
Wall
Kerb Channel Line
Top of Kerb
Edge of Surface
Top of Bank
Bottom of Bank
Canopy / Overhang
Line Marking
Centre Line
Watercourse
Centre Line
Barrier
Fence
Gate
Overhead Powerline
Overhead Utilities
Contour Lines
Inspection Chamber
0.25 Flow direction and pipe diameter
1 Station and Name
BH 1 Monitoring Borehole
Tree / Bush / Sapling
Area of Vegetation/ Extent of Tree Canopy
Hedge
Body of Water
Body of Water from OS
+50.00 Spot Level
Assumed Surface Water Drainage Line
Surface Water Drainage Line

AP	Anchor Point	FBW	Fence Barbed Wire	LB	Litter Bin
BG	Back Gully	FCB	Fence Closed Board	LP	Lamp Post
BO	Bollard	FCL	Fence Chain Link	MH	Manhole
BS	Bus Stop	FEL	Fence Electric	Mkr	Service Marker
BT	British Telecom	FMP	Fence Metal Panel	PB	Post Box
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CMP	Cable Marker Post	FPW	Fence Post & Wire	SP	Sign Post
		FSP	Fence Steel Palisade	ST	Stop Tap
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CTV	Cable TV	FFL	Finished Floor Level	TCB	Telephone Call Box
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Rev	Date	Details of issue / revision	Drw	Rev.
P1	15.12.22	First Issue	BC	DS

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Enviromena Project Management UK Limited

Project Title

Nailcote Farm, Warwickshire

Drawing Title

Existing Site Plan Sheet 2 of 6

Drawn:	B. Connelly	Reviewed:	D.Smith		
BWB Ref:	221748.00	Date:	15.12.22	Scale@A0:	1:500

Drawing Status

Information

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NFW-BWB-00-02-DR-G-001	S2	P1

Station Coordinates			
Station Name	Eastings (m)	Northings (m)	Height (m)
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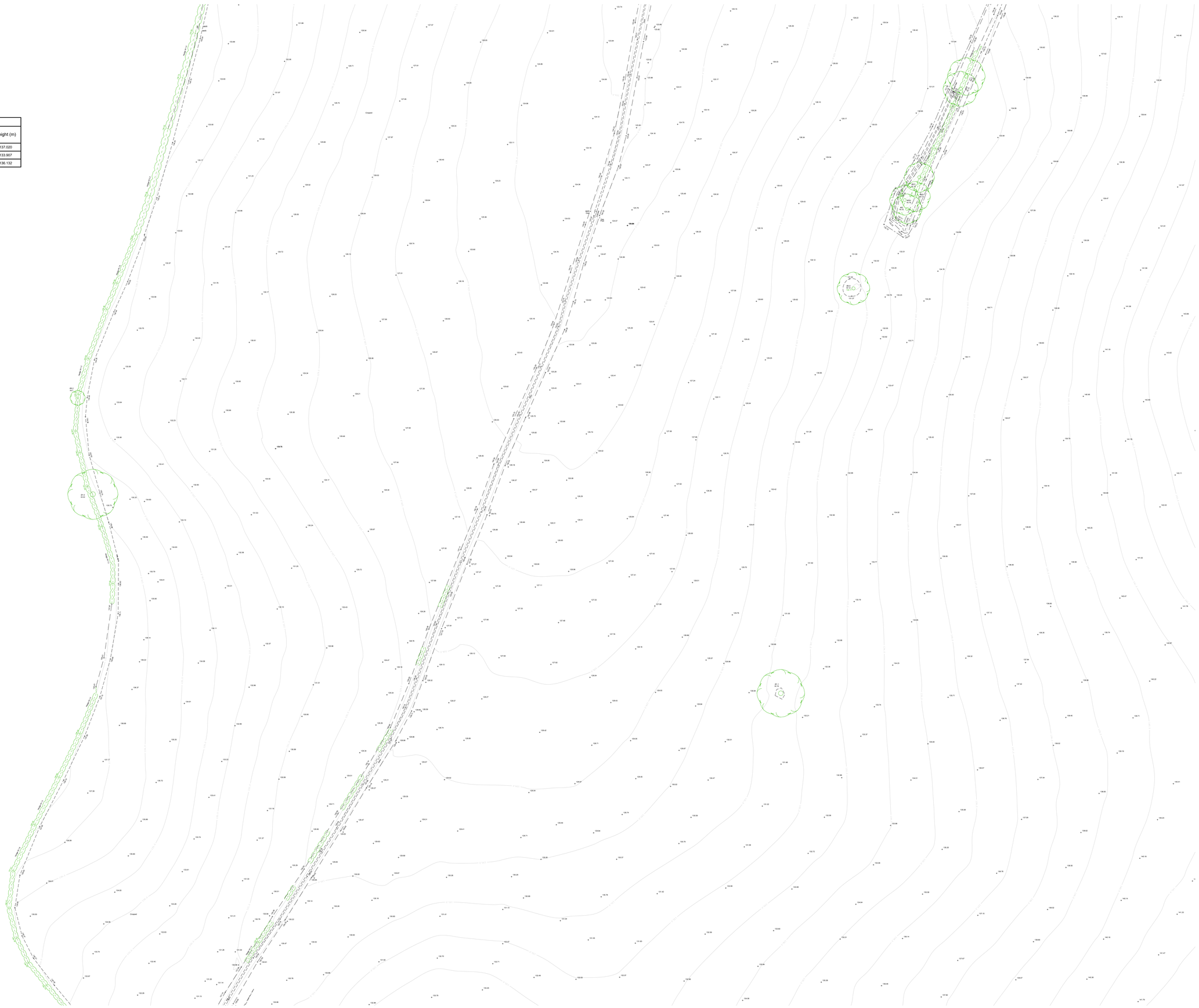
BWB03	427147.832	285812.084	136.132



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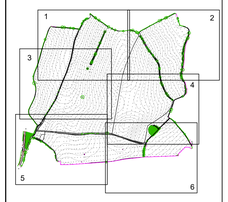

Legend

OS Buildings
Surveyed Buildings
Building
Wall
Kerb Channel Line
Top of Kerb
Edge of Surface
Top of Bank
Bottom of Bank
Canopy / Overhang
Line Marking
Centre Line
Watercourse
Centre Line
Barrier
Fence
Gate
Overhead Powerline
Overhead Utilities
Contour Lines
Inspection Chamber
0.25 Flow direction and pipe diameter
1 Station and Name
BH 1 Monitoring Borehole
Tree / Bush / Sapling
Area of Vegetation/ Extent of Tree Canopy
Hedge
Body of Water
Body of Water from OS
50.00 Spot Level
Assumed Surface Water Drainage Line
Surface Water Drainage Line

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FL	Floodlight			WO	Wash Out

Rev	Date	Details of issue / revision	Drw	Rev
P1	15.12.22	First Issue	BC	DS

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Enviromena Project Management UK Limited

Project Title

Nailcote Farm, Warwickshire

Drawing Title

Existing Site Plan Sheet 2 of 6

Drawn:	B. Connelly		Reviewed:	D.Smith	
BWB Ref:	221748.00	Date:	15.12.22	Scale@A0:	1:500

Drawing Status

Information

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NFW-BWB-00-03-DR-G-001	S2	P1

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Station Name	Eastings (m)	Northings (m)	Height (m)
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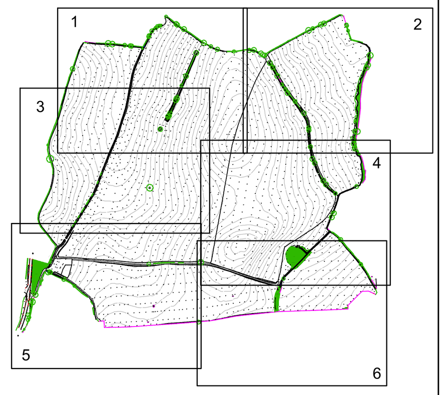
Key Plan



Legend

- OS Buildings
- Surveyed Buildings
- Building
- Wall
- Kerb Channel Line
- Top of Kerb
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- 0.25 Flow direction and pipe diameter
- 1 Station and Name
- BH 1 Monitoring Borehole
- Tree / Bush / Sapling
- Area of Vegetation/ Extent of Tree Canopy
- Hedge
- Body of Water
- Body of Water from OS
- +50.00 Spot Level
- Assumed Surface Water Drainage Line
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Project Title

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Drawing Title

Existing Site Plan Sheet 4 of 6

Drawn:	B. Connelly	Reviewed:	D.Smith		
BWB Ref:	221748.00	Date:	15.12.22	Scale@A0:	1:500

Drawing Status

Information

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NFW-BWB-00-04-DR-G-001	S2	P1

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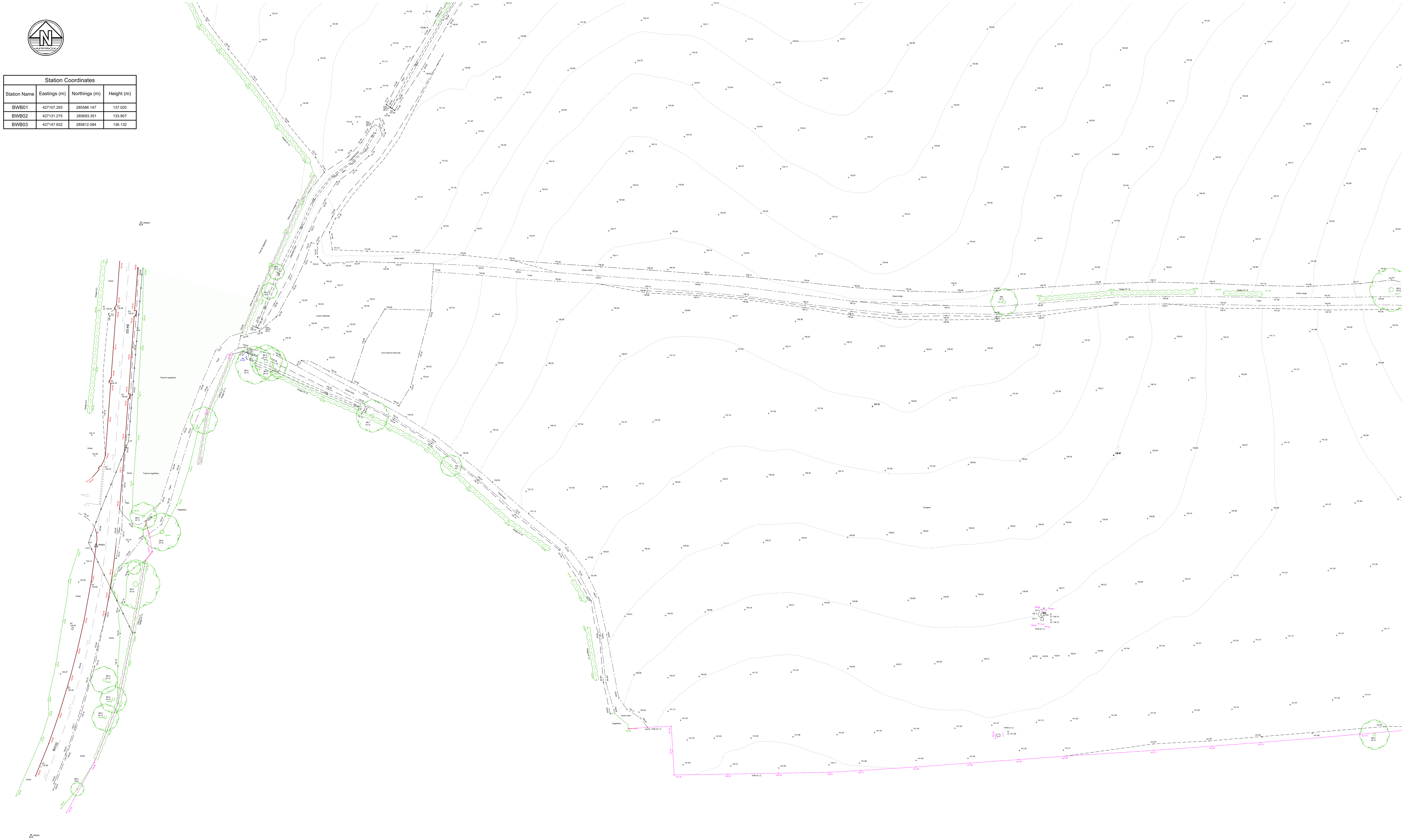

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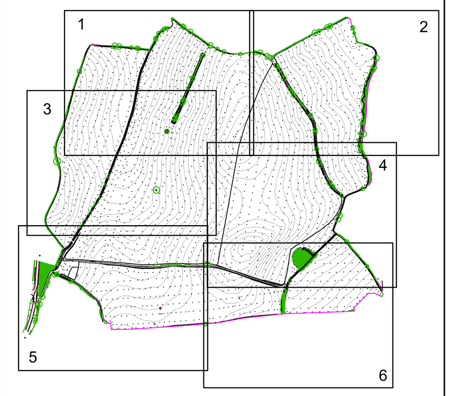

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Surveyed Buildings
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Top of Kerb
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Line Marking
Centre Line
Watercourse Centre Line
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C	Crest	FMR	Fence Metal Railing	PT	Post
CL	Cover Level	FOB	Fence Open Board	RE	Rodding Eye
CMP	Cable Marker Post	FPW	Fence Post & Wire	SP	Sign Post
		FSP	Fence Steel Palisade	ST	Stop Tap
CCTV	Security Camera	FWM	Fence Wire Mesh	SV	Stop Valve
CTV	Cable TV	FFL	Finished Floor Level	TCB	Telephone Call Box
DC	Drainage Channel	FP	Flagpole	THL	Threshold Level
		Gas	Gas	TL	Traffic Light
DK	Drop Kerb	GV	Gas Valve	TP	Telegraph Post
DP	Down Pipe	GY	Gully	TS	Traffic Signal
Elec	Electric	Ht	Height	UTS	Unable to Survey
EP	Electricity Post	IC	Inspection Chamber	WL	Water Level
ER	Earth Rod	IFL	Internal Floor Level	WM	Water Meter
FH	Fire Hydrant	IL	Invert Level (as a reduced level)	WO	Wash Out
FL	Floodlight				

Rev	Date	Details of issue / revision	Drw	Rev
P1	15.12.22	First Issue	BC	DS

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Client

Enviromena Project Management UK Limited

Project Title

Nailcote Farm, Warwickshire

Drawing Title

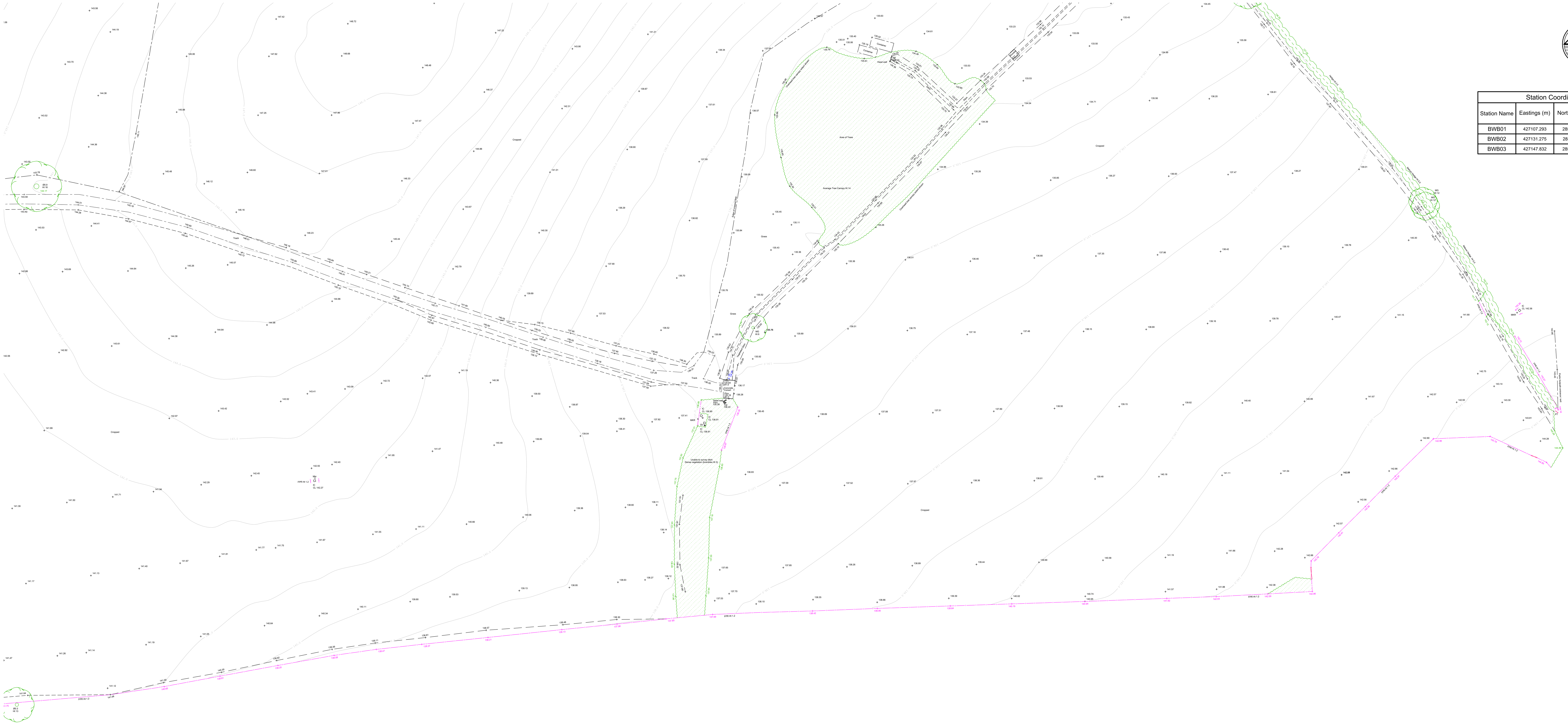
Existing Site Plan Sheet 5 of 6

Drawn:	B. Connelly	Reviewed:	D.Smith		
BWB Ref:	221748.00	Date:	15.12.22	Scale@A0:	1:500

Drawing Status

Information

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NFW-BWB-00-05-DR-G-001	S2	P1



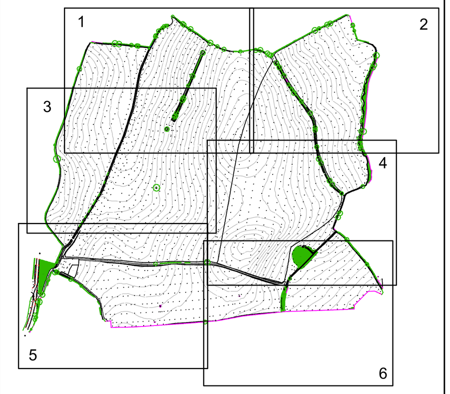
Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in metres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. No scale factor has been applied to this survey, therefore the os coordinates are to be treated as arbitrary. Please refer to survey station information below for on site control establishment.
6. All coordinates and height data relate to OSGB36(15). Control stations are coordinated by means of GPS receiving real time corrections via OS smart net.
7. All manhole data is collected from ground level therefore discrepancies may occur. More accurate data is only achievable via confined space entry.
8. OS license number: 100022432

APPROX

Station Coordinates			
Station Name	Eastings (m)	Northings (m)	Height (m)
BWB01	427107.293	285586.147	137.020
BWB02	427131.275	285693.351	133.907
BWB03	427147.832	285812.084	136.132

Key Plan



Legend

- OS Buildings
- Surveyed Buildings
- Building
- Wall
- Kerb Channel Line
- Top of Kerb
- Edge of Surface
- Top of Bank
- Bottom of Bank
- Canopy / Overhang
- Line Marking
- Centre Line
- Watercourse Centre Line
- Barrier
- Fence
- Gate
- Overhead Powerline
- Overhead Utilities
- Contour Lines
- Inspection Chamber
- 0.25 Flow direction and pipe diameter
- 1 Station and Name
- BH 1 Monitoring Borehole
- Tree / Bush / Sapling
- Area of Vegetation/ Extent of Tree Canopy
- Hedge
- Body of Water
- Body of Water from OS
- 50.00 Spot Level
- Assumed Surface Water Drainage Line
- Surface Water Drainage Line

AP	Anchor Point	FBW	Fence Barbed Wire	LB	Litter Bin
BG	Back Gully	FCB	Fence Closed Board	LP	Lamp Post
BO	Bollard	FCL	Fence Chain Link	MH	Manhole
BS	Bus Stop	FEL	Fence Electric	Mkr	Service Marker
BT	British Telecom	FMP	Fence Metal Panel	PB	Post Box
C	Crest	FMR	Fence Metal Railing	PT	Post
CL	Cover Level	FOB	Fence Open Board	RE	Rodding Eye
CMP	Cable Marker Post	FPW	Fence Post & Wire	SP	Sign Post
CCTV	Security Camera	FSP	Fence Steel Palisade	ST	Stop Tap
CTV	Cable TV	FWM	Fence Wire Mesh	SV	Stop Valve
DC	Drainage Channel	FFL	Finished Floor Level	TCB	Telephone Call Box
DK	Drop Kerb	FP	Flagpole	THL	Threshold Level
DP	Down Pipe	Gas	Gas	TL	Traffic Light
Elec	Electric	GV	Gas Valve	TP	Telegraph Post
EP	Electricity Post	GY	Gully	TS	Traffic Signal
ER	Earth Rod	Ht	Height	UTS	Unable to Survey
FH	Fire Hydrant	IC	Inspection Chamber	WL	Water Level
FL	Floodlight	IFL	Internal Floor Level	WM	Water Meter
		IL	Invert Level (as a reduced level)	WO	Wash Out

Rev	Date	Details of issue / revision	Drw	Rev
P1	15.12.22	First Issue	BC	DS

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Client
Enviromena Project Management UK Limited

Project Title
Nailcote Farm, Warwickshire

Drawing Title
Existing Site Plan Sheet 6 of 6

Drawn:	B. Connelly	Reviewed:	D.Smith		
BWB Ref:	221748.00	Date:	15.12.22	Scale@A0:	1:500

Drawing Status
Information

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NFW-BWB-00-06-DR-G-001	S2	P1

Appendix 4: Conceptual Drainage Strategy

Section of Swale

Scale 1:100

Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Enclosed topographical survey based on BWB Consulting drawing (Dwg No:NFW-BWB-00-ZZ-M2-G-0001) dated 15.12.22
6. Enclosed masterplan based on Enviromena Project Management UK Limited (Dwg No. "P.NailcoteFarm_01_GeneralLayout_RevN")
7. This report should be read in conjunction with BWB Consulting Drainage Strategy 'NFW-BWB-ZZ-XX-RP-CD-0001'.
8. This drawing is a proof of concept only, do not consider costing or constructing from this drawing.

Legend

- Site Boundary
- Measured Impermeable Area
- Swales
- Indicative Infiltration Trench
- General Direction of Overland Flow

Measured Impermeable Area: 387m^3 (0.04ha)

Rev	Date	Details of issue / revision	Drw	Rev
P06	22.11.23	Updated based on latest Masterplan	MB	LR
P05	07.03.23	Update of Masterplan	WJ	MB
P04	17.02.23	Removal of Easement shown.	WJ	MB
P03	16.02.23	Masterplan update and repositioning of swales	MB	KA
P02	09.02.23	Masterplan update and reduction in swales	WJ	MB
P01	27.01.23	Preliminary Issue	WJ	MB

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Client

Enviromena Project Management UK Limited

Project Title

Nailcote Farm, Warwickshire

Drawing Title

Conceptual Drainage Strategy

Drawn:	W. James		Reviewed:	M. Bailey	
BWB Ref:	221748	Date:	27.01.23	Scale@A1:	1:2000

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NFW-BWB-ZZ-XX-DR-CD-0001	S2	P06

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Appendix 5: Pre and Post Development Runoff Calculations

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.150
Area (ha)	62.200	Urban	0.000
SAAR (mm)	700	Region Number	Region 4

Results	**l/s**
QBAR Rural	24.6
QBAR Urban	24.6
Q100 years	63.2
Q1 year	20.4
Q2 years	22.0
Q5 years	30.2
Q10 years	36.6
Q20 years	43.7
Q25 years	46.2
Q30 years	48.2
Q50 years	54.1
Q100 years	63.2
Q200 years	74.3
Q250 years	78.0
Q1000 years	102.3

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IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.150
Area (ha)	62.200	Urban	0.000
SAAR (mm)	980	Region Number	Region 4

Results	**l/s**
QBAR Rural	36.5
QBAR Urban	36.5
Q100 years	93.7
Q1 year	30.3
Q2 years	32.7
Q5 years	44.8
Q10 years	54.3
Q20 years	64.8
Q25 years	68.5
Q30 years	71.4
Q50 years	80.3
Q100 years	93.7
Q200 years	110.1
Q250 years	115.6
Q1000 years	151.7

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IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.150
Area (ha)	62.200	Urban	0.001
SAAR (mm)	700	Region Number	Region 4

Results	**l/s**
QBAR Rural	24.6
QBAR Urban	24.7
Q100 years	63.4
Q1 year	20.5
Q2 years	22.1
Q5 years	30.4
Q10 years	36.8
Q20 years	43.8
Q25 years	46.3
Q30 years	48.3
Q50 years	54.3
Q100 years	63.4
Q200 years	74.5
Q250 years	78.2
Q1000 years	102.5

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IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.150
Area (ha)	62.200	Urban	0.001
SAAR (mm)	980	Region Number	Region 4

Results	**l/s**
QBAR Rural	36.5
QBAR Urban	36.5
Q100 years	93.9
Q1 year	30.3
Q2 years	32.8
Q5 years	45.0
Q10 years	54.4
Q20 years	64.9
Q25 years	68.6
Q30 years	71.6
Q50 years	80.4
Q100 years	93.9
Q200 years	110.3
Q250 years	115.8
Q1000 years	151.9

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Appendix 6: Pre and Post Development Runoff Volumes

Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
FEH Rainfall Version	2013
Site Location	GB 428050 287000 SP 28050 87000
Data Type	Catchment
Areal Reduction Factor	1.00
Area (ha)	62.200
SAAR (mm)	709
CWI	106.161
SPR Host	32.470
URBEXT (1990)	0.0107

Results

Percentage Runoff (%)	32.22
Greenfield Runoff Volume (m^3)	12906.902

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Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
FEH Rainfall Version	2013
Site Location	GB 428050 287000 SP 28050 87000
Data Type	Catchment
Areal Reduction Factor	1.00
Area (ha)	62.160
SAAR (mm)	709
CWI	106.161
SPR Host	32.470
URBEXT (1990)	0.0107

Results

Percentage Runoff (%)	32.22
Greenfield Runoff Volume (m^3)	12898.601

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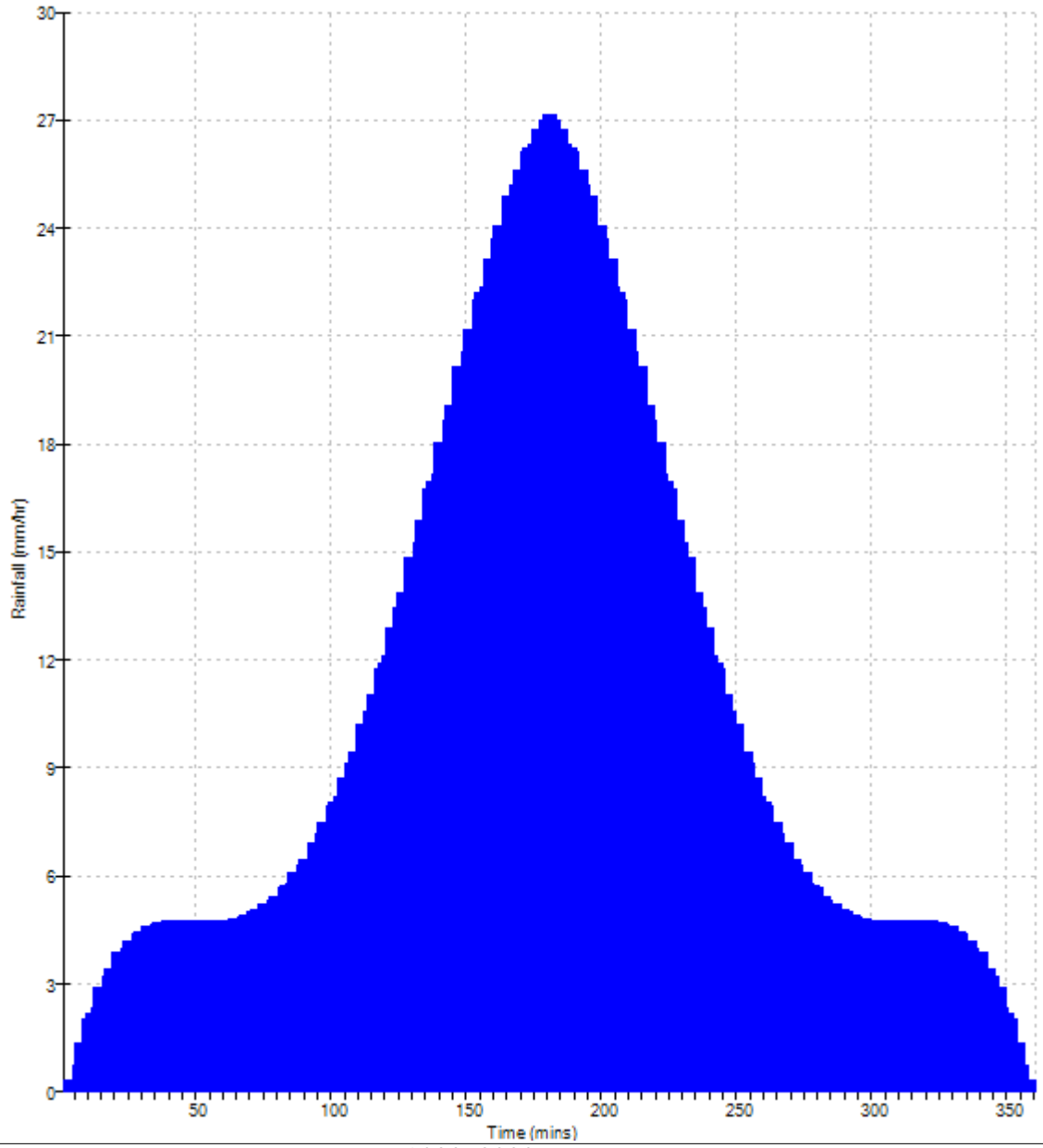
Appendix 7: Rainfall Profile

Rainfall profile

Storm duration (mins) 360

FEH Data

FEH Rainfall Version	2013
Site Location	GB 428050 287000 SP 28050 87000
Data Type	Catchment
Peak Intensity (mm/hr)	27.146
Ave. Intensity (mm/hr)	10.733
Return Period (years)	100.0



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