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Project No: 313619

Flood Risk Assessment and Water Management Statement: Land adjacent to Pamington, Ashchurch

Prepared for:

Greystoke Land

Banbury Road,
Oxford,
OX2 6PE

Contents Amendment Record

This report has been issued and amended as follows:

Revision	Description	Date	Signed
1.0	Final	22/11/2023	Josh Rigby

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Acknowledgement

Appointment

This report has been prepared for the sole and exclusive use of Greystoke Land Ltd in accordance with the scope of work presented in Mabbett & Associates Ltd (Mabbett) Letter Agreement (313619/LA/DH), dated 07 July 2023. This report is based on information and data collected by Mabbett. Should any of the information be incorrect, incomplete, or subject to change, Mabbett may wish to revise the report accordingly.

This report has been prepared by the following Mabbett personnel:

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1.0 Introduction

Project Understanding

The Environment Agency (EA) Flood Map for Planning shows that the Site is located wholly within Flood Zone 1. However, since the Site measures in excess of 1 hectare, a Flood Risk Assessment and Water Management Statement to support the application.

The purpose of this report is to evaluate the potential flood risk to the Site, the impact of the proposed development on flood risk elsewhere, and the proposed measures that could be incorporated to mitigate the identified risk. This report has been prepared in accordance with the guidance contained in the National Planning Policy Framework (NPPF) revised in 2021, and the National Planning Practice Guidance (NPPG) Flood Risk and Coastal Change.

Gloucestershire County Council as Lead Local Flood Authority (LLFA) is a statutory consultee for major planning applications in relation to surface water drainage, requiring that all planning applications are accompanied by a Sustainable Water Management Statement. The aim of the Sustainable Water Management Statement is to identify water management measures, including Sustainable Drainage Systems (SuDS), to provide surface water runoff reduction and treatment.

This report considers the following national and local policies:

- National Planning Policy Framework (NPPF) (2021)[1];
- National Planning Practice Guidance (NPPG) (2014)[2];
- CIRIA Guidance: The SuDS Manual (C753) (2017)[3]; and
- Halton Borough Council Local Development and Planning Policies.

Sources of Information

The following sources of information have been reviewed and assessed for the purpose of this FRA:

- EA online flood maps[4];
- British Geological Society (BGS) Interactive Map[5];
- MAGIC Interactive Map[6];
- Tewkesbury Borough Council Level 1 Strategic Flood Risk Assessment, Halcrow, Sep 2018 (2008 Level 1 SFRA);
- Tewkesbury Borough Council Level 2 Strategic Flood Risk Assessment, Halcrow, Oct 2011 (2011 Level 2 SFRA);
- Gloucester, Cheltenham, and Tewkesbury JCS Level 2 Strategic Flood Risk Assessment – Additional Assessments, Capita Symonds, Sep 2012 (2012 Level 2 SFRA);
- Tewkesbury Borough Council Level 2 Strategic Flood Risk Assessment, JBA, Nov 2017 (2017 Level 2 SFRA); and
- Soakaway Testing, Wessex and West Ground Investigation, Oct 2023.

Reference of Terms

This report should be read with the Reference of Terms included as section 7.0 of this report.

1 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1004408/NPPF_JULY_2021.pdf
2 http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/
3 https://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx
4 https://flood-map-for-planning.service.gov.uk/
5 http://mapapps.bgs.ac.uk/geologyofbritain/home.html
6 http://www.magic.gov.uk/

2.0 Baseline Conditions

The aim of this section of the report is to outline key environmental information associated with the baseline environment.

Area (approx.)	13.414 ha	National Grid Reference (NGR)	394369, 232861

Figure 1: Site Location Plan

Site Location	The site is located 4.82km east of Tewkesbury town centre and 2km east of junction 9 of the M5 motorway.
Existing Site Conditions	Online mapping (including Google Maps / Google Streetview imagery and OS mapping, accessed July 2023) shows that the site is wholly comprised of arable fields which is not formally drained and is therefore considered to be 100% permeable. Access to the site is provided from the B4079 which forms the eastern boundary of the site.
Topography	A topographical survey has been undertaken by Interlocks Surveys Limited on 14th August 2023 (Dwg No. 230543). The topographical survey shows that the main development area (excluding access tracks to the north and west) slopes from approximately 26m AOD in the south-west of the site down to approximately 21m AOD in the northern extent. The pedestrian access in the west is relatively flat with levels recorded between 22.78m AOD and 21.53m AOD. The pedestrian access in the north falls from south to north with levels measured at approximately 18.91m AOD at the junction with the B4079.

	Topographic levels to m AOD have been derived from a 1 m resolution Environment Agency (EA) composite 'Light Detecting and Ranging' (LiDAR) Digital Terrain Model (DTM). A review of LiDAR ground elevation data corroborates the topographical survey and also show the wider area falls towards the northwest in this area. Topographical information is provided as Appendix B.
Hydrology	The nearest watercourse is an unnamed land drain (ordinary watercourse) which flows south to north through the centre of the site. The land drain is part of a network of land drains which drain the area. Given the local topography and the direction of travel it is highly likely the land drainage network ultimately discharges to Tirtle Brook. Photo 1 taken from google Streetview (grid ref: 394129, 233140) identifies the local land drainage ditch which flows parallel to the B4079 at the point where the proposed northern pedestrian access Tirtle Brook is a Main River (falls within the jurisdiction of the EA), it is situated approximately 460m north of the main body of the site at its closest point. Tirtle Brook flows west to east in this direction. The Site sits within an SSSI Impact Risk Zone for the Severn Ham Tewkesbury SSSI (3.5km to the West) and Old River Severn, Upper Lode SSSI (some 4.3km to the west)

Photo 1: View of Land Drainage Ditch Parallel to B4079 Facing North-West

Geology	Reference to the British Geological Survey (BGS) online mapping (1:50,000 scale) indicates that the site is underlain by Cheltenham Sand and Gravel superficial deposits in the eastern and western extents, the remining majority of the site is sat straight on bedrock. The underlying bedrock is identified as Charmouth Mudstone Formation. The geological mapping is available at a scale of 1:50,000 and as such may not be accurate on a site-specific basis. There are no accessible historical BGS borehole record within 1km of the Site boundary. Soakaway testing was undertaken by Wessex and West Ground Investigation in October 2023. The testing comprised a total of 5 trial pits to depths between 1.5 and 2.0m bgl with soakaway testing undertaken to the BRE365 methodology.

	The encountered geology comprised Made Ground to a maximum depth of 0.7m bgl over gravelly sand ranging from 0.5m to 1.15m bgl. Over Charmouth Mudstone Formation bedrock to depth. None of the test locations completed a single depth with very little soakage observed during the initial 4hr period. Therefore, all of the tests are considered to have failed. The soakaway testing results are included as Appendix C.
Hydrogeology	According to the EA's Aquifer Designation data, obtained from MAGIC Map's online mapping [accessed July 2023], the superficial Cheltenham Sand and Gravel is classified as a Secondary A Aquifer. The underlying Charmouth Mudstone Formation is described as a Secondary (undifferentiated) Aquifer. The EA's 'Source Protection Zones' data, obtained from MAGIC Map's online mapping [accessed July 2023], indicates that the site is not located within a Groundwater Source Protection Zone.
Local Drainage	Public sewer records have been obtained from Severn Trent and are included in Appendix D. The Severn Trent sewer records show that there is a public foul sewer is situated within the B4079 to the north-east of the site. The sewer records indicate that the public foul sewer originates at manhole 3001 and flows north-west within the B4079 away from the site. Manhole 3001 is recorded as having a cover level of 22.36m AOD, an invert level of 20.07m AOD and a depth to invert of 2.29m. No public surface water and /or combined sewers are shown within close proximity to the site.
Development Proposals	It is proposed to develop the site for residential use. Any proposed residential development will include associated, access, infrastructure, and soft landscaping. A proposed development plan is included in Appendix E. The proposed development will introduce hardstanding areas in the form of buildings and access. Given the outline nature of the development the development areas have not been finalised. For the purposes of this report, it is assumed that 30% of the total site area will be hardstood, given the outline proposals this is considered to be conservative. Hardstanding areas are assumed at this stage to occupy approximately 40,242m^2 or 30% of the total site area. The remaining permeable, soft landscaped areas will occupy 93,898m^2 or 70% of the total site area.

3.0 Relevant Planning Policy and Guidance

Introduction

The aim of this section of the report is to discuss the main aspects of the local and national planning policies that are relevant to any proposed development on the Site and relevant guidance and legislation.

National Planning Policy Framework

Flood risk in England is normally considered through the planning process in the NPPF (2021), produced by Ministry of Housing, Communities and Local Government.

The principal aim of the NPPF assessment of flood risk is that:

> "Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere".

The NPPF requires a FRA to be produced where development Sites are:

- Greater than one hectare in size;
- All proposals for new development (including minor development and change of use) in Flood Zones 2 and 3;
- Or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the EA); and
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

The NPPF requires that developers consider not just the flood risk to the development but also the impact that the development might have on flood risk elsewhere. As well as Main Rivers and the sea, it is also necessary to consider flood risk from other sources, including surface water, groundwater, Ordinary Watercourses, artificial drainage systems, canals, and reservoirs.

Vulnerability Classification

In accordance with Table 2 of the NPPG: Flood Risk and Coastal Change, residential developments are **'more vulnerable'**.

Table 1: Flood Risk Vulnerability Classification (from Table 3 of online Planning Practice Guidance)

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water-Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a	Exception Test required	✗	Exception Test required	✓	✓
Zone 3b	Exception Test required	✗	✗	✗	✓

✓ development is permitted
✗ development is not permitted

Sequential Test

A key part of the NPPF is that a proposed development must first pass a "Sequential Test" to demonstrate that the overall development proposal is appropriate in terms of flood risk. It ensures that a sequential approach is followed to guide new development to areas with the lowest probability of flooding.

Exception Test

The Exception Test determines whether the benefits of the proposed development will outweigh the potential flood risk.

Table 3 of the NPPG (reproduced above as Table 1), states that 'more vulnerable' development is considered appropriate within Flood Zone 1. The development therefore passes the flood risk Sequential Test, and the Exception Test does not need to be applied.

Local Policy

The Joint Core Strategy (JCS) is a partnership between Gloucester City Council, Cheltenham Borough Council and Tewkesbury Borough Council, which sets out a strategic planning framework for the three areas. The JCS was adopted by all three councils in December 2017 and is now undergoing a review. The JCS includes the following policy with regards to flood risk and drainage:

Policy INF2: Flood Risk Management:

1. *Development proposals must avoid areas at risk of flooding, in accordance with a risk- based sequential approach. Proposals must not increase the level of risk to the safety of occupiers of a site, the local community, or the wider environment either on the site or elsewhere. For sites of strategic scale, the cumulative impact of the proposed development on flood risk in relation to existing settlements, communities or allocated sites must be assessed and effectively mitigated.*
2. *Minimising the risk of flooding and providing resilience to flooding, taking into account climate change, will be achieved by:*
    i. *Requiring new development to, where possible, contribute to a reduction in existing flood risk.*
    ii. *Applying a sequential test for assessment of applications for development giving priority to land in Flood Zone 1, and, if no suitable land can be found in Flood Zone 1, applying the exception test.*
    iii. *Requiring new development that could cause or exacerbate flooding to be subject to a flood risk assessment which conforms to national policy and incorporates the latest available modelling and historic data and information and guidance contained in the authorities' Strategic Flood Risk Assessments and Supplementary Planning Documents, in order to demonstrate it will be safe, without increasing flood risk elsewhere.*
    iv. *Requiring new development to incorporate suitable Sustainable Drainage Systems (SuDS) where appropriate in the view of the local authority to manage surface water drainage: to avoid any increase in discharge into the public sewer system; to ensure that flood risk is not increased on-site or elsewhere; and to protect the quality of the receiving watercourse and groundwater. Where possible, the authorities will promote the retrofitting of SuDs and encourage development proposals to reduce the overall flood risk through the design and layout of schemes which enhance natural forms of drainage. Developers will be required to fully fund such mitigation measures for the expected lifetime of the development including adequate provision for on-going maintenance.*
    v. *Working with key partners, including the Environment Agency and Gloucestershire County Council, to ensure that any risk of flooding from development proposals is appropriately mitigated and the natural environment is protected in all new development.*

The Tewkesbury Borough Local Plan 2011-2031 was adopted on 8 June 2022 at a Special Meeting of Full Council. The Local Plan includes the following policy with regards to flood risk and drainage:

Policy ENV2 Flood Risk and Water Management In order to avoid and manage the risk of flooding to and from new development in the Borough, in addition to the requirements of the National Planning Policy Framework and the Joint Core Strategy the Council will apply the following principles:

- *Proposals (including surface water drainage schemes) should be designed to appropriate, locally specific allowances for climate change for peak river flood flows and rainfall intensity and undertake new hydraulic modelling where necessary.*

- *Opportunities to reduce the existing risk of flooding from all sources in the Borough will be sought, including, requiring developments to contribute towards the provision of additional flood storage on sites located within the headwaters of the Borough's watercourses or other techniques such as natural flood management and re-naturalisation of watercourses (link with Policy NAT2)*
- *All proposals will be expected to incorporate sustainable drainage systems where appropriate and proportionate to the scale and nature of development proposed.*
- *Proposals must demonstrate that development is designed to use and manage water efficiently, including rainwater harvesting and greywater recycling where possible.*
- *Surface water drainage proposals should, where appropriate, achieve significant betterment on existing discharge rates for all corresponding storm events.*
- *Sustainable drainage systems should be designed to achieve multifunctional benefits. Priority should be given to green/soft solutions and the integration of sustainable drainage systems with green infrastructure and street networks.*
- *Arrangements for the long-term maintenance of sustainable drainage systems must be in place to the Council's satisfaction.*
- *Opportunities to improve and subsequently maintain existing measures for providing an adequate warning system within the borough, through appropriate financial contributions, 121 will be sought where any new development relies on such a service over its lifetime to allow safe access/egress for future residents.*
- *Foul water drainage from new development should, wherever possible, be managed via the mains sewer. Adequate infrastructure to accommodate this (both in terms of physical capacity and environmental capacity) must be available or capable of being made available in a timely manner.*

Climate Change

As the Site is within Flood Zone 1 and is not within close proximity of any identified flood zones and therefore, hydraulic modelling is not considered to be required If this was not the case the works would require consideration of 32% (higher central) and 59% (upper end) Climate Change (CC) allowance for flood risk as recommended by the EA[7] for sites within the Avon Warwickshire Management Catchment.

Consultation

A pre-planning opinion request was submitted to the EA in August 2023. The EA stated in their response dated 22nd August 2023, *'Based on the apparent scale and nature of the proposals, and our data/records, we would not provide bespoke or detailed comment on this, and we would be unlikely to make formal comment on a future planning application (unless the formal submission indicates otherwise to the Local Planning Authority in accordance with our consultation arrangements)'.*

A consultation request was submitted to the LLFA in August 2023. The LLFA provided their standard pre-app advice which is included as Appendix F and has been considered throughout this report.

A pre-development enquiry request has not yet been submitted given there is no proposed surface water discharges to the public sewer.

The Site is not located within an Internal Drainage Board (IDB) District.

7 Environment Agency Climate Change Guidance: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

4.0 Assessment of Flood Risk

The aim of this section of the report is to assess and summarise the existing flood risk at the site.

Tidal Flood Risk	The Site is situated at a minimum of approximately 21m AOD and is significantly above sea level. Therefore, there is **no risk** from tidal flooding.

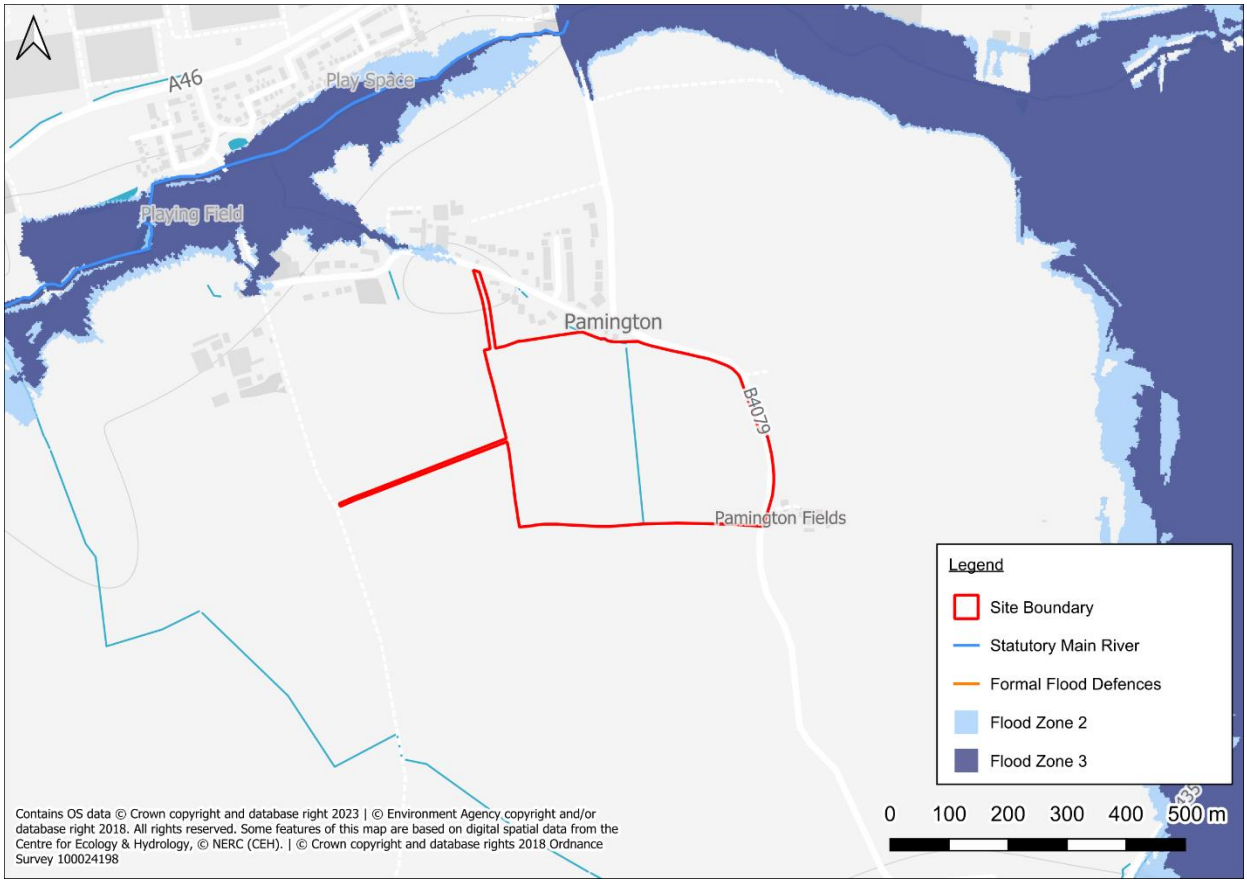


Figure 2: EA's Flood Map for Planning

Fluvial Flood Risk	The nearest watercourse is an unnamed land drain (ordinary watercourse) which flows south to north through the centre of the site. Tirtle Brook is a Main River and is situated approximately 460m north of the main body of the site at its closest point. The site is shown to be located wholly within Flood Zone 1 as shown on the EA's Flood Map for Planning (Figure 2 below). The EA 'Historical Flood Map' does not identify any recorded historical flood events at the site or in the immediate vicinity. The main body of the site is situated at a minimum of 21m AOD rising to 26m AOD, Tirtle Brook and the Flood Zone 2 extent associated with it tracks closely to the 18.5m AOD contour. The local Flood Zone is therefore, 2.5m below the site. Any out of channel flooding from the watercourse is unlikely to flow toward the Site and will flow to the west away from the Site following the local topography. The Capita Symonds 2012 Level 2 SFRA includes areas adjacent to this development site. Although the site isn't shown on the provided mapping the provided 1 in 100 + climate change (cc) fluvial flood extent and hazard mapping confirms that the flooding associated with Tirtle Brook stops before it reaches the site.

	The unnamed land drain which flows through the centre of the site has not been included within the hydraulic model, which forms the basis of the EA's Flood Map for Planning. In lieu of site-specific modelling the EA's Long-Term Flood Risk Map (Flood Risk from Surface Water) can be utilised, especially in open agricultural, low vegetation land such as this site. The EA's Long-Term Flood Risk Map (Flood Risk from Surface Water) included as Figure 3 below indicates that the unnamed land drain is considered to be at between a low risk of surface water flooding, (between a 1% and 0.1% annual probability of flooding) and high risk of surface water flooding, (greater than 3.3% annual probability of flooding). The flood extent is kept close to the channel of the identified watercourse indicating that little out of channel flooding can be expected during the low-risk events. Mitigation measures proposed to ensure the site remains at low risk from this unnamed land drain is included in the 'Summary of Flood Risk and Mitigation' section below. The Site is therefore considered to be at **low** risk of fluvial flooding.
Surface Water Flood Risk	The EA's Long-Term Flood Risk Map (Flood Risk from Surface Water) included as Figure 3 indicates that the vast majority of the Site is at very low risk of surface water flooding, meaning it has a less than 0.1% annual probability of flooding. An identified flow route associated with the unnamed land drain running south to north through the centre of the site has been assessed in the fluvial section above. It can therefore be concluded that the site is at a **very low** risk of surface water flooding.

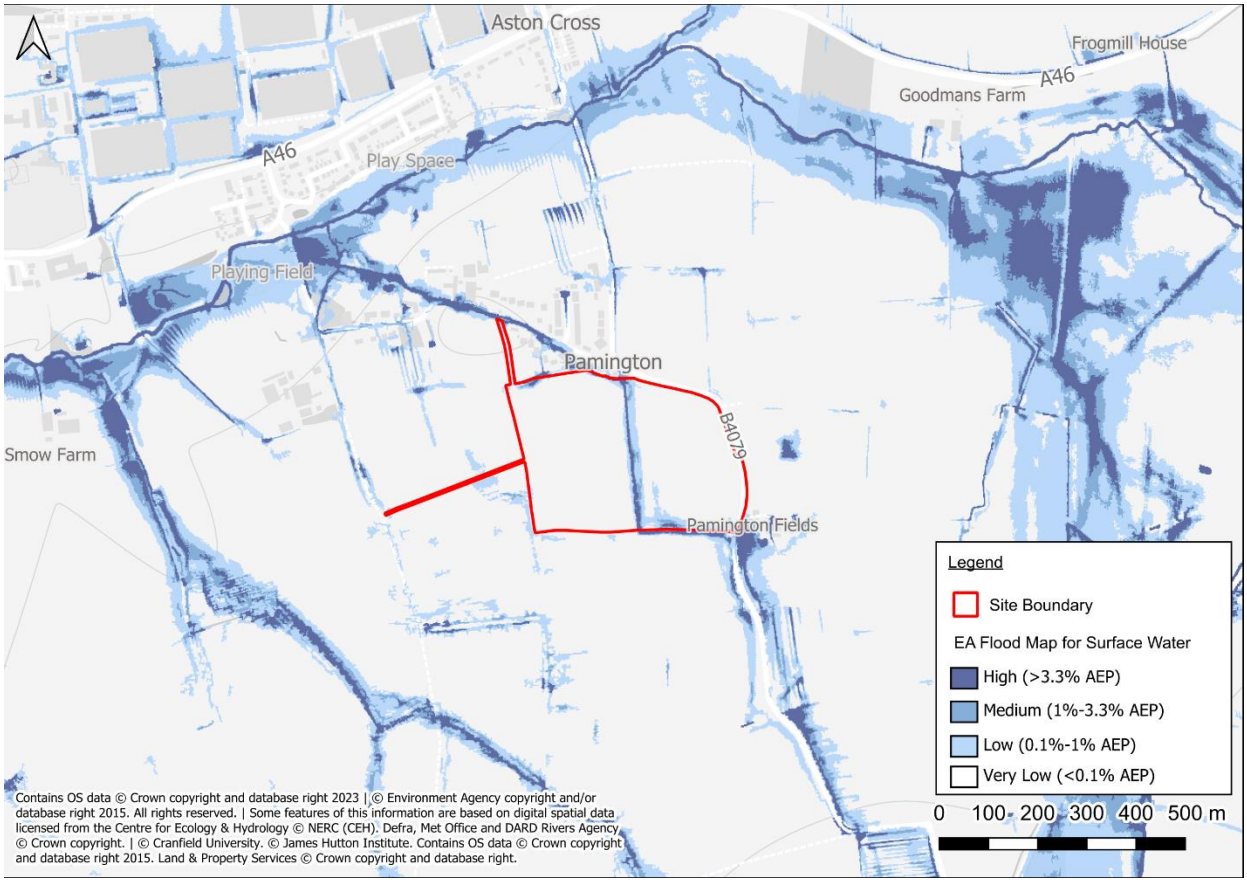


Figure 3: EA's Long-Term Flood Risk Map (Flood Risk from Surface Water)

Groundwater Flood Risk	BGS online mapping (1:50,000 scale) indicates that the site is underlain by Cheltenham Sand and Gravel superficial deposits in the eastern and western extents, the remining majority of the site is directly onto the underlying Charmouth Mudstone Formation bedrock.

		There are no records of groundwater flooding at or near to the Site recorded within the local SFRA's. Groundwater levels correspond with river levels. As such groundwater flooding could occur during periods of prolonged high-water levels in the unnamed land drain which runs through the centre of the site. The local isolated Cheltenham Sand and Gravel superficial deposits may present areas at localised elevated groundwater flood risk owing to the impermeable bedrock deposits. However, the areas of the site developed ass housing will be covered by hardstanding, limiting the vertical migration of groundwater. Furthermore, no basement levels are identified on plans. It can therefore be concluded that the risk of groundwater flooding is **low**.
Artificial Sources Flood Risk	**Sewer Flooding**	The Severn Trent public sewer records indicate that the nearest public sewer is the 150mm diameter foul sewer originating at manhole 3001, the sewer then flows north-west within the B4079 away from the site. There are no distinct flow routes in the area which would direct any potential flooding arising from the 150mm foul sewer towards the Site. Any flooding arising from this sewer will be contained within the road and flow northwards following the local topography. The 2008 Level 1 SFRA The DG5 data received from STW has been provided at four-digit postcode level, hence no street level information on flooding was available. In summary it is evident that 30 postcode areas within Tewkesbury Borough are identified as having properties at risk of flooding from artificial drainage systems and surface water runoff. The site's postcode area (GL20) had nine recorded floods from sewers as recorded in the Severn Trent water dg5 register. The risk for this area is described as medium. Medium It can therefore be concluded that the risk of sewer flooding is **very low**.
	Reservoir and Canal Flooding	There are no canals and /or reservoirs within the vicinity of the Site. The EA 'Flood Risk from Reservoirs' map shows that the Site is not at risk of flooding from reservoirs. The EA state that reservoir flooding is extremely unlikely to happen. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the EA ensure that reservoirs are inspected regularly, and essential safety work is carried out. It can therefore be concluded that there is **no risk** of flooding from reservoirs and canals.
Residual Flood Risks		A residual risk is an exceedance event, such as the 1 in 1000-year (0.1% AEP) flood event that would overtop the Tirtle Brook and potentially impact the Site. As the probability of a 1 in 1000-year flood event occurring is 0.1% in any given year, the probability is low and, therefore, no further mitigation beyond what is proposed is required.

Summary of Flood Risk and Mitigation

It can be concluded that fluvial flooding from the unnamed land drain is the main potential source of flood risk to the Site. The associated risk will be mitigated by maintaining a green corridor around the land drain and placing all residential properties in an area considered to be at a very low risk of surface water flooding, (less than 0.1% annual probability of flooding) ensuring the properties are elevated above any residual risk of fluvial, surface water and groundwater flooding. In accordance with Building Regulations, finished floor levels of the properties should be set 150mm above surrounding ground levels.

The proposed access over the unnamed land drain will need to ensure continued free flow of water post development. A culvert larger than the existing land drain will ensure this.

Source of Flooding		Assessed Level of Risk	Further Comments
Tidal Flood Risk		No Risk	N/A
Fluvial Flood Risk		Low	N/A
Surface Water Flood Risk		Very Low	N/A
Groundwater Flood Risk		Low	N/A
Artificial Sources Flood Risk	Sewer Flooding	Very Low	N/A
	Reservoir and Canal Flooding	No Risk	N/A

5.0 Water Management Statement

Introduction

The Site currently comprises undeveloped agricultural land which is not formally drained and is therefore considered to be 100% permeable.

Given the outline nature of the development the development areas have not been finalised. For the purposes of this report, it is assumed that 30% of the total site area will be hardstood, this is considered to be conservative given the large areas of POS and soft landscaping areas proposed. The proposed development will introduce 40,242m^2 of hardstanding in the form of buildings and access.

The increase in hardstanding area will result in an increase in surface water runoff rates and volumes. In order to ensure the proposed development will not increase flood risk elsewhere, surface water discharge from the Site will be controlled.

Drainage Hierarchy

The recommended surface water drainage hierarchy (Paragraph 080 of the NPPG: Flood Risk and Coastal Change) is to utilise soakaway systems or infiltration as the preferred option, followed by discharging to an appropriate watercourse. If this is not feasible, the final option is to discharge to an existing public sewer.

Surface Water Discharge to Soakaway	The first consideration for the disposal of surface water is infiltration (soakaways and permeable surfaces). As described above the Site is only partially underlain by small, isolated outcrops of Cheltenham Sand and Gravel superficial deposits. The superficial deposits are underlain by Charmouth Mudstone Formation bedrock. Where small, isolated areas of permeable deposits are underlain by low permeability bedrock there is a strong likelihood of elevated groundwater levels. Infiltration tests have been undertaken in accordance with the BRE365 specification and all tests on site failed. Therefore, soakaways are not suitable on this site.
Surface Water Discharge to Watercourse	As soakaways are not suitable a connection to a watercourse is the next consideration. The nearest watercourse is the unnamed land drain which flows through the centre of the site. The land drain forms part of the wider land drainage network which ultimately discharges to Tirtle Brook. The local levels at the area where the local land drain crosses the northern extent of the northern pedestrian access is approximately 18.35m AOD. Discharge to the unnamed land drain, at a limited discharge rate (discussed in 'Surface Water Discharge' section below), is feasible via gravity.
Surface Water Discharge to Sewer	As described above, a connection to the unnamed land drain flowing through the site is feasible and therefore a connection to the public surface water sewer is not required.

Surface Water Discharge

The existing greenfield runoff rates have been estimated using the Revitalised Flood Hydrograph Model (ReFH2) method. Given the site is bisected by the unnamed land drain the area to the east and the area to the west will need to be drained by distinct drainage systems.

The area east of the unnamed land drain measures 28,546m^2 and the area to the west measures 22,680m^2. Table 2 below provides the calculated greenfield runoff rates for a range of return periods.

Table 2: Existing Greenfield Runoff Rates (ReFH2)

Return period (years)	Existing Greenfield Discharge Rates	
	Western Area (l/s)	Eastern Area (l/s)
1 in 1	13.58	17.09
1 in 2 (QMED)	15.49	19.49
1 in 30	35.60	44.79
1 in 100	47.05	59.19
1 in 1000	75.12	94.49

A flow rate of **15.49 l/s** is proposed for the Western Area of the site and **19.49 l/s** is proposed for the Eastern Area of the site to ensure significant betterment during any storm in excess of the 1 in 2-year (QMED) storm.

Attenuation Storage

In order to achieve restrict the discharge rate from both parcels to the 1 in 2-year (QMED) greenfield runoff rate attenuation storage will be required. Storage estimates have been provided using HR Wallingford's 'Surface water storage volume estimation[8]' tool and are included in Appendix G. Table 3 below provides the attenuation requirements for the proposed parcels assuming 40% hardstanding area.

For the purposes of this report, it is assumed that 40% of the total site area will be hardstood, given the outline proposals this is considered to be conservative given the landscaping proposed. Therefore, the area east of the unnamed land drain is assumed to have 11,418m^2 of hardstanding and the area to the west is assumed to have 9,072m^2 of hardstanding.

Table 3: Estimated Attenuation Requirements for the 1 in 100 + 40% CC Event

	1 in 2 (QMED) (l/s)	Estimated Hardstanding area (m^2)	Attenuation requirement (m^3)
Western Area	15.49	9,072	569
Eastern Area	19.49	11,418	718

The attenuation volumes are provided for indicative purposes only and should be verified at the detailed design stage.

Sustainable Drainage Systems

Attenuation storage should be provided in the form of SuDS where practical. The following SuDS options have been considered:

Soakaways	As described above, the use of soakaways is not considered feasible on this site.
Swales, Detention Basins, and Ponds	Sufficient space is available on Site to utilise ponds, basins and /or swales as an above ground attenuation feature. To facilitate gravity drainage, attenuation features should be located at the lower northern extents of the Site in either the western or eastern parcels.

8 https://www.uksuds.com/tools/members/surface-water-storage-volume-estimation-members

	An open surface water attenuation feature such as ponds, basins, or swales in a residential area presents a safety risk; the hazards and appropriate mitigation should be considered at the detailed design stage.
Filter Drains/Strips	Filter drains are trenches filled with stone/gravel that create temporary subsurface storage for the filtration, attenuation, and conveyance of surface water runoff. Ideally, filter drains receive lateral inflow from adjacent impermeable surfaces pre-treated over a filter strip. Filter drains can help manage peak flows by naturally limiting rates of conveyance through the filter medium and by providing attenuation storage when the rate of flow at the outlet is controlled. Filter drains can be effectively incorporated into the landscape and public open spaces and can have minimal land-take requirements. The use of filter drains is typically restricted to flat sites (unless placed parallel to contours). Filter drains are best located adjacent to (small) impermeable surfaces such as car parks and roads. Filter Drains/Strips should be considered within the detailed drainage design.
Bioretention systems	Bioretention systems (including rain gardens) are shallow landscaped depressions that can reduce runoff rates and volumes and treat pollution. They also provide attractive landscape features and biodiversity. Bioretention systems can help reduce flow rates from a site by promoting infiltration / evapotranspiration and providing some attenuation storage. Bioretention systems can also provide very effective treatment functionality. Bioretention systems are a very flexible surface water management component that can be integrated into a wide variety of developments / densities using different shapes, materials, planting, and dimensions. Bioretention systems (including rain gardens) should be considered within the detailed drainage design.
Tree Pits	Engineered tree pits, serve as bioretention areas, they capture incoming run off from permeable surfaces, and remove it through transpiration, evaporation, and infiltration. Tree pits can be incorporated into residential and commercial areas and used in applications such as car parks, verges, landscaped areas, and paving. In the urban environment they provide all the benefits of tree planting, with addition surface water mitigation.
Porous/Permeable Surfacing	Permeable surfacing could be incorporated within private roads and driveways. Storage would be provided within the sub-grade material prior to controlled release to the receiving unnamed land drain. The amount of storage offered by permeable surfacing is subject to sub-grade depth and Site gradient. The use of permeable surfacing should be considered at the detailed design stage.
Green Roofs	Green roofs are not identified on development plans. Given the nature of the proposed development, the significant additional cost involved in installing and maintaining green roofs and the additional works required to allow for the additional loading on the building, green roofs are not considered a practical option. The benefits achieved through installing a green roof would be disproportionate to the significant ongoing maintenance and construction costs involved.
Rainwater Harvesting	The attenuation benefits provided using rainwater harvesting are limited and would only be realised when the tanks were not full. However, rainwater harvesting techniques could be incorporated within the final design.
Underground Attenuation Tanks	Storage could be provided within underground attenuation tanks or within oversized pipes. Sufficient space for underground tanks could be provided within site access, and or car parking areas.

Preferred Drainage Scheme

Soakaways are not considered to be feasible at this site, therefore, in line with the drainage hierarchy surface water runoff will be discharged to the unnamed land drain which flows through the site at a combined rate of 34.98 l/s. Surface water runoff up to the 1 in 100-year plus 40% climate change allowance event will be attenuated on Site. A total attenuation volume of 569m³ will be required to achieve the discharge rate for the western area and a total attenuation volume of 718m³ will be required to achieve the discharge rate for the eastern area and will be provided in the form of attenuation basins / ponds situated within the soft landscaping areas towards the northern extent of the site. At the detailed design stage, the additional SuDS components including, filter strips / drains, swales, porous surfacing, and tree pits should be considered to contribute to the four pillars of SuDS.

The proposed surface water drainage scheme will ensure no increase in runoff over the lifetime of the development and will create betterment during any storm in excess of the 1 in 2-year event.

Event Exceedance

Storage will be provided for the 1 in 100-year plus 40% CC event. Storm events in excess of the 1 in 100-year plus 40% CC event should be permitted to produce temporary shallow depth flooding within the car park / access road / landscaped areas. Finished floor levels will be set at a minimum of …mm above surrounding ground levels ensuring exceedance flooding will not affect the buildings.

Surface Water Treatment

The Site sits within an SSSI Impact Risk Zone for the Severn Ham Tewkesbury SSSI (3.2 km to the West) and Old River Severn, Upper Lode SSSI (some 4km to the west). In accordance with the CIRIA C753 publication 'The SuDS Manual' (2015), residential roofs have a 'very low' pollution hazard level, with low traffic roads classified as having a 'low' pollution hazard level. Table 3 below shows the pollution hazard indices for each land use.

Table 3: Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2*	0.2	0.05
Low Traffic Roads	Low	0.5	0.4	0.4

Table extract taken from the CIRIA C753 publication 'The SuDS Manual' – Table 26.2

* Indices values range from 0-1.

Where practical, runoff from roofs and roads will be directed to attenuation ponds and where possible through multiple SuDS components to provide multiple treatment trains. Table 4 below demonstrates that all SuDS components provide sufficient treatment based on the proposed site uses.

Table 4: SuDS Mitigation Indices

	Mitigation Indices		
Type of SuDS	**Total Suspended Solids (TSS)**	**Metals**	**Hydrocarbons**
Permeable Pavement	0.7	0.6	0.7
Swale	0.5	0.6	0.6
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5

Table extract taken from the CIRIA C753 publication 'The SuDS Manual' – Table 26.3

It can be concluded that the inclusion of detention basins, ponds, swales and/or permeable surfacing will provide sufficient treatment individually and further treatment will be provided when there are multiple treatment trains included, compounding the treatment. Where attenuation is provided in a below ground system (tank storage), treatment will need to be provided by a suitably sized separator.

Maintenance

Maintenance of communal drainage features such as permeable surfacing, ponds or an attenuation tank will be the responsibility of the Site owner. Maintenance of shared surface water drainage systems can be arranged through appointment of a Site management company.

Foul Water Discharge

Foul flows should be discharged to the 150mm public foul sewer in the B4079 to the north-east of the site. Manhole 3001 is recorded as having a cover level of 22.36m AOD, an invert level of 20.07m AOD and a depth to invert of 2.29m. Therefore, given the minimum site level is approximately 21m AOD a gravity connection can be achieved.

Any new connection will need to be agreed with Severn Trent.

Other Considerations

Maintenance access to the unnamed land drain should be retained. Maintenance access can be ensured by providing an 8 m buffer either side of the unnamed land drain.

Any proposed works within 8m of the unnamed land drain including the proposed access over the watercourse is likely to require land drainage consent from Gloucestershire County Council under amendments to the Land Drainage Act 1991. Under delegated powers contained in Section 13(4) of the Flood and Water Management Act 2010 consenting of works on ordinary water courses has been delegated to the District and Borough Councils.

6.0 Conclusions and Recommendations

Conclusions

The Site is located within Flood Zone 1 on the Environment Agency (EA) 'Flood Map for Planning (Rivers and Sea)' – an area considered to have the lowest probability of fluvial and tidal flooding. The Site is shown to be located outside and approximately 2.5m above the extreme 0.1% annual probability flood extent.

The proposed development will introduce impermeable drainage area in the form of buildings and access. This will result in an increase in surface water runoff. In order to ensure the increase in surface water runoff will not increase flood risk elsewhere, flow control will be used, and attenuation provided on Site to accommodate storm events up to and including the 1 in 100-year plus 40% climate change event.

All methods of surface water discharge have been assessed. As soakaways are not possible, discharge of surface water to the unnamed land drain at the existing 1 in 2-year (QMED) rate appears to be the most practical option. This will need to be agreed with the LLFA.

Attenuation storage will be required on Site in order to restrict surface water discharge. Attenuation can be provided within attenuation basins / ponds situated within the soft landscaping areas towards the northern extent of the site. At the detailed design stage, the additional SuDS components including, filter strips / drains, swales, porous surfacing, and tree pits should be considered to contribute to the attenuation requirements for the site as well as providing amenity and biodiversity benefits for the site.

Foul flows should be discharged to the 150mm public foul sewer in the B4079 to the north-east of the site. A gravity connection can be achieved.

Recommendations

Flood Risk

- Ensure all residential properties are located outside of the high-risk surface water flood extents.
- Set finished floor levels150mm above surrounding ground level.

Water Management Statement

- Verify the attenuation volumes included in this report when undertaking detailed drainage design; and
- Make provision for sustainable drainage features in the lower northern extents of the Site.

Other

- Maintenance access to the unnamed land drain should be retained. Maintenance access can be ensured by providing an 8 m buffer either side of the unnamed land drain; and
- Land drainage consent will be required for any works within close proximity to the land drain.

7.0 Reference of Terms

Tidal Flooding

Tidal flooding is caused by high tides coinciding with a low-pressure storm system which raises sea and tidal water levels, overwhelming coastal and river defences. This may be made worse by gale-force winds blowing the raised body of water up tidal river basins some distance from the coast, due to floodwater being forced up the tidal reaches of rivers and estuaries. Such flooding may become more frequent in future years due to rising sea levels.

Fluvial Flooding

Fluvial flooding typically occurs when a river's capacity is exceeded, and the excess water overtops the riverbanks. It can also occur when the watercourse has a high level downstream, perhaps due to structures or blockage, thus limiting conveyance. This creates a backup of water which can overtop the banks. Typical flooding issues occur when the natural floodplain has been urbanised and the river has been confined.

Flood Zones

The flood risk from fluvial (Main Rivers) and tidal flooding is assessed through the use of the EA Flood Maps (flood risk from rivers or the sea). This map defines three zones of different flood risk, the third of which is subdivided into two categories:

- Zone 1 "Low probability of flooding" – This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%);
- Zone 2 "Medium probability of flooding" – This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year;
- Zone 3a "High probability of flooding" – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year; and
- Zone 3b "Functional floodplain" – A sub-part of Zone 3, this zone comprises land where water has to flow or be stored in times of flood. This zone is not normally included within the national Flood Map for Planning and is calculated where necessary using detailed hydraulic modelling.

Surface Water (Pluvial) Flooding

Pluvial flooding, also known as surface water flooding, occurs when the volume of precipitation exceeds the capacity of drainage systems, including drains and surface water sewers. This results in an inability to drain away through these systems or infiltrate into the land, causing overland flow. The intensity of pluvial flooding can be exacerbated by factors such as blocked road gullies, drains and sewers, saturated and waterlogged land, and an increase in impervious surfaces.

Surface Water Runoff

Surface water runoff is defined as water flowing over the ground that has not yet entered a drainage channel or similar. It usually occurs because of an intense period of rainfall which exceeds the infiltration capacity of the ground. Typically, runoff occurs on sloping land or where the ground surface is relatively impermeable. The ground can be impermeable either naturally due to the soil type or geology, or due to development which places impervious material over the ground surface (e.g. paving and roads).

Sewer Flooding

Flooding from sewers primarily occurs when flow entering a system exceeds available capacity or if the network capacity has been reduced through blockage or collapse. In the case of surface water sewers that discharge to watercourses, the same effect can be caused as a result of high-water levels in the receiving watercourse. As a result, water can begin to surcharge the sewer network, emerging at ground level through gullies and manholes and potentially causing flooding to highways and properties. If this occurs flooding can represent a significant hazard to human health due to the potential for contaminants in flood water.

Groundwater Flooding

Groundwater flooding is caused by the emergence of water from beneath the ground at either point or diffuse locations when the natural level of the water table rises above ground level. This can result in deep and long-lasting flooding of low-lying or below-ground infrastructure such as underpasses and basements. Groundwater flooding can cause significant damage to property, especially in urban areas, and can pose further risks to the environment and ground stability.

Canal Failure

Canal failure can occur due to high-intensity rainfall or structural failure and can be dangerous due to the rapid release of large volumes of water. It is typically limited to raised canal reaches and can result in a rapid peak in flow followed by a gradual reduction.

Reservoirs Failure

Reservoir failure can be a particularly dangerous form of flooding as it results in the sudden release of large volumes of water that can travel at high velocity, causing deep and widespread flooding. The likelihood of this occurring is low as large reservoirs are managed in accordance with the Reservoirs Act 1975. The EA's online reservoir inundation map illustrates the maximum flood extents that could occur in the event of a reservoir failure.

Aquifers

Principal Aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

- Secondary A Aquifers are 'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers'.
- Secondary B Aquifers are 'predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons, and weathering. These are generally the water-bearing parts of the former non-aquifers'.
- Secondary Undifferentiated Aquifers are assigned in 'cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type'.
- Unproductive Strata are 'rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow'.

Source Protection Zones

Source Protection Zones (SPZs) are areas of land through which water infiltrates into a groundwater borehole, well or spring that is used for public drinking water supply. These zones show the risk of contamination from potential pollution. SPZ's have been created as public facing boundaries where discrete groundwater bodies within SPZ's have been dissolved on zone number where common boundaries and overlaps have been removed. SPZs are defined around large and public potable groundwater abstraction sites. The purpose of SPZs is to provide additional protection to safeguard drinking water quality through constraining the proximity of an activity that may impact upon a drinking water abstraction.

- Zone 1 (Inner Protection Zone) is defined by a travel time of 50-days or less from any point within the zone at, or below, the water table. Additionally, the zone has as a minimum a 50-metre radius.
- Zone 2: (Outer Protection Zone) - This zone is defined by the 400-day travel time from a point below the water table. Additionally, this zone has a minimum radius of 250 or 500 metres, depending on the size of the abstraction.
- Zone 3: (Total catchment) - This zone is defined as the total area needed to support the abstraction or discharge from the protected groundwater source. A further Zone 4, or 'Zone of Special Interest' was previously defined for some groundwater sources.

Appendix A – Limitations

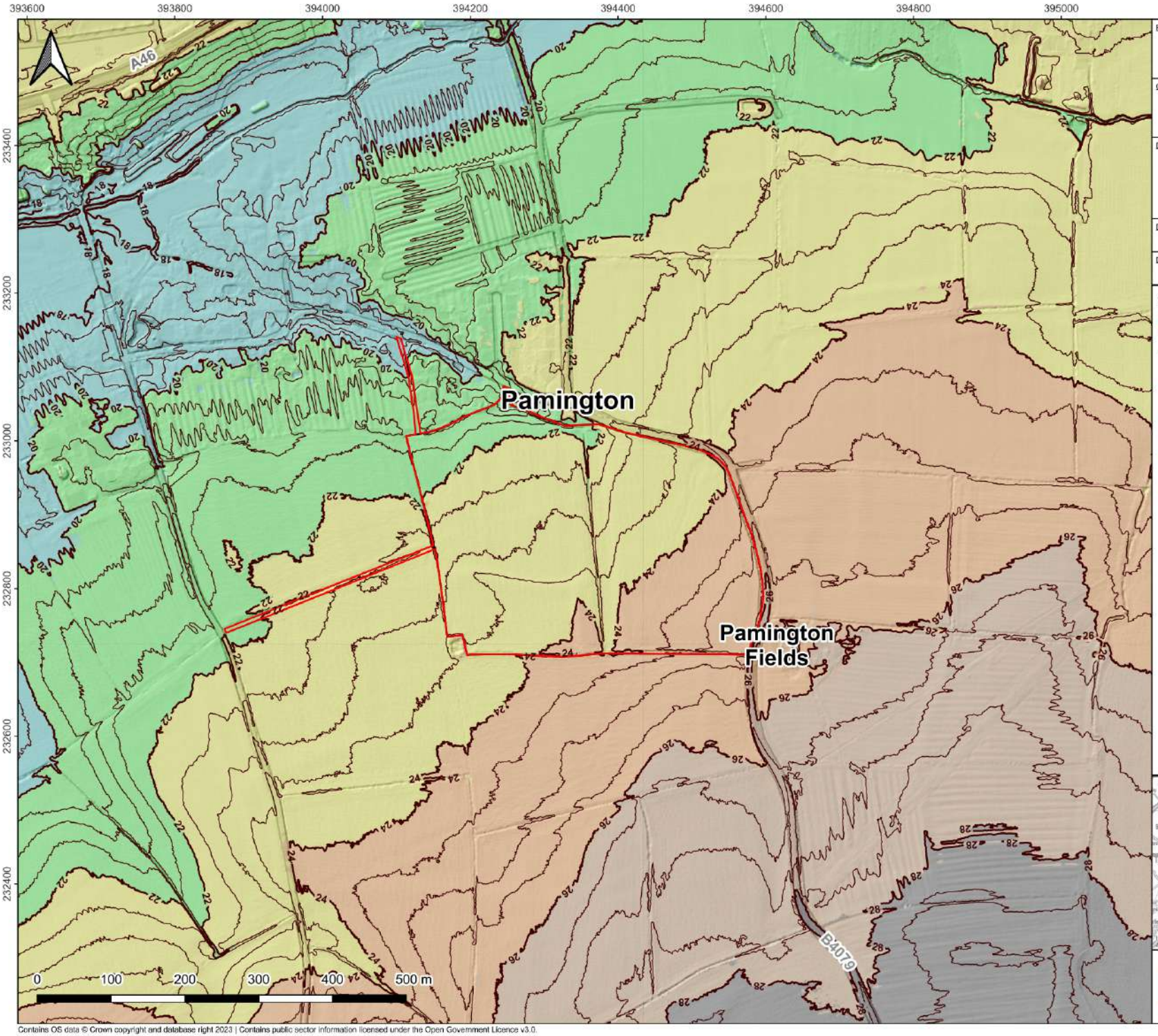
Limitations

The recommendations contained in this Report represent Mabbett professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant. Mabbett does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

Mabbett obtained, reviewed, and evaluated information in preparing this Report from the Client and others. Mabbett conclusions, opinions and recommendations has been determined using this information. Mabbett does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which Mabbett has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by Mabbett for the sole and exclusive use of the Client and for the specific purpose for which Mabbett was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Mabbett, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, Mabbett does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Mabbett from and against all claims, losses, and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by the Consultant.

APPENDIX B – TOPOGRAPHICAL INFORMATION



Project Reference:

313619 Land adjacent to Pamington, Ashchurch

Client:

GREYSTOKE LAND

Drawing Title:

Site Elevations
EA LiDAR DTM
1m Resolution - Dated 2022

Drawing Name:	Revision:	Date:
313619-ENG-DAT-03	-	28 Jul 2023

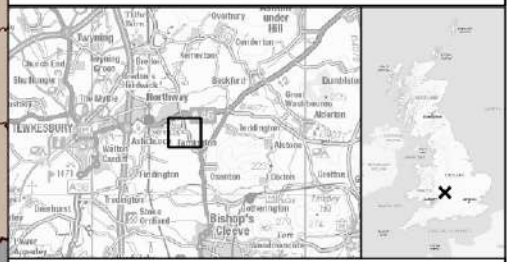
Drawing Scale (A3):	Drawing Status:	Drawn:	Checked:	Approved:
1:5000	Final	DH	JR	JR

Legend

- Site Boundary
- Contours (2m major, 0.5m minor)

Elevation (m AOD)

- <= 20
- 20 - 22
- 22 - 24
- 24 - 26
- 26 - 28
- > 28



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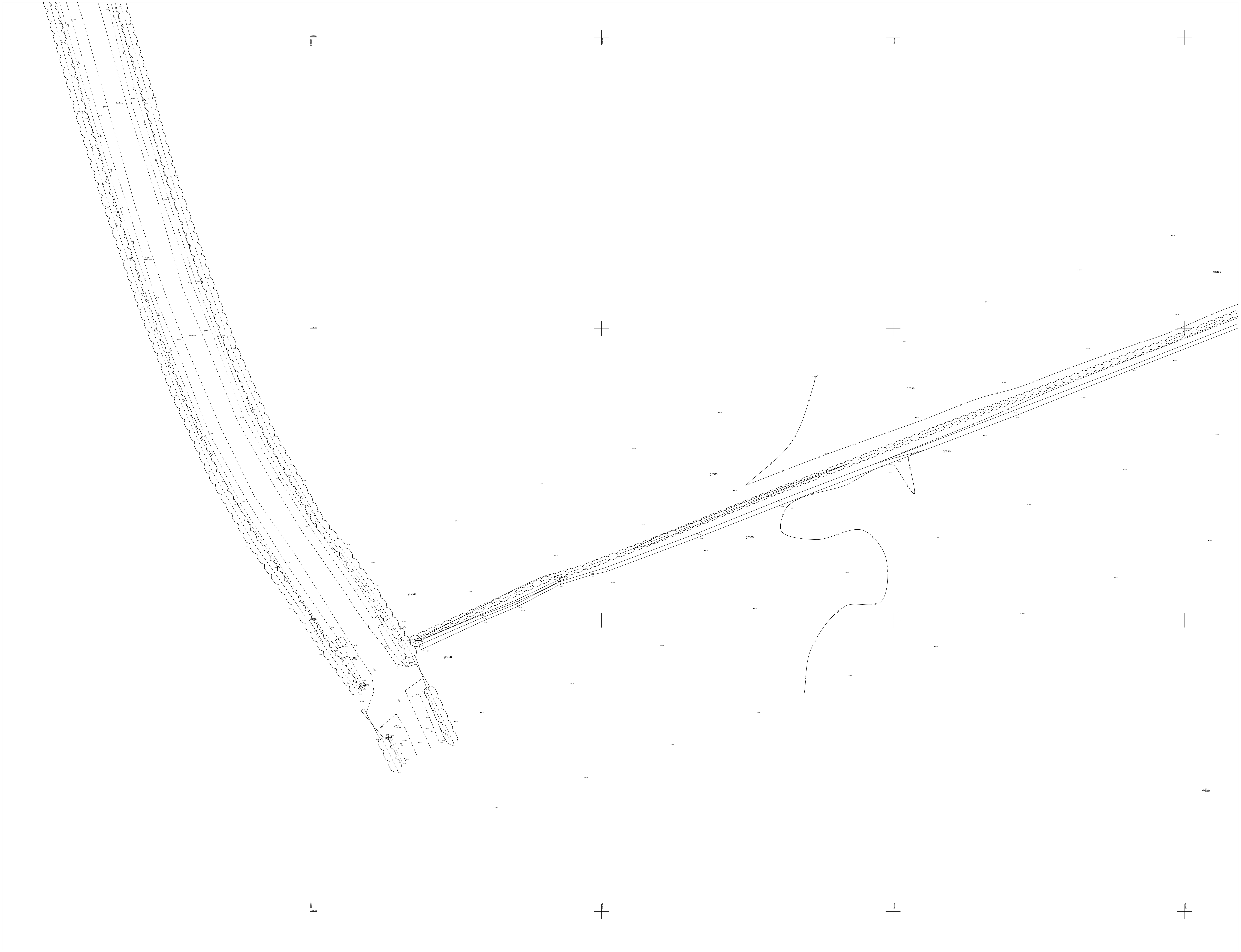

Symbol & Abbreviation Key.

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- CLOSE BOARD FENCE
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General.

This survey has been prepared with a scaling accuracy for a plot at a scale of 1:200.

All tree heights and spreads are approximate. We have tried to identify tree types, however if tree species are critical specialist advice should be gained.

Drainage pipe sizes have been measured from the surface. Chamber access has not been gained for safety reasons, therefore sizes should be regarded as approximate.

Some detail may have been omitted due to parked vehicles.

Notes.

Coordinates related to drawing reference 210275
Levels related to GPS.

N

Rev	Details of Revision	Drawn	Date

Surveyed	Drawn	Date	Checked	Date	Approved	Date
KN	KN	14/08/2023	GD	15/08/23	GD	15/08/23

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TOPOGRAPHICAL SURVEY

PAMINGTON COURT FARM,
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GL20 8LY

Dwg No. **230543** Sheet **1 OF 12**

Scale 1:200 A0 Sheet Rev. -

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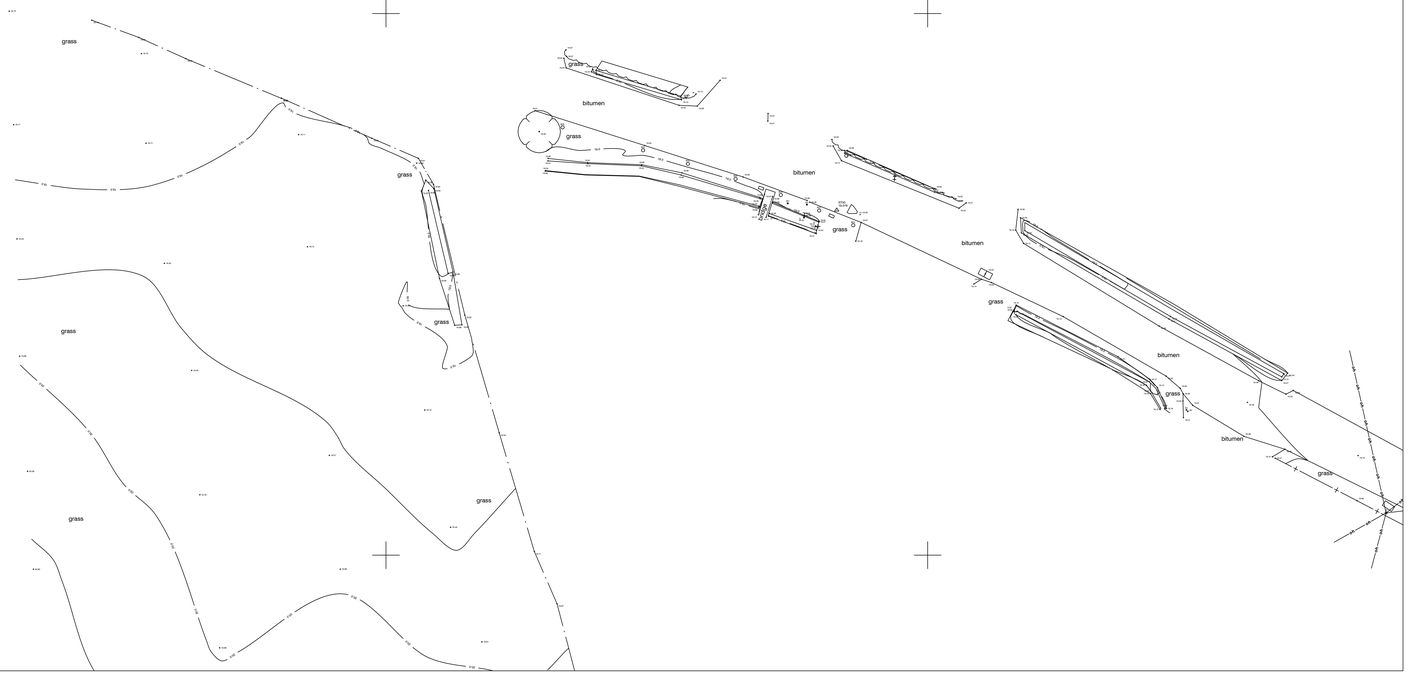

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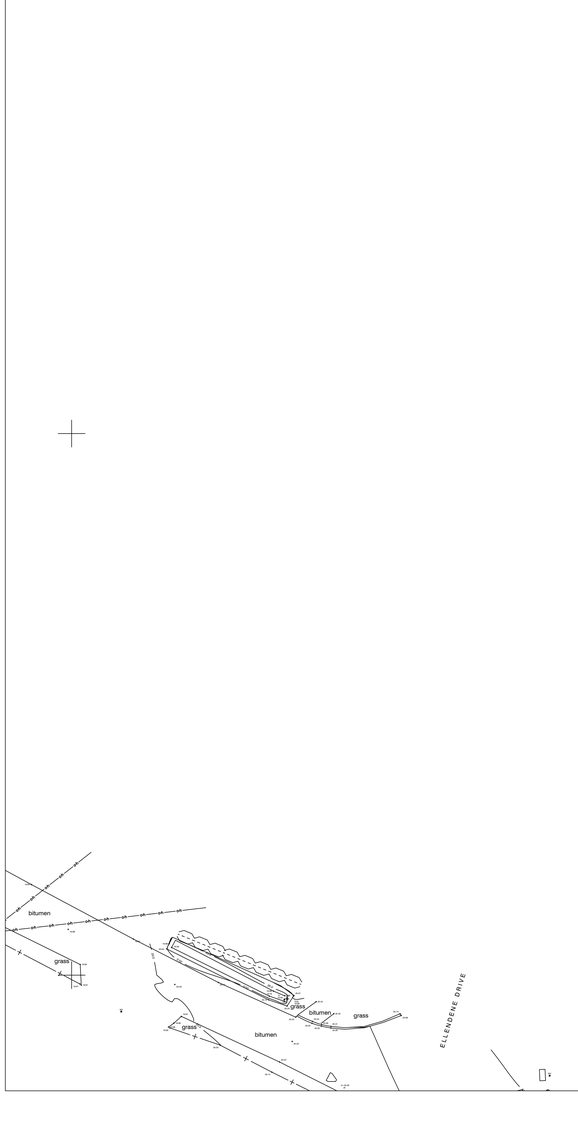
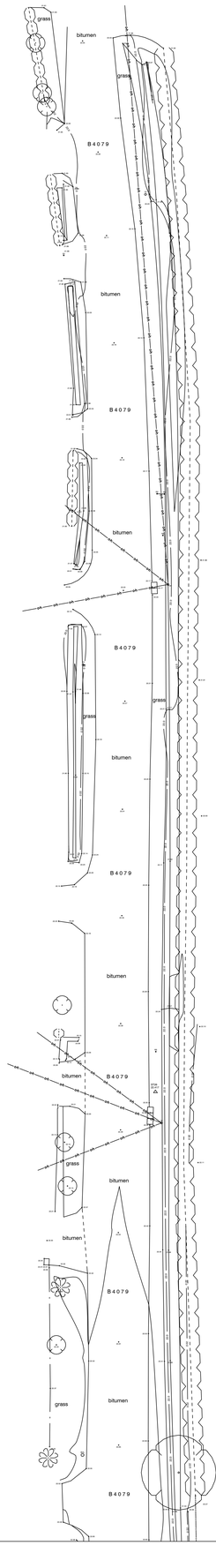
Dwg No. **230543** Sheet **2 OF 12**

Scale 1:200 A0 Sheet Rev. -





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CTV	CABLE TV	RS	ROAD SIGN
CL	COVER LEVEL	SP	SIGN POST
CR	CABLE RISER	SV	STOP VALVE
DP	DOWN PIPE	TL	TRAFFIC LIGHT
ER	EARTH ROD	TP	TELEGRAPH POLE
EP	ELECTRICITY POLE	TOF	TOP OF FENCE
EM	ELECTRICITY MARKER	TOH	TOP OF HEDGE
FB	FUSE BOX	TOR	TOP OF RAILINGS
FH	FIRE HYDRANT	TOS	SERVICE LEVEL
FP	FENCE POST	TOW	TOP OF WALL
FL	FLOOR LEVEL	UTL	UNABLE TO LIFT
GV	GAS VALVE	VM	VALVE MARKER
GM	GAS MARKER	VP	VENT PIPE
GU	GULLY	WL	WATER LEVEL
HM	HYDRANT MARKER	WM	WATER MARKER
IL	INVERT LEVEL	WO	WASH OUT

General.

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Levels related to GPS.

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Client.

GREYSTOKE LAND
75D BANBURY ROAD,
OXFORD,
OX2 6PE

Title.

TOPOGRAPHICAL SURVEY

PAMINGTON COURT FARM,
ASHCHURCH,
TEWKESBURY,
GL20 8LY

Dwg No. **230543** Sheet **4 OF 12**

Scale 1:200 A0 Sheet Rev. -

Symbol & Abbreviation Key.

- BARBED WIRE FENCE
- POST & RAIL FENCE
- CLOSE BOARD FENCE
- RAILINGS
- CHAIN LINK FENCE
- OTHER FENCE
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- DROPPED KERB
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- BUSH
- BUILDING
- BOREHOLE
- SURVEY STATION
- ORDNANCE SURVEY BENCH MARK

A/C	AIR CONDITIONING UNIT	KO	KERB OFFLET
AV	AIR VALVE	LC	LIGHTING COLUMN
BOL	BOLLARD	LP	LAMP POST
BH	BOREHOLE	NP	NAME PLATE
BL	BED LEVEL	NB	NOTICE BOARD
BM	BENCH MARK	PR	PIPE RISER
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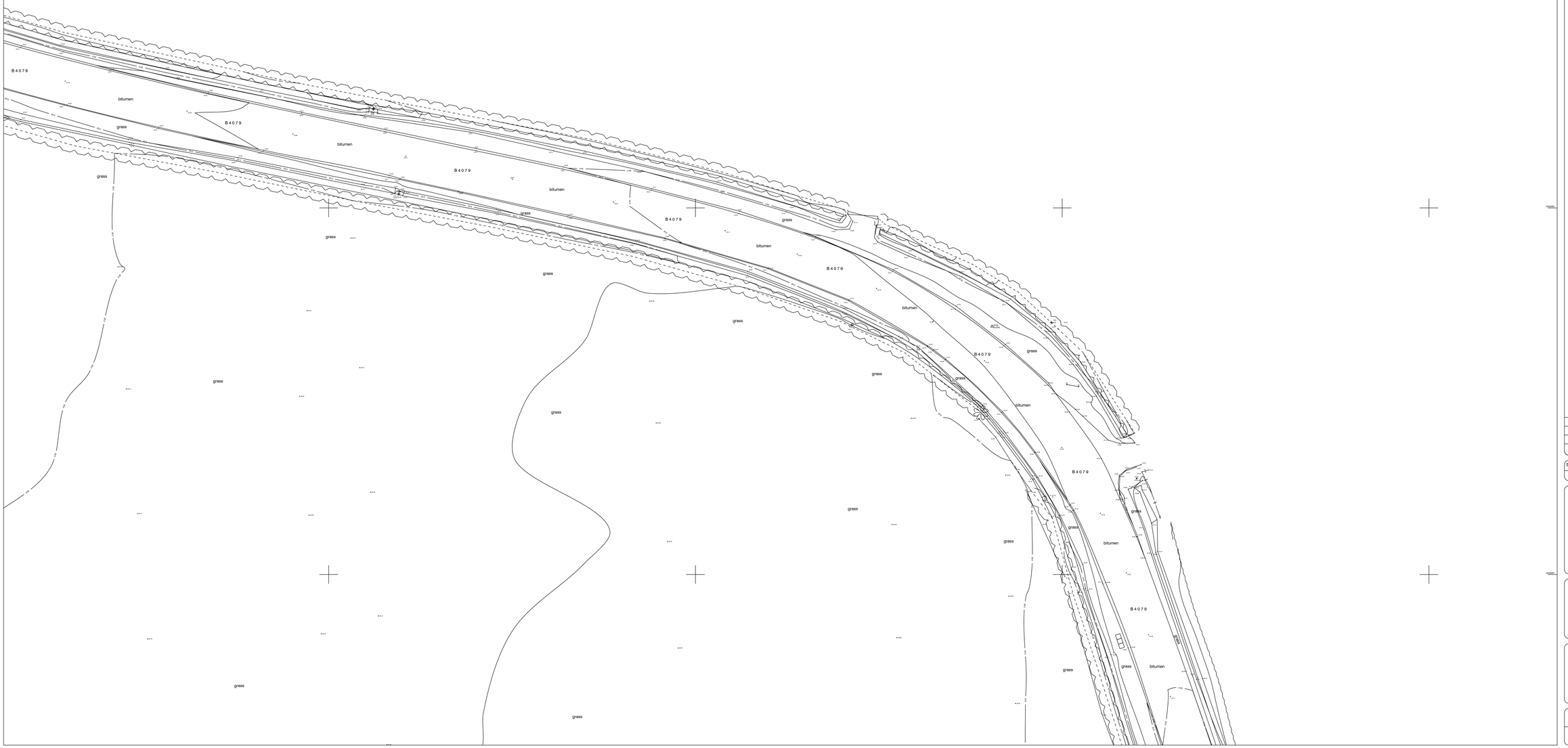
TOPOGRAPHICAL SURVEY

PAMINGTON COURT FARM,
ASHCHURCH,
TEWKESBURY,
GL20 8LY

Dwg No. **230543** Sheet **5 OF 12**

Scale 1:200 A0 Sheet Rev. -



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TOPOGRAPHICAL SURVEY

PAMINGTON COURT FARM,
ASHCHURCH,
TEWKESBURY,
GL20 8LY

Dwg No. **230543** Sheet **6 OF 12**

Scale 1:200 A0 Sheet Rev. -

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TOPOGRAPHICAL SURVEY

PAMINGTON COURT FARM,
ASHCHURCH,
TEWKESBURY,
GL20 8LY

Dwg No. **230543** Sheet **7 OF 12**

Scale 1:200 A0 Sheet Rev. -

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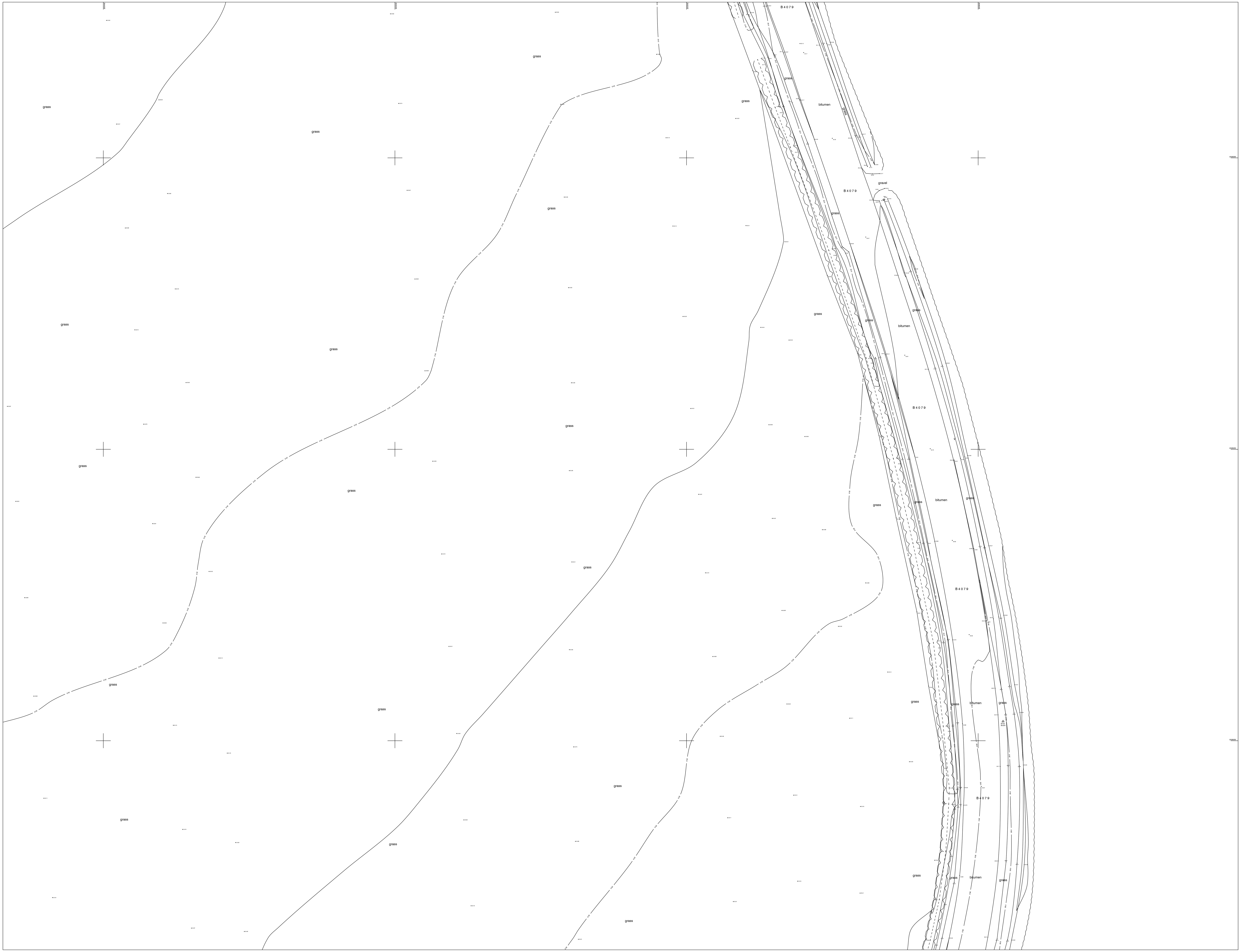
TOPOGRAPHICAL SURVEY

PAMINGTON COURT FARM,
ASHCHURCH,
TEWKESBURY,
GL20 8LY

Dwg No. **230543** Sheet **8 OF 12**

Scale 1:200 A0 Sheet Rev. -



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TOPOGRAPHICAL SURVEY

PAMINGTON COURT FARM,
ASHCHURCH,
TEWKESBURY,
GL20 8LY

Dwg No. **230543** Sheet **9 OF 12**

Scale 1:200 A0 Sheet Rev. -

Symbol & Abbreviation Key.

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TOPOGRAPHICAL SURVEY

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Dwg No. **230543** Sheet **10 OF 12**

Scale 1:200 A0 Sheet Rev. -

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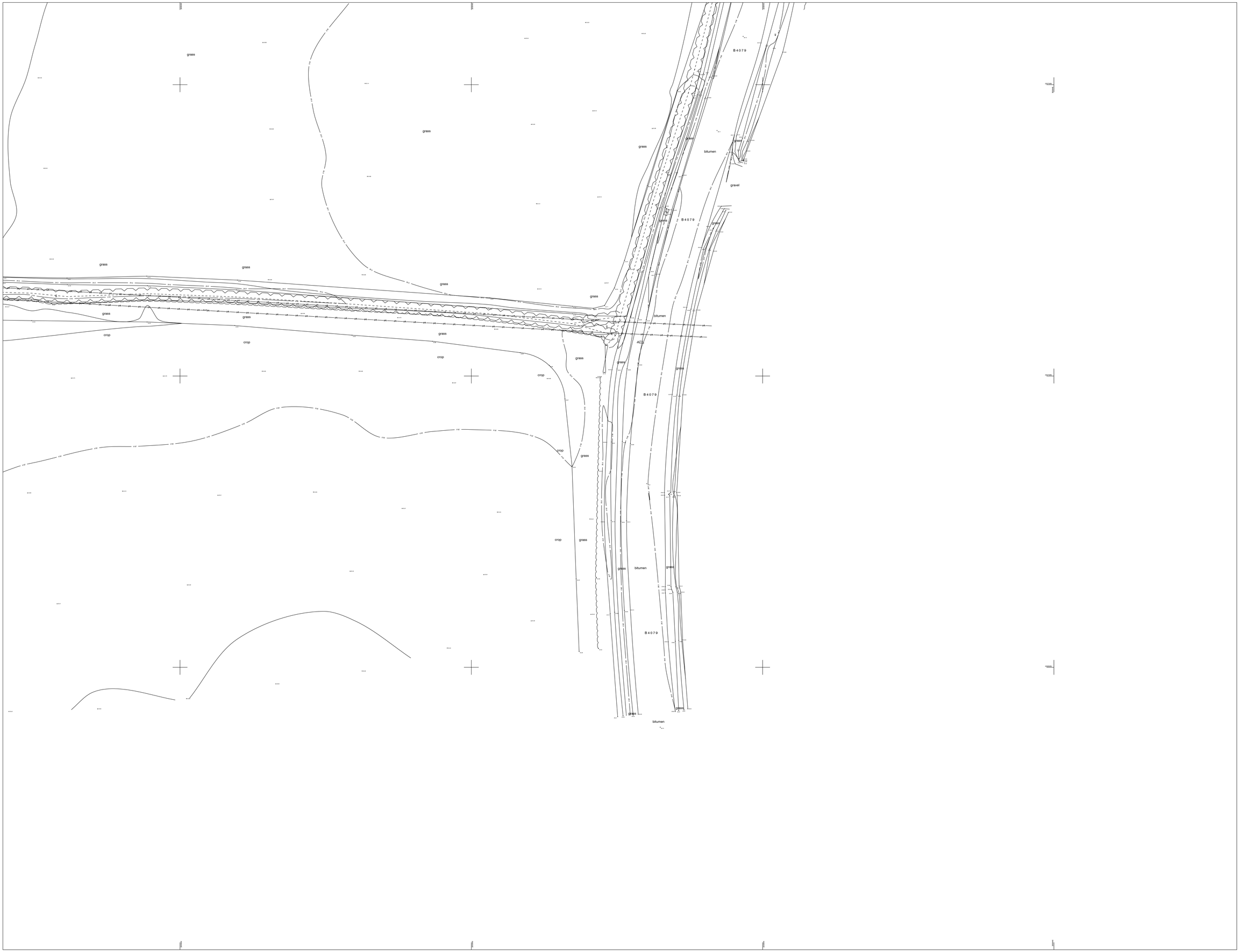
Dwg No. **230543** Sheet **11 OF 12**

Scale 1:200 A0 Sheet Rev. -



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Some detail may have been omitted due to parked vehicles.

Notes.

Coordinates related to drawing reference 210275
Levels related to GPS.

Rev	Details of Revision	Drawn	Date

Surveyed	Drawn	Date	Checked	Date	Approved	Date
KN	KN	14/08/2023	GD	15/08/23	GD	15/08/23

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Client.

GREYSTOKE LAND
75D BANBURY ROAD,
OXFORD,
OX2 6PE

Title.

TOPOGRAPHICAL SURVEY

PAMINGTON COURT FARM,
ASHCHURCH,
TEWKESBURY,
GL20 8LY

Dwg No. **230543** Sheet **12 OF 12**

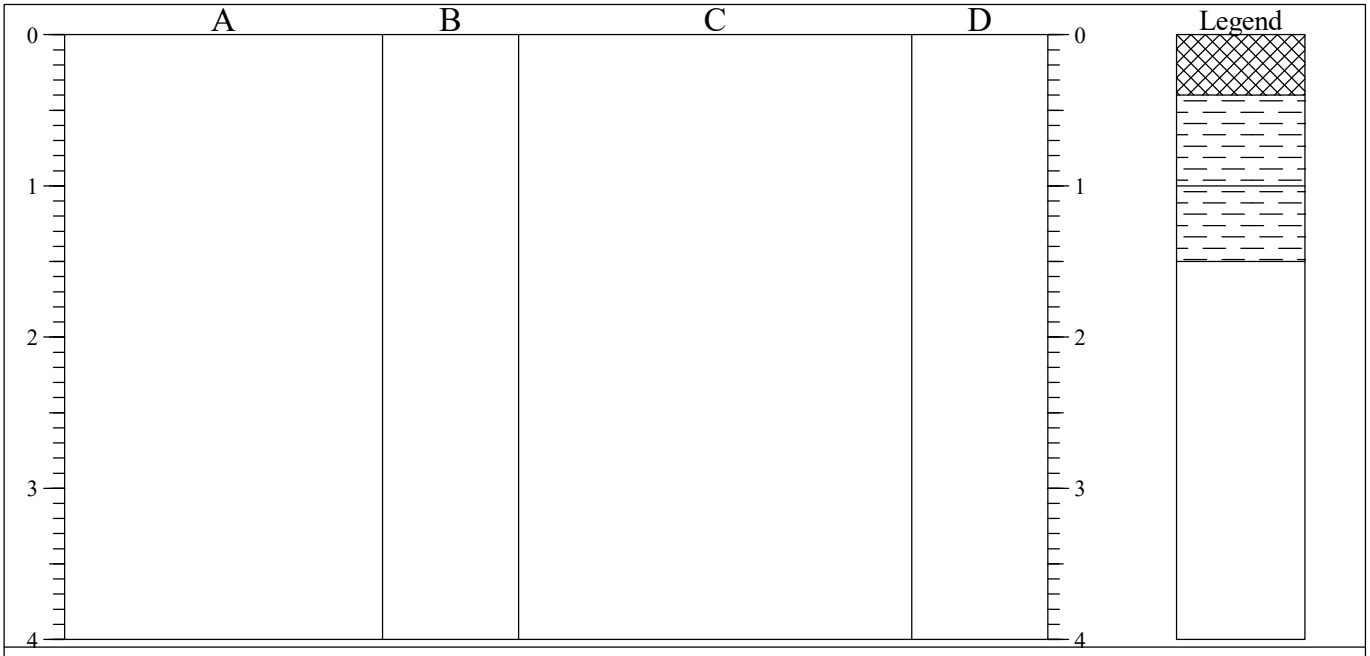
Scale 1:200 A0 Sheet Rev. -

APPENDIX C – SOAKAWAY TESTING RESULTS

Wessex and West Ground Investigation

TRIAL PIT LOG

Project				TRIAL PIT No
Pamington				**TP101**
Job No: E1002	Start Date: 24-10-23 End Date: 24-10-23	Ground Level (m)	Co-Ordinates ()	
Contractor: WWGI				Sheet: 1 of 1

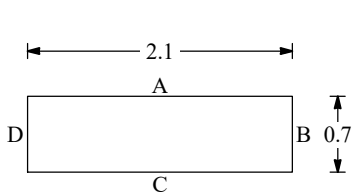


STRATA

SAMPLES & TESTS

Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.40		MADE GROUND: Soft to firm brown slightly sandy CLAY with frequent rootlets. [REWORKED NATURAL DEPOSITS]			
0.40-1.00		Firm to stiff grey slightly sandy CLAY with occasional pockets of light brown sandy clay. [WEATHERED CHARMOUTH MUDSTONE FORMATION]			
1.00-1.50		Stiff grey friable slightly gravelly CLAY. Gravel is angular and subangular fine and medium of mudstone. [CHARMOUTH MUDSTONE FORMATION]			

Shoring/Support: None
Stability: Stable



GENERAL REMARKS

Groundwater not encountered. Soakaway infiltration test carried out.

All dimensions in metres Scale 1:50	Client: Mabbett	Plant: Wheeled backhoe excavator	Logged By: CP

Trial Pit Soakaway Test

Based on BRE DG 365:2016

Project	Pamington	Status	LOCATION ID
Project ID	E1002	CHECKED	TP101

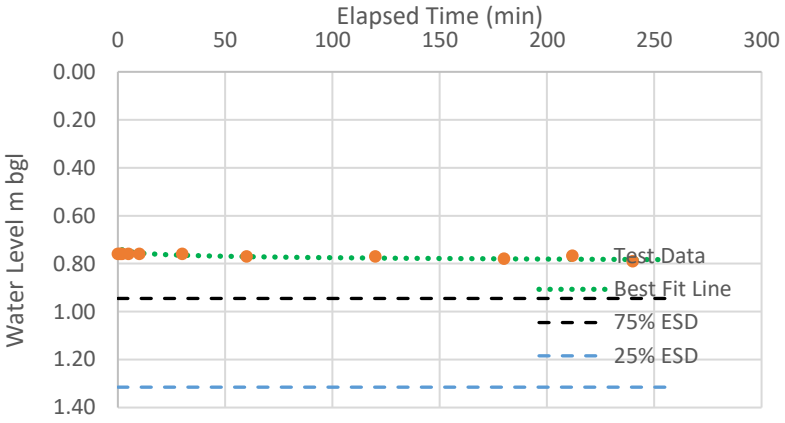
Trial Pit Details

	Test 1	Test 2	Test 3				
Depth	1.50			Ground Level	mAOD	Date Excavated	24/10/2023
Width	0.70			Coordinates	mE	Date Tested	24/10/2023
Length	2.10				mN		

Test 1

Time min	Depth to Water m bgl
0	0.76
1	0.76
2	0.76
5	0.76
10	0.76
30	0.76
60	0.77
120	0.77
180	0.78
240	0.79

Test Parameters	
75% esd (mbgl)	0.95
50% esd (mbgl)	1.13
25% esd (mbgl)	1.32
A_{s50} (m^2)	3.54
V_{p75-25} (m^3)	0.54
t_{75} (min)	5.0E+09
t_{25}(min)	3.3E+22
Data Fit R^2	0.664



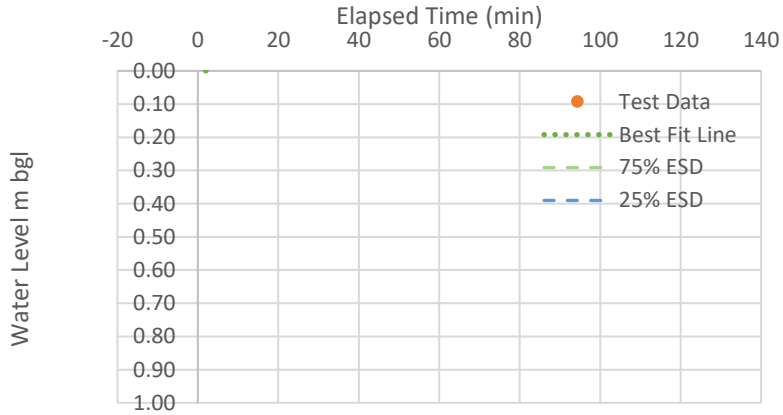
Infiltration rate f (ms^{-1}) **NOT PERMEABLE**

Total effective storage depth (esd) (m) 0.74

Test 2

Time min	Depth to Water m bgl
0	
1	
2	
4	
8	
15	
30	
45	
60	
120	

Test Parameters	
75% esd (mbgl)	
50% esd (mbgl)	
25% esd (mbgl)	
A_{s50} (m^2)	
V_{p75-25} (m^3)	
t_{75} (min)	
t_{25}(min)	
Data Fit R^2	



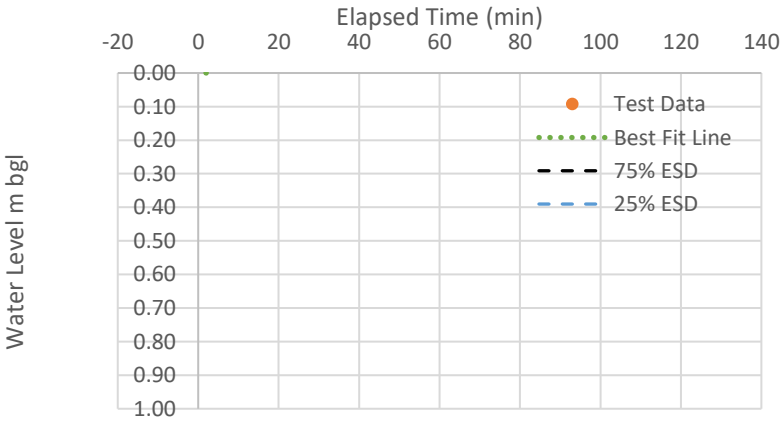
Infiltration rate f (ms^{-1}) **NO VALID DATA**

Total effective storage depth (esd) (m)

Test 3

Time min	Depth to Water m bgl
0	
1	
2	
4	
8	
15	
30	
45	
60	
120	

Test Parameters	
75% esd (mbgl)	
50% esd (mbgl)	
25% esd (mbgl)	
A_{s50} (m^2)	
V_{p75-25} (m^3)	
t_{75} (min)	
t_{25}(min)	
Data Fit R^2	



Infiltration rate f (ms^{-1}) **NO VALID DATA**

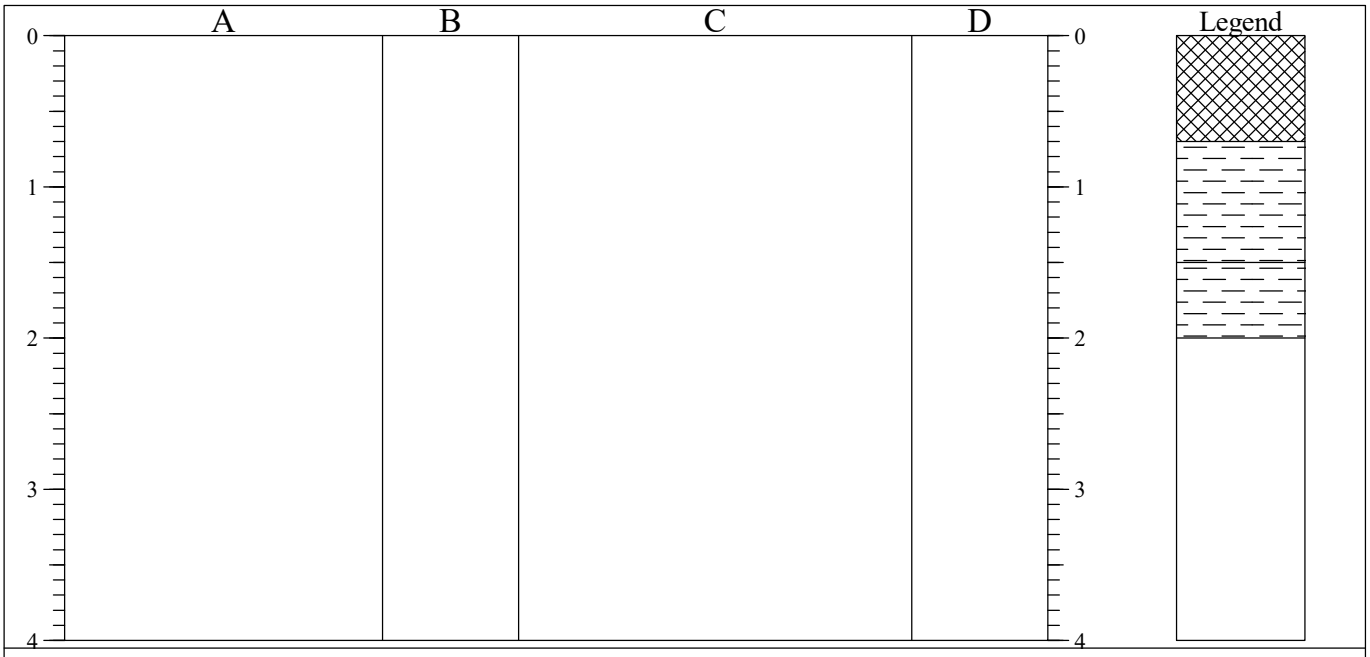
Total effective storage depth (esd) (m) 0.00

Carried out by	Notes:	Logged	Checked
Wessex and West	Insufficient fall to calculate. Tests 2 and 3 abandoned.	CP	IP

Wessex and West Ground Investigation

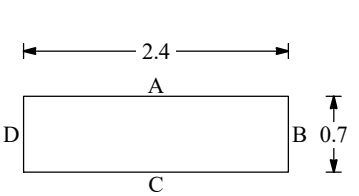
TRIAL PIT LOG

Project				TRIAL PIT No
Pamington				**TP102**
Job No: E1002	Start Date: 24-10-23 End Date: 24-10-23	Ground Level (m)	Co-Ordinates ()	
Contractor: WWGI				Sheet: 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.70		MADE GROUND: Soft to firm brown slightly sandy CLAY with frequent rootlets. [REWORKED NATURAL DEPOSITS]			
0.70-1.50		Firm to stiff grey slightly sandy CLAY with occasional pockets of light brown sandy clay. [WEATHERED CHARMOUTH MUDSTONE FORMATION]			
1.50-2.00		Stiff grey friable slightly gravelly CLAY with relict rock fabric. Gravel is angular and subangular fine and medium of mudstone. [CHARMOUTH MUDSTONE FORMATION]			

Shoring/Support: None
Stability: Stable



GENERAL REMARKS

Groundwater not encountered. Soakaway infiltration test carried out.

All dimensions in metres Scale 1:50	Client: Mabbett	Plant: Wheeled backhoe excavator	Logged By: CP

Trial Pit Soakaway Test

Based on BRE DG 365:2016

Project	Pamington	Status	LOCATION ID
Project ID	E1002	CHECKED	TP102

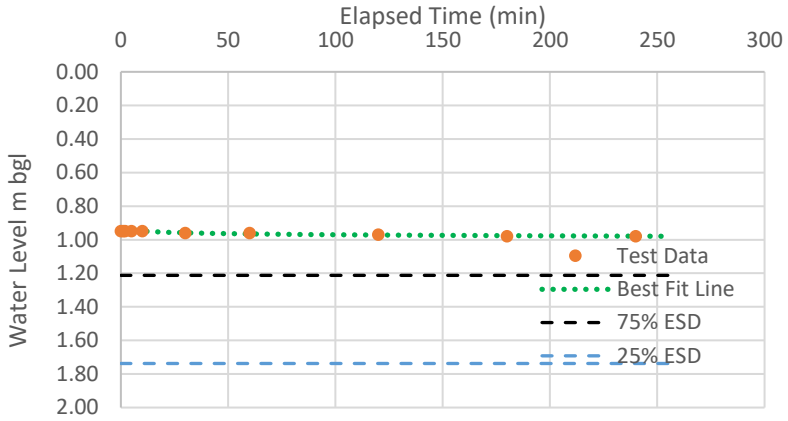
Trial Pit Details

	Test 1	Test 2	Test 3				
Depth	2.00			Ground Level	mAOD	Date Excavated	24/10/2023
Width	0.70			Coordinates	mE	Date Tested	24/10/2023
Length	2.40				mN		

Test 1

Time min	Depth to Water m bgl
0	0.95
1	0.95
2	0.95
5	0.95
10	0.95
30	0.96
60	0.96
120	0.97
180	0.98
240	0.98

Test Parameters	
75% esd (mbgl)	1.21
50% esd (mbgl)	1.48
25% esd (mbgl)	1.74
A_{s50} (m^2)	4.94
V_{p75-25} (m^3)	0.88
t_{75} (min)	4.4E+11
t_{25}(min)	1.6E+27
Data Fit R^2	0.823



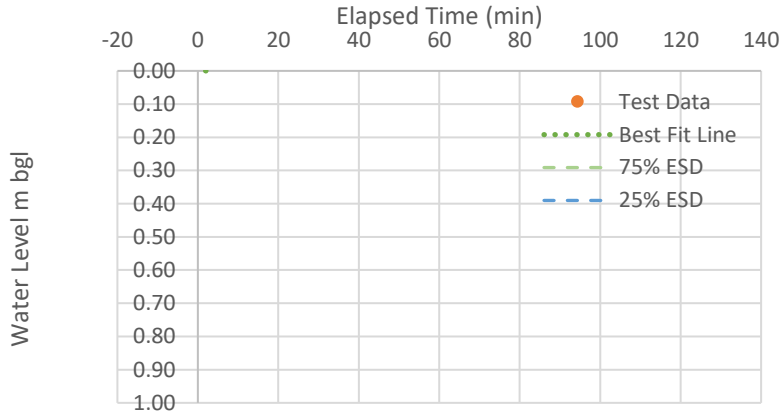
Infiltration rate f (ms^{-1}) **NOT PERMEABLE**

Total effective storage depth (esd) (m) 1.05

Test 2

Time min	Depth to Water m bgl
0	
1	
2	
4	
8	
15	
30	
45	
60	
120	

Test Parameters	
75% esd (mbgl)	
50% esd (mbgl)	
25% esd (mbgl)	
A_{s50} (m^2)	
V_{p75-25} (m^3)	
t_{75} (min)	
t_{25}(min)	
Data Fit R^2	



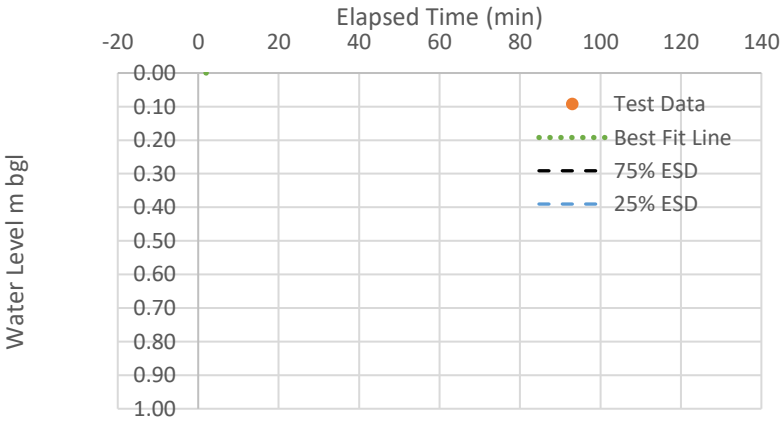
Infiltration rate f (ms^{-1}) **NO VALID DATA**

Total effective storage depth (esd) (m)

Test 3

Time min	Depth to Water m bgl
0	
1	
2	
4	
8	
15	
30	
45	
60	
120	

Test Parameters	
75% esd (mbgl)	
50% esd (mbgl)	
25% esd (mbgl)	
A_{s50} (m^2)	
V_{p75-25} (m^3)	
t_{75} (min)	
t_{25}(min)	
Data Fit R^2	



Infiltration rate f (ms^{-1}) **NO VALID DATA**

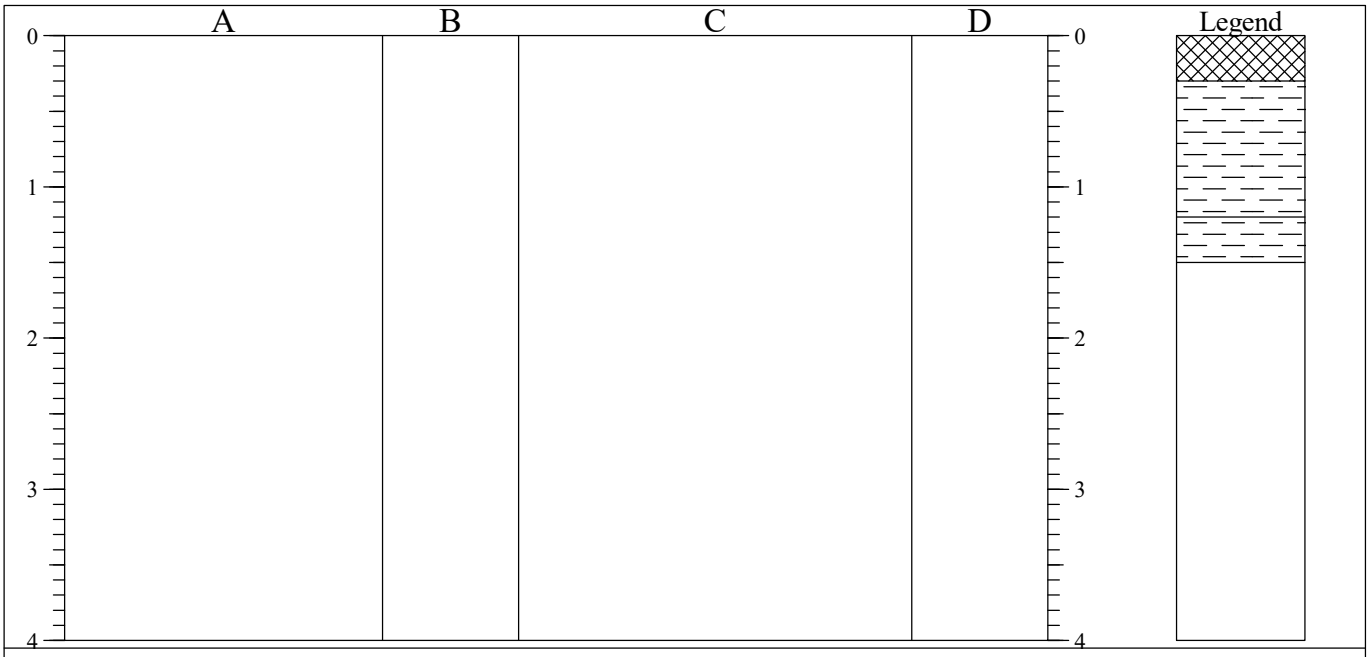
Total effective storage depth (esd) (m) 0.00

Carried out by	Notes:	Logged	Checked
Wessex and West	Insufficient fall to calculate. Tests 2 and 3 abandoned.	CP	IP

Wessex and West Ground Investigation

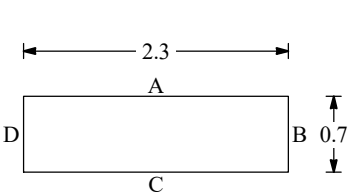
TRIAL PIT LOG

Project				TRIAL PIT No
Pamington				**TP103**
Job No: E1002	Start Date: 24-10-23 End Date: 24-10-23	Ground Level (m)	Co-Ordinates ()	
Contractor: WWGI				Sheet: 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		MADE GROUND: Soft to firm brown slightly sandy CLAY with frequent rootlets. [REWORKED NATURAL DEPOSITS]			
0.30-1.20		Firm to stiff grey slightly sandy slightly gravelly CLAY with occasional pockets of light brown sandy clay. Gravel is subangular to rounded fine to coarse of mudstone. [POSSIBLE REWORKED NATURAL DEPOSITS] 0.30 - 0.40 Eastern extent of pit: soft to firm brown slightly sandy to sandy CLAY.			
1.20-1.50		Stiff grey friable slightly gravelly CLAY with relict rock fabric. Gravel is angular and subangular fine and medium of mudstone. [CHARMOUTH MUDSTONE FORMATION]			

Shoring/Support: None
Stability: Stable



GENERAL REMARKS

Groundwater not encountered. Soakaway infiltration test carried out.

All dimensions in metres Scale 1:50	Client: Mabbett	Plant: Wheeled backhoe excavator	Logged By: CP

Trial Pit Soakaway Test

Based on BRE DG 365:2016

Project	Pamington	Status	LOCATION ID
Project ID	E1002	CHECKED	TP103

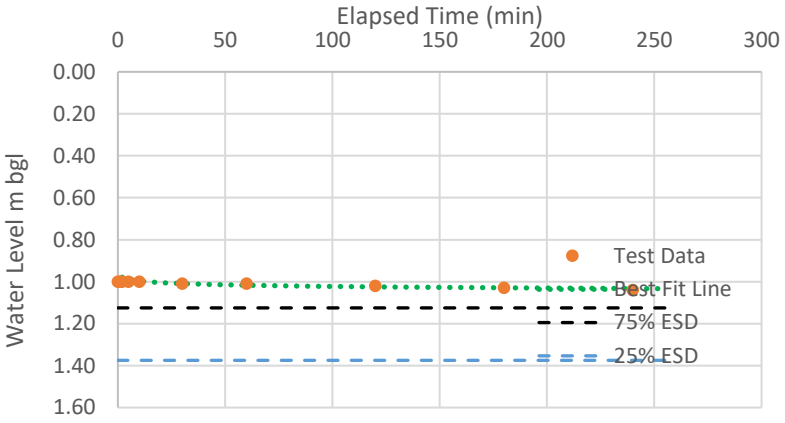
Trial Pit Details

	Test 1	Test 2	Test 3				
Depth	1.50			Ground Level	mAOD	Date Excavated	24/10/2023
Width	0.70			Coordinates	mE	Date Tested	24/10/2023
Length	2.30				mN		

Test 1

Time min	Depth to Water m bgl
0	1.00
1	1.00
2	1.00
5	1.00
10	1.00
30	1.01
60	1.01
120	1.02
180	1.03
240	1.04

Test Parameters	
75% esd (mbgl)	1.13
50% esd (mbgl)	1.25
25% esd (mbgl)	1.38
A_{s50} (m^2)	3.11
V_{p75-25} (m^3)	0.40
t_{75} (min)	4.8E+05
t_{25}(min)	2.7E+13
Data Fit R^2	0.774



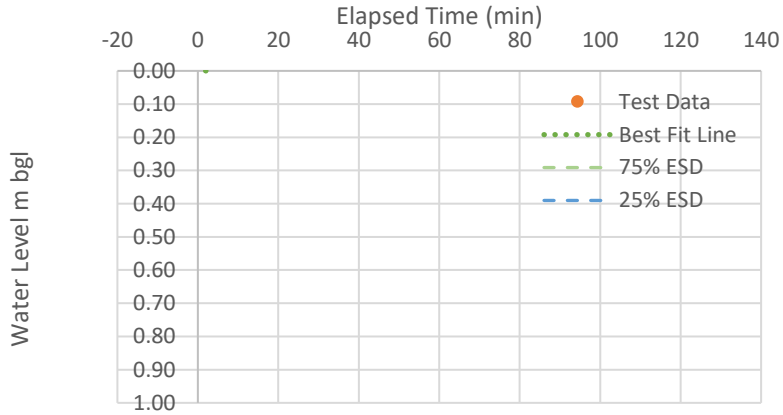
Infiltration rate f (ms^{-1}) **NOT PERMEABLE**

Total effective storage depth (esd) (m) 0.50

Test 2

Time min	Depth to Water m bgl
0	
1	
2	
4	
8	
15	
30	
45	
60	
120	

Test Parameters	
75% esd (mbgl)	
50% esd (mbgl)	
25% esd (mbgl)	
A_{s50} (m^2)	
V_{p75-25} (m^3)	
t_{75} (min)	
t_{25}(min)	
Data Fit R^2	



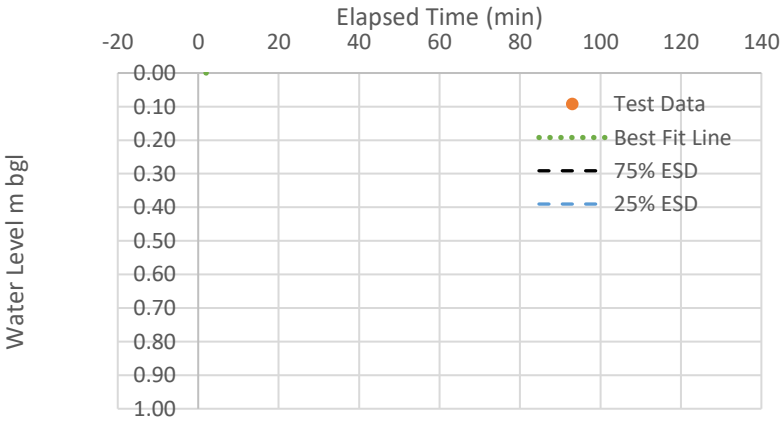
Infiltration rate f (ms^{-1}) **NO VALID DATA**

Total effective storage depth (esd) (m)

Test 3

Time min	Depth to Water m bgl
0	
1	
2	
4	
8	
15	
30	
45	
60	
120	

Test Parameters	
75% esd (mbgl)	
50% esd (mbgl)	
25% esd (mbgl)	
A_{s50} (m^2)	
V_{p75-25} (m^3)	
t_{75} (min)	
t_{25}(min)	
Data Fit R^2	



Infiltration rate f (ms^{-1}) **NO VALID DATA**

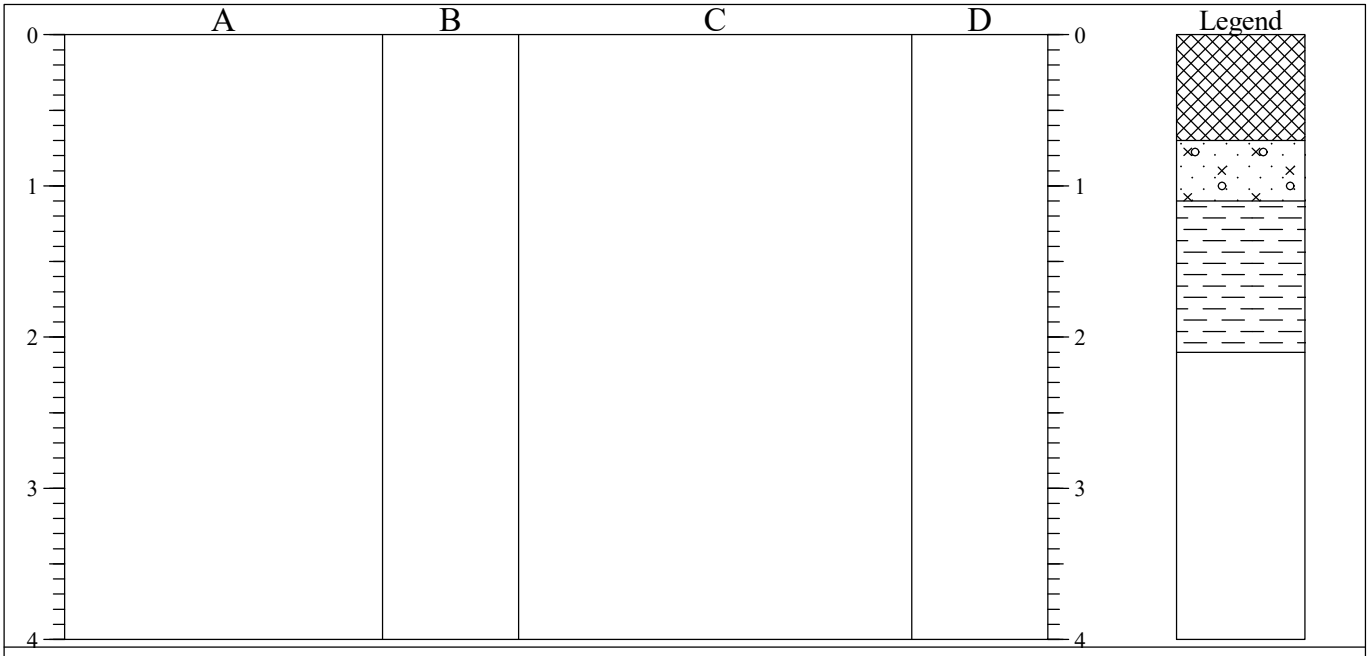
Total effective storage depth (esd) (m) 0.00

Carried out by	Notes:	Logged	Checked
Wessex and West	Insufficient fall to calculate. Tests 2 and 3 abandoned.	CP	IP

Wessex and West Ground Investigation

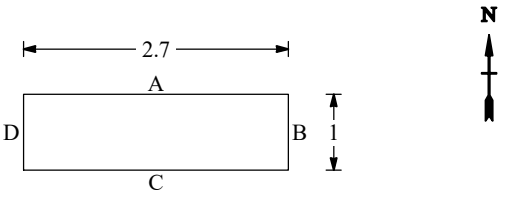
TRIAL PIT LOG

Project				TRIAL PIT No
Pamington				**TP104**
Job No: E1002	Start Date: 24-10-23 End Date: 24-10-23	Ground Level (m)	Co-Ordinates ()	
Contractor: WWGI				Sheet: 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.70		MADE GROUND: Soft becoming soft to firm brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of flint and mudstone. [REWORKED NATURAL DEPOSITS]			
		0.60 Land drain exposed in southern face, pit moved northwards.			
0.70-1.10		Brown silty gravelly SAND. Gravel is subrounded and rounded fine to coarse of limestone.			
1.10-2.10		Stiff grey locally mottled brownish grey CLAY with relict rock fabric. [CHARMOUTH MUDSTONE FORMATION] 1.30 Possible slip plane noted in base of pit.			

Shoring/Support: None
Stability: Stable



GENERAL REMARKS

Water seepage observed at 1.30m bgl possibly along slip surface. Soakaway infiltration test carried out.

All dimensions in metres Scale 1:50	Client: Mabbett	Plant: Wheeled backhoe excavator	Logged By: CP

Trial Pit Soakaway Test

Based on BRE DG 365:2016

Project	Pamington	Status	LOCATION ID
Project ID	E1002	CHECKED	TP104

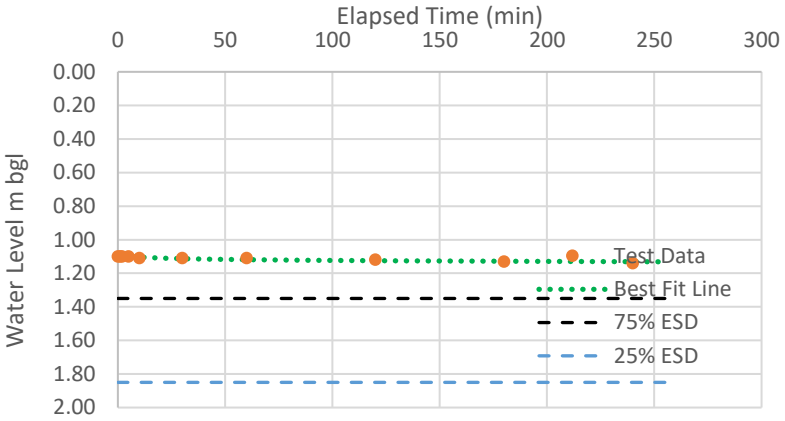
Trial Pit Details

	Test 1	Test 2	Test 3				
Depth	2.10			Ground Level	mAOD	Date Excavated	24/10/2023
Width	1.00			Coordinates	mE	Date Tested	24/10/2023
Length	2.70				mN		

Test 1

Time min	Depth to Water m bgl
0	1.10
1	1.10
2	1.10
5	1.10
10	1.11
30	1.11
60	1.11
120	1.12
180	1.13
240	1.14

Test Parameters	
75% esd (mbgl)	1.35
50% esd (mbgl)	1.60
25% esd (mbgl)	1.85
A_{s50} (m^2)	6.40
V_{p75-25} (m^3)	1.35
t_{75} (min)	1.5E+12
t_{25}(min)	4.2E+29
Data Fit R^2	0.789



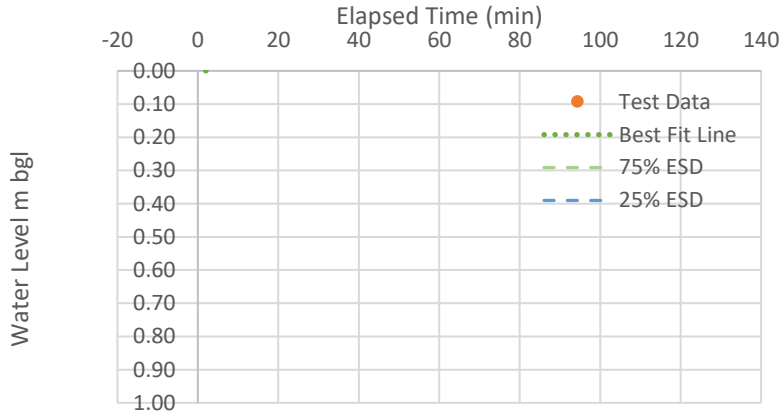
Infiltration rate f (ms^{-1}) **NOT PERMEABLE**

Total effective storage depth (esd) (m) 1.00

Test 2

Time min	Depth to Water m bgl
0	
1	
2	
4	
8	
15	
30	
45	
60	
120	

Test Parameters
75% esd (mbgl)
50% esd (mbgl)
25% esd (mbgl)
A_{s50} (m^2)
V_{p75-25} (m^3)
t_{75} (min)
t_{25}(min)
Data Fit R^2



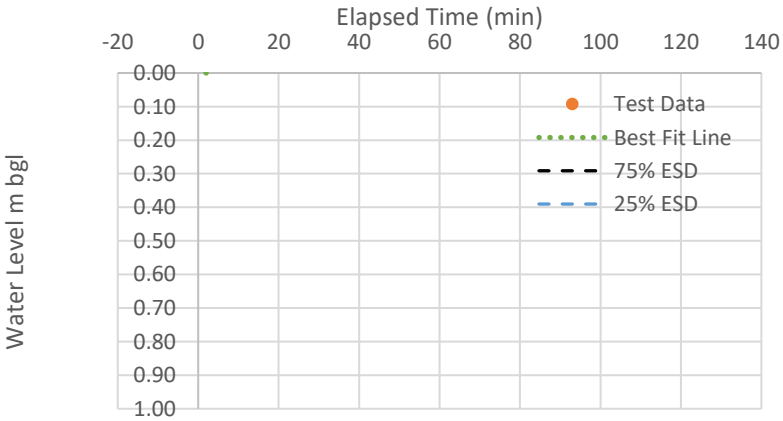
Infiltration rate f (ms^{-1}) **NO VALID DATA**

Total effective storage depth (esd) (m)

Test 3

Time min	Depth to Water m bgl
0	
1	
2	
4	
8	
15	
30	
45	
60	
120	

Test Parameters
75% esd (mbgl)
50% esd (mbgl)
25% esd (mbgl)
A_{s50} (m^2)
V_{p75-25} (m^3)
t_{75} (min)
t_{25}(min)
Data Fit R^2



Infiltration rate f (ms^{-1}) **NO VALID DATA**

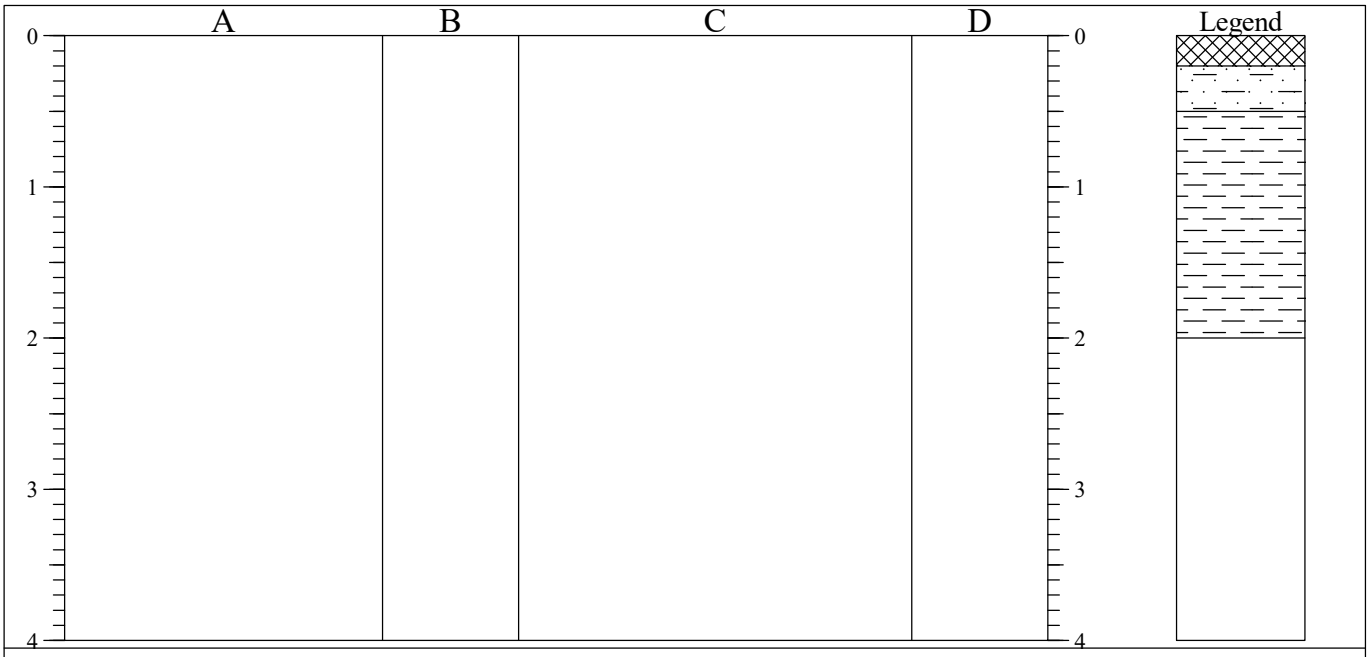
Total effective storage depth (esd) (m) 0.00

Carried out by	Notes:	Logged	Checked
Wessex and West	Insufficient fall to calculate. Tests 2 and 3 abandoned.	CP	IP

Wessex and West Ground Investigation

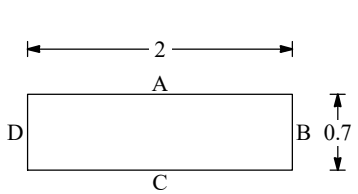
TRIAL PIT LOG

Project				TRIAL PIT No
Pamington				**TP105**
Job No: E1002	Start Date: 24-10-23 End Date: 24-10-23	Ground Level (m)	Co-Ordinates ()	
Contractor: WWGI				Sheet: 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.20		MADE GROUND: Soft to firm brown slightly sandy CLAY with frequent rootlets.			
0.20-0.50		[REWORKED NATURAL DEPOSITS] Firm brown very clayey SAND locally tending to firm sandy CLAY.			
0.50-2.00		Stiff locally very stiff grey slightly gravelly CLAY with frequent pockets of brown sandy clay. Gravel is angular and subangular fine and medium of mudstone. [CHARMOUTH MUDSTONE FORMATION]			

Shoring/Support: None
Stability: Stable



GENERAL REMARKS

Groundwater not encountered. Soakaway infiltration test carried out.

All dimensions in metres Scale 1:50	Client: Mabbett	Plant: Wheeled backhoe excavator	Logged By: CP

Trial Pit Soakaway Test

Based on BRE DG 365:2016

Project	Pamington	Status	LOCATION ID
Project ID	E1002	CHECKED	TP105

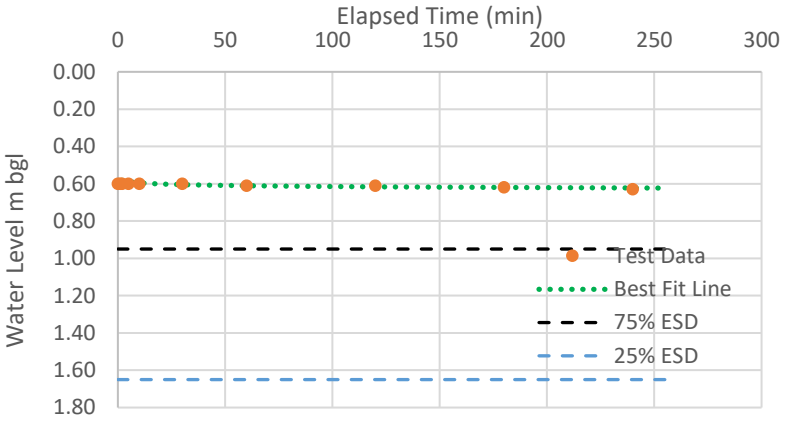
Trial Pit Details

	Test 1	Test 2	Test 3				
Depth	2.00			Ground Level	mAOD	Date Excavated	24/10/2023
Width	0.70			Coordinates	mE	Date Tested	24/10/2023
Length	2.00				mN		

Test 1

Time min	Depth to Water m bgl
0	0.60
1	0.60
2	0.60
5	0.60
10	0.60
30	0.60
60	0.61
120	0.61
180	0.62
240	0.63

Test Parameters	
75% esd (mbgl)	0.95
50% esd (mbgl)	1.30
25% esd (mbgl)	1.65
A_{s50} (m^2)	5.18
V_{p75-25} (m^3)	0.98
t_{75} (min)	2.4E+15
t_{25}(min)	2.4E+32
Data Fit R^2	0.665



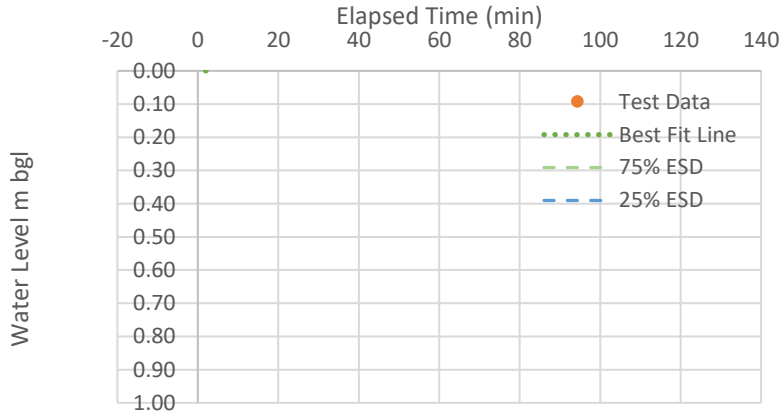
Infiltration rate f (ms^{-1}) **NOT PERMEABLE**

Total effective storage depth (esd) (m) 1.40

Test 2

Time min	Depth to Water m bgl
0	
1	
2	
4	
8	
15	
30	
45	
60	
120	

Test Parameters	
75% esd (mbgl)	
50% esd (mbgl)	
25% esd (mbgl)	
A_{s50} (m^2)	
V_{p75-25} (m^3)	
t_{75} (min)	
t_{25}(min)	
Data Fit R^2	



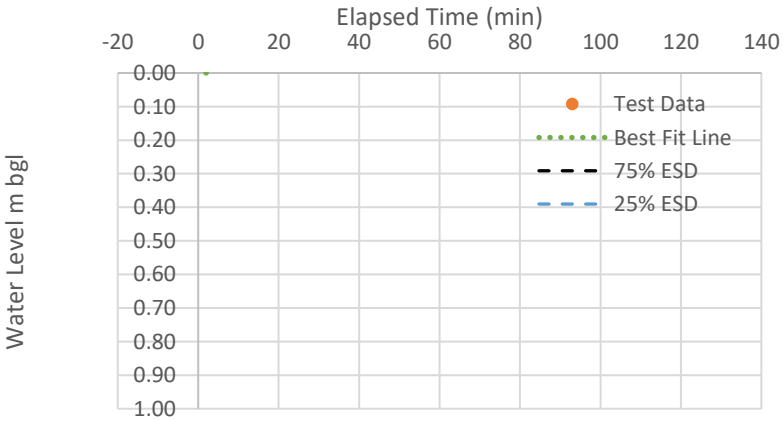
Infiltration rate f (ms^{-1}) **NO VALID DATA**

Total effective storage depth (esd) (m)

Test 3

Time min	Depth to Water m bgl
0	
1	
2	
4	
8	
15	
30	
45	
60	
120	

Test Parameters	
75% esd (mbgl)	
50% esd (mbgl)	
25% esd (mbgl)	
A_{s50} (m^2)	
V_{p75-25} (m^3)	
t_{75} (min)	
t_{25}(min)	
Data Fit R^2	



Infiltration rate f (ms^{-1}) **NO VALID DATA**

Total effective storage depth (esd) (m) 0.00

Carried out by	Notes:	Logged	Checked
Wessex and West	Insufficient fall to calculate. Tests 2 and 3 abandoned.	CP	IP

APPENDIX D – SEWER PLANS

(c) Crown copyright and database rights 2023 Ordnance Survey 100031673 | Date: 04/08/23 | Scale: 1:1250 | Map Centre: 394202,232879 | Data updated: 14/07/23 | Our Ref: 1242659 - 1 | Wastewater Plan A1

Public Foul Gravity/Lateral Drain
Public Combined Gravity/Lateral Drain
Public Surface Water Gravity/Lateral Drain
Pressure Foul
Pressure Combined
Pressure Surface Water
Highway Drain
Overflow Pipe
Disposal Pipe
Culverted Water Course
Pumping Station
Fitting
Manhole Foul
Manhole Surface
Abandoned Pipe
Chamber
Section 104 sewers are shown in green
Private sewers are shown in magenta

utilitysitesearch@outlook.com
m1

SEVERN TRENT

GENERAL CONDITIONS AND PRECAUTIONS TO BE TAKEN WHEN CARRYING OUT WORK ADJACENT TO SEVERN TRENT WATER'S APPARATUS

Please ensure that a copy of these conditions is passed to your representative and/or your contractor on site. If any damage is caused to Severn Trent Water Limited (STW) apparatus (defined below), the person, contractor or subcontractor responsible must inform STW immediately on:
0800 783 4444 (24 hours)

a) These general conditions and precautions apply to the public sewerage, water distribution and cables in ducts including (but not limited to) sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991(a legal agreement between a developer and STW, where a developer agrees to build sewers to an agreed standard, which STW will then adopt); mains installed in accordance with an agreement for the self-construction of water mains entered into with STW and the assets described at condition b) of these general conditions and precautions. Such apparatus is referred to as "STW Apparatus" in these general conditions and precautions.

b) Please be aware that due to The Private Sewers Transfer Regulations June 2011, the number of public sewers has increased, but many of these are not shown on the public sewer record. However, some idea of their positions may be obtained from the position of inspection covers and their existence must be anticipated.

c) On request, STW will issue a copy of the plan showing the approximate locations of STW Apparatus although in certain instances a charge will be made. The position of private drains, private sewers and water service pipes to properties are not normally shown but their presence must be anticipated. This plan and the information supplied with it is furnished as a general guide only and STW does not guarantee its accuracy.

d) STW does not update these plans on a regular basis. Therefore the position and depth of STW Apparatus may change and this plan is issued subject to any such change. Before any works are carried out, you should confirm whether any changes to the plan have been made since it was issued.

e) The plan must not be relied upon in the event of excavations or other works in the vicinity of STW Apparatus. It is your responsibility to ascertain the precise location of any STW Apparatus prior to undertaking any development or other works (including but not limited to excavations).

f) No person or company shall be relieved from liability for loss and/or damage caused to STW Apparatus by reason of the actual position and/or depths of STW Apparatus being different from those shown on the plan.

In order to achieve safe working conditions adjacent to any STW Apparatus the following should be observed:

1. All STW Apparatus should be located by hand digging prior to the use of mechanical excavators.

2. All information set out in any plans received from us, or given by our staff at the site of the works, about the position and depth of the mains, is approximate. Every possible precaution should be taken to avoid damage to STW Apparatus. You or your contractor must ensure the safety of STW Apparatus and will be responsible for the cost of repairing any loss and/or damage caused (including without limitation replacement parts).

3. Water mains are normally laid at a depth of 900mm. No records are kept of customer service pipes which are normally laid at a depth of 750mm; but some idea of their positions may be obtained from the position of stop tap covers and their existence must be anticipated.

4. During construction work, where heavy plant will cross the line of STW Apparatus, specific crossing points must be agreed with STW and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW Apparatus at other locations must be prevented.

5. Where it is proposed to carry out piling or boring within 20 metres of any STW Apparatus, STW should be consulted to enable any affected STW Apparatus to be surveyed prior to the works commencing.

6. Where excavation of trenches adjacent to any STW Apparatus affects its support, the STW Apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to bends and other fittings.

7. Where a trench is excavated crossing or parallel to the line of any STW Apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the STW Apparatus. In special cases, it may be necessary to provide permanent support to STW Apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW Apparatus.

8. No other apparatus should be laid along the line of STW Apparatus irrespective of clearance. Above ground apparatus must not be located within a minimum of 3 metres either side of the centre line of STW Apparatus for smaller sized pipes and 6 metres either side for larger sized pipes without prior approval. No manhole or chamber shall be built over or around any STW Apparatus.

9. A minimum radial clearance of 300 millimetres should be allowed between any plant or equipment being installed and existing STW Apparatus. We reserve the right to increase this distance where strategic assets are affected.

10. Where any STW Apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW Apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged to you.

11. It may be necessary to adjust the finished level of any surface boxes which may fall within your proposed construction. Please ensure that these are not damaged, buried or otherwise rendered inaccessible as a result of the works and that all stop taps, valves, hydrants, etc. remain accessible and operable. Minor reduction in existing levels may result in conflict with STW Apparatus such as valve spindles or tops of hydrants housed under the surface boxes. Checks should be made during site investigations to ascertain the level of such STW Apparatus in order to determine any necessary alterations in advance of the works.

12. With regard to any proposed resurfacing works, you are required to contact STW on the number given above to arrange a site inspection to establish the condition of any STW Apparatus in the nature of surface boxes or manhole covers and frames affected by the works. STW will then advise on any measures to be taken, in the event of this a proportionate charge will be made.

13. You are advised that STW will not agree to either the erection of posts, directly over or within 1.0 metre of valves and hydrants,

14. No explosives are to be used in the vicinity of any STW Apparatus without prior consultation with STW.

TREE PLANTING RESTRICTIONS

There are many problems with the location of trees adjacent to sewers, water mains and other STW Apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW Apparatus.

15. Please ensure that, in relation to STW Apparatus, the mature root systems and canopies of any tree planted do not and will not encroach within the recommended distances specified in the notes below.

16. Both Poplar and Willow trees have extensive root systems and should not be planted within 12 metres of a sewer, water main or other STW Apparatus.

17. The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW Apparatus. E.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear. Asset Protection Statements Updated May 2014

18. STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 2 metre of the centre line of a sewer, water main or other STW Apparatus.

19. In certain circumstances, both STW and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main of other STW Apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
	F		0	0
0101	F	18.62	17.6	1.02
1101	F	19.04	18.05	0.99
1102	F		0	0
1103	F		0	0
2001	F	20.31	19.08	1.23
2002	F	21.55	19.66	1.89
3001	F	22.36	20.07	2.29
7101	F	18.49	15.57	2.92
7102	F	18.56	15.29	3.27
8101	F	19.3	16.46	2.84
8102	F	19.28	16.45	2.83
8103	F	19	15.98	3.02
9101	F	18.71	17.08	1.63
9102	F	18.9	16.95	1.95
9103	F	19.41	16.74	2.67
9201	F		0	0
2101	S	21.38	20.03	1.35
2102	S	21.41	20.56	0.85

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

APPENDIX E – PROPOSED DEVELOPMENT PLANS

Pamington, Ashchurch

Illustrative Masterplan

Notes

1) This drawing is to be read in conjunction with all other relevant MHP drawings and information supplied by other consultants.

2) Hatch patterns displayed on this drawing are indicative only and do not represent actual paving units or material sizes.

3) All tree planting in proximity to buildings to be checked by engineers to ensure foundation detailing is appropriate.

Rev:		Date:	Drawn:	Checked:
E	Western footpath moved away from boundary to maintain dark corridor, proposed central swales moved.	10-11-23	DAL	PSH
D	Central junction moved away from drainage ditch, attenuation features increased. Site entrance internal junction revised, red line boundary updated.	06-11-23	DAL	PSH
C	Eastern development parcel revised following identification of U/G services, highways access position amended.	26-10-23	DAL	PSH
B	Access revised and highways swales included, red line updated on western PROW and north western corner.	13-09-23	DAL	PSH
A	Transfer land omitted from red line, north west access increased to 9m width, ponds resized and bio retention swales included.	11-09-23	DAL	PSH

Revisions:

Project: Pamington, Ashchurch

Client: Greystoke Land

Title: Illustrative Masterplan

Drawing number: 23122.101 Rev: E

Status: FOR INFORMATION

Drawn By:	Checked By:	Date:	Scale @ A1:
DAL	PSH	25-08-23	1:1000

LANDSCAPE ARCHITECTURE
MASTERPLANNING
ARBORICULTURE
mhp

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APPENDIX F – LLFA CONSULTATION RESPONSE

In response to the request for pre-application advice on surface water drainage on the above application the Lead Local Flood Authority (LLFA) can advise as follows.

A surface water drainage strategy is required for all applications and for sites greater than 1 ha or those within the Environment Agency's flood zones 2 or 3, a site specific flood risk assessment (FRA) is also required. Guidance on FRAs can be found at: https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications.

The Risk of Flooding from Surface Water (RoFfSW) maps from the Environment Agency show there are areas of the site at high risk of surface water flooding. Particularly along the northern and southern boundaries and through the middle of the site. These maps can be seen here: https://check-long-term-flood-risk.service.gov.uk/map. There is also an ordinary watercourse flowing from south to north through the middle of the site and then along the northern boundary.

The drainage strategy should comply with the principles of Sustainable Drainage Systems (SuDS) hierarchy for surface water. In doing so, consideration should be given first to infiltration, then discharge to a watercourse, then connecting to a public surface water sewer and finally connecting to a public combined sewer (with the necessary permissions from the relevant water company) if there are no other viable options. Where connections require crossing of third party land, agreement in principle from the relevant party should be included.

Where necessary, infiltration tests should be completed to BRE Digest 365 standard and the results provided. Please note that discharging to an ordinary watercourse (which includes ditches) may require Land Drainage Consent from Tewkesbury Borough Council. If the strategy is to discharge into a watercourse then there would need to be proof that the site will still be able to drain or there is sufficient storage onsite for when the watercourse is in high flow or when the watercourse is in flood. If the site doesn't currently drain into the watercourse then we would need to provide proof that the risk of flooding is not increased as a result of increasing the discharge into it.

There should be no surface water flooding on site for rainfall events up to and including the 1 in 30 year event and no internal flooding to properties (including basements) up to the 1 in 100 year event (plus 40% for climate change). Development should not increase flood risk outside of the site. Exceedance flow routes for events greater than the 1 in 100 year storm should be identified and should avoid properties including gardens. When developing next to a watercourse, it is recommended a 5-8m strip of land be kept free for maintenance purposes.

Any attenuation features should be shown including calculations for stored volumes and discharge rates. For greenfield developments, the peak discharge rate up to the 1 in 100 year rainfall event (plus 40% for climate change) should never exceed the

peak greenfield runoff rate for the same event. For brownfield developments, the peak discharge rate from the development up to the 1 in 100 year rainfall event (plus 40%) should be as close as is reasonably practicable to the greenfield runoff rate for the same event. If this is not feasible then Gloucestershire County Council will accept a 40% reduction over the pre development discharge rate. It should never exceed the pre-development discharge rate for the same event.

For greenfield developments, the runoff volume up to the 1 in 100 year, 6 hour rainfall event (plus 40% climate change) should not exceed the greenfield runoff volume for the same event. For brownfield sites the runoff volume up to the 1 in 100 year, 6 hour event (plus 40% climate change) should be constrained to a value as close as is reasonably practicable to the Greenfield runoff volume. Where this isn't practicable, the runoff volume should be reduced by 40% of the existing volume and should never exceed it.

The strategy should not result in any deterioration in water quality and the use of SuDS should improve water quality wherever possible. Information provided by the SuDS manual, CIRIA C753, should be considered when designing the SuDS system.

Please note, Tewkesbury Borough Council has a Flood and Water Management Supplementary Planning Document, which can be found at the following website: https://www.tewkesbury.gov.uk/local-plan#flood-and-water-management-spd.

For more information and to access our "Standing Advice and Development Guidance" and "Gloucestershire SuDS Design and Maintenance Guide" documents please visit our website: https://www.gloucestershire.gov.uk/planning-and-environment/flood-risk-management/flooding-information/information-for-developers/

APPENDIX G – ATTENUATION REQUIREMENTS

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Josh Rigby
Site name:	Western Parcel
Site location:	Land adjacent to Pamington, Ashchurch, Tewkesbury

Site Details

Latitude:	51.99434° N
Longitude:	2.08341° W
Reference:	2434215275
Date:	Aug 09 2023 16:56

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site characteristics

Total site area (ha):	2.2680
Significant public open space (ha):	1.3603
Area positively drained (ha):	0.907699999999997
Impermeable area (ha):	0.9072
Percentage of drained area that is impermeable (%):	100
Impervious area drained via infiltration (ha):	0
Return period for infiltration system design (year):	10
Impervious area drained to rainwater harvesting (ha):	0
Return period for rainwater harvesting system (year):	10
Compliance factor for rainwater harvesting system (%):	66
Net site area for storage volume design (ha):	0.91
Net impermable area for storage volume design (ha):	0.91
Pervious area contribution to runoff (%):	0

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Soil characteristics

	Default	Edited
SPR HOST:	--	0.3

Flow inputs

	Default
Q1 (l/s):	15.49
Q1 (l/s):	13.58
Q30 (l/s):	35.60
Q100 (l/s):	47.05

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	--	71.61
Rainfall 100 yrs 12 hrs:	--	86.82
FEH / FSR conversion factor:	1.06	1.38
SAAR (mm):	624	624
M5-60 Rainfall Depth (mm):	17	17
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydological region:	4	4
Q_{BAR} for net site area (l/s):	17.41	6.97

Design criteria

Climate change allowance factor:	1.4
Urban creep allowance factor:	1.1
Volume control approach	Flow control to max of 2 l/s/ha or Qbar
Interception rainfall depth (mm):	5
Minimum flow rate (l/s):	15.49

Site discharge rates

	Default	Edited
1 in 1 year (l/s):	15.5	15.5
1 in 30 years (l/s):	15.5	15.5
1 in 100 year (l/s):	15.5	15.5

Estimated storage volumes

	Default	Edited
Attenuation storage 1/100 years (m³):	569	569
Long term storage 1/100 years (m³):	0	0
Total storage 1/100 years (m³):	569	569

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

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Josh Rigby
Site name:	Eastern Parcel
Site location:	Land adjacent to Pamington, AshchurchTewkesbury

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site Details

Latitude:	51.99434° N
Longitude:	2.08341° W
Reference:	708422528
Date:	Aug 09 2023 16:47

Site characteristics

Total site area (ha):	2.854602
Significant public open space (ha):	1.712802
Area positively drained (ha):	1.1418
Impermeable area (ha):	1.1418
Percentage of drained area that is impermeable (%):	100
Impervious area drained via infiltration (ha):	0
Return period for infiltration system design (year):	10
Impervious area drained to rainwater harvesting (ha):	0
Return period for rainwater harvesting system (year):	10
Compliance factor for rainwater harvesting system (%):	66
Net site area for storage volume design (ha):	1.14
Net impermable area for storage volume design (ha):	1.14
Pervious area contribution to runoff (%):	0

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Soil characteristics

	Default	Edited
SPR HOST:	--	0.3

Flow inputs

	Default
Q1 (l/s):	19.49
Q1 (l/s):	17.09
Q30 (l/s):	44.79
Q100 (l/s):	59.19

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	--	71.61
Rainfall 100 yrs 12 hrs:	--	86.82
FEH / FSR conversion factor:	1.06	1.38
SAAR (mm):	624	624
M5-60 Rainfall Depth (mm):	17	17
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydological region:	4	4
Q_{BAR} for net site area (l/s):	21.91	8.76

Design criteria

Climate change allowance factor:	1.4
Urban creep allowance factor:	1.1
Volume control approach	Flow control to max of 2 l/s/ha or Qbar
Interception rainfall depth (mm):	5
Minimum flow rate (l/s):	19.49

Site discharge rates

	Default	Edited
1 in 1 year (l/s):	19.5	19.5
1 in 30 years (l/s):	19.5	19.5
1 in 100 year (l/s):	19.5	19.5

Estimated storage volumes

	Default	Edited
Attenuation storage 1/100 years (m³):	716	716
Long term storage 1/100 years (m³):	0	0
Total storage 1/100 years (m³):	716	716

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