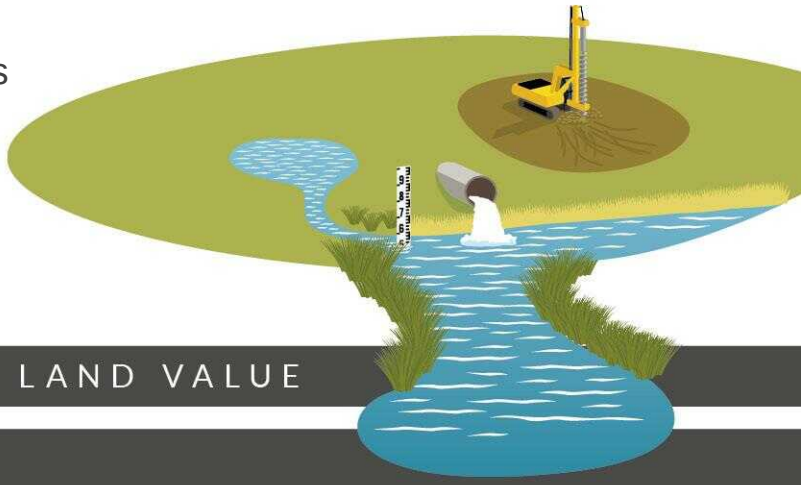
To be read alongside Sustainable Drainage Strategy, prepared by BWB

ALMONDBURY SEND SCHOOL, HUDDERSFIELD

FLOOD RISK ASSESSMENT & OUTLINE DRAINAGE STRATEGY

Job Number: FRA 22 1180
Date: February 2023
Client: Wilde Consulting Engineers



INCREASING LAND VALUE

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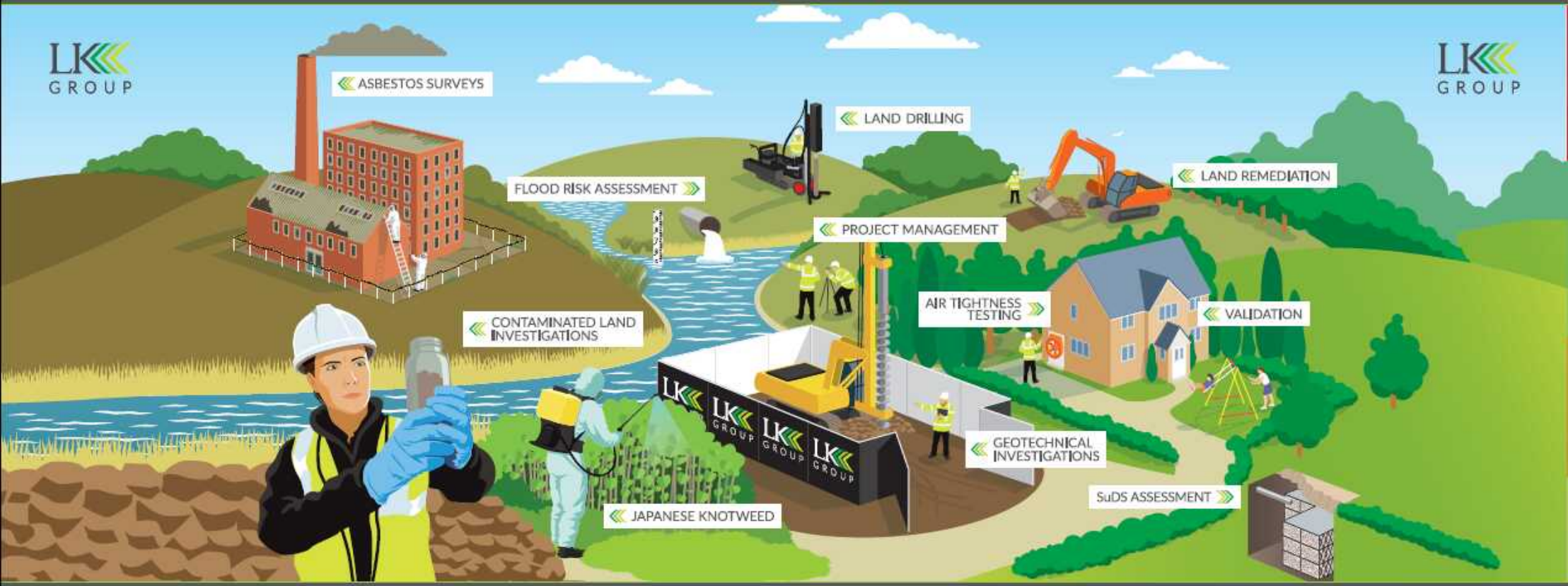

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Site Address	Land off Fernside Avenue, Huddersfield, HD5 8PQ		
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Prepared By	Jenna Lowe – Flood Risk Engineer	**Reviewed By**	Mark Jones - Associate

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EXECUTIVE SUMMARY

Scope and Background

This Flood Risk Assessment and Outline Drainage Strategy (FRA) has been undertaken by LK Consult Ltd (LKC) to support a planning application for the redevelopment of the Almondbury Sports Centre and former Almondbury School, Huddersfield. It is understood that the development will comprise proposals to retain the swimming pool and sports centre following the demolition of the existing school building.

LKC has prepared this FRA in line with the NPPF and Technical Guidance where appropriate.

In considering the proposals the following key principles have therefore been applied:

- Identification of flood risks.
- Protection of users of the new development.
- No increased flood risk to third parties.

Consultations

The Environment Agency (EA) has been consulted to inform the preparation of this report. They have provided a more detailed flood map, but no modelled data was available.

Kirklees Council (LLFA) and Yorkshire Water (YW) were also consulted concerning flood risk.

All relevant consultees have confirmed that there is a Negligible to Very Low risk of flooding to this site from all sources except pluvial and surface water sources which pose a Low risk of flooding.

Flood Risk

Environment Agency flood maps indicate that the site is potentially vulnerable to fluvial flooding from the Fenay Beck, east of the site.

The site is shown on the Environment Agency's (EA) website Flood Zone Mapping as being in Flood Zone 1 (PPG Table 1).

The site is in Flood Zone 1 – Very Low Risk – annual probability of flooding less than 0.1% (1 in 1000).

Mitigation

Design

Site falls will be arranged to allow reasonably level access for occupants and visitors and to allow the site to be free-draining in case of local ponding at times of heavy rainfall. Floor levels of the sports centre and swimming pool will remain the same as the existing levels.

The development will not result in a reduction in flood plain storage compared to the existing situation.

In considering the potential drainage options for the site at present it is assumed that surface water runoff arising from the development will discharge into the existing surface water sewer located within the site boundary via the existing connection from the school.

The proposed development will decrease the proportion of the site covered by impermeable surfaces and will therefore generate less runoff. Attenuation will be required as an allowance for climate change.

Foul sewage arising from the development will be discharged into the 300mm public combined sewer recorded on site to the southeast.

The outline drainage strategy considers the use of attenuation-based SuDS to be feasible with a discharge to the sewer on the southern boundary of the site. Therefore, the most effective strategy, in line with the SuDS management train, would be to have a detention facility at the southern boundary. The required detention basin/tank or similar has been estimated to be **779.4m^3** for the 1 in 30-year flow restriction.

Similarly, the estimated volume to be retained on site for the 1 in 100-year storm event including an allowance for climate change is between **1334.2m^3** and **1626.2m^3**.

The site is considered to be at Low risk of flooding. It is recommended that the minimum finished floor levels for the development should be set at no lower than the existing levels. This is to allow for overland flow during exceedance flows from an extreme event or a drainage failure.

Access

Access close to the site is elevated above potential flood levels and will always provide safe access to and from the site from Fernside Avenue.

Contents

EXECUTIVE SUMMARY **iv**

1 Introduction 1
1.1 Background 1
1.2 Site Details 2

2 Site Setting 3
2.1 Vulnerability 3
2.2 The Sequential and Exception Tests 3
2.3 Environmental Setting 4
2.4 Site Reconnaissance 5
2.5 Site and Access Levels 8

3 Consultation 9

4 Assessment of Flood Risk 11
4.1 Flood Zones 11
4.2 Sources of Flooding 11
4.3 Summary of Flood Risk 12

5 Surface Water Management 13
5.1 Infiltration 13
5.2 Surface Water Drainage Strategy 14
5.3 Surface Water Attenuation Requirements 16
5.4 Site Specific SuDS 17
5.5 Foul Drainage 17

6 Mitigation Measures 18
6.1 Proposed Site levels and Developments Level 18
6.2 Safe Access 18
6.3 Flood Resistance and Resilience 18
6.4 Residual Risk 18

7 Conclusions 19

Appendices

Appendix A: Figures, Plans and Drawings
Appendix B: Site Information
Appendix C: Environment Agency Data
Appendix D: Consultee Correspondence
Appendix E: Calculations

1 Introduction

1.1 Background

LK Consult Ltd (LKC) were commissioned by Wilde Consulting Engineers to carry out a Flood Risk Assessment (FRA) and Outline Drainage Strategy for land off Fernside Avenue, Huddersfield. The report was undertaken in support of a future planning application to redevelop the site for commercial use.

The report will address the vulnerability to flooding from all possible sources and will also consider the impact of the development on surface water runoff accounting for climate change and the potential to increase flood risk elsewhere. The Outline Drainage Strategy in Section 5 will provide an overview of the SuDS techniques which could be considered on the site. The issues of actual flood risk are discussed in Section 4.

Government policy with respect to development in flood risk areas is contained within the Department of Communities and Local Government National Planning Policy Framework[1] and accompanying Technical Guidance of March 2012 (revised to the Planning Practice Guidance (PPG)[2], which supersedes Planning Policy Statement 25 (PPS25) 'Development and Flood Risk'. The guidance on Climate Change allowance issued by the Environment Agency in February 2016 has also been considered.

LKC has prepared this Flood Risk Assessment (FRA) in line with the NPPF and the PPG where appropriate. The level of detail entered into any flood risk assessment is dependent upon the scale and potential impact of the proposed development, and the vulnerability classification of the proposed land-use.

[1] DCLG (2021). "National Planning Policy Framework." Department of Communities and Local Government. July 2021.
[2] DCLG (2014). "Planning Practice Guidance" http://planningguidance.communities.gov.uk, April 2014.

1.2 Site Details

A summary of the general site details is presented in Table 1-1. Plans, Drawings and Figures are provided in Appendix A. Figure 1 indicates the site location and boundary. At this stage LKC has not been provided with a proposed development plan.

Site Details	
Location	Land south of Fernside Avenue, Almondbury, Huddersfield, HD5 8PQ. Centred at approximate National Grid Reference 417065E, 415910N.
Area	Approximately 8.09 Ha (full site area). Proposed re-development area is 2.60 Ha.
Topography	120 metres above ordnance datum (AOD) in the southeast of the site and 138.4m AOD in the northwest. Ground levels around the existing buildings are generally 131-135m AOD, three hardstood courts are present to the south of the school buildings on plateaus at 130-134m AOD. The site is sloping down steeply towards the southeast.
Current Land Use	Site Vacant school buildings with associated playing fields, car park and sports pitches. An active swimming pool and sports hall are present adjacent to school buildings. Surrounding Area/ Boundary Treatment North: Hill View Academy, Fernside Avenue and residential properties. East: Residential properties. South: Residential properties. West: Almondbury Cricket Club and residential properties.
Proposed Development	A proposed development plan is not available at this stage, however, it is understood the development will comprise proposals to retain the swimming pool and sports centre following the demolition of the existing school building.

Table 1-1: Summary of site details.

2 Site Setting

2.1 Vulnerability

As an initial phase in identifying whether a site is potentially at risk of flooding, LKC has consulted the Environment Agency's (EA) website Flood Zone Mapping. This mapping is (often) based on coarse scale modelling and provides only an initial indication of the flood risk to a site. The Environment Agency Flood Zone maps were developed using a very coarse Digital Elevation Map (DEM) and are superseded by a more detailed analysis of modelled flood levels and topographic survey levels.

The Flood Zones divide the floodplain into three categories of flood risk, and do not take flood defences into account. The NPPF defines the Flood Zones as:

- Flood Zone 1 – little or no risk, with annual probability of flooding from rivers and the sea of less than 0.1% (1 in 1000).
- Flood Zone 2 – low risk, with annual probability of flooding of 0.1 to 1.0% from rivers and 0.1 to 0.5% from the sea.
- Flood Zone 3 – medium to high risk of flooding with an annual probability of flooding of 1.0% or greater from rivers, and 0.5% or greater from the sea.

The Flood Zone Mapping indicates the site as being within Flood Zone 1 in the PPG (paragraph 065, Table 1).

The development site is in Flood Zone 1 and over 1 hectare in size, so under current regulations a Flood Risk Assessment will be necessary to accompany the Planning Application.

The proposed development is for a commercial end use and this is classified within the 'Less Vulnerable' category in the PPG (paragraph 066, Table 2).

2.2 The Sequential and Exception Tests

The NPPF does not require that the Sequential Test be applied to development proposals in Flood Zone 1. Since the site has been shown to be located in Zone 1 for flood risk (see section 4.1), a sequential approach should not be required for planning.

However, the principles should still be applied for developments within the site such that, for example, dwellings are situated on a high part of the site when there is a risk of local surface water flooding. The issues of actual flood risk are discussed below. The issues of safety and reduction in flood risk to others required by an Exception Test are also addressed in this document.

The Local Planning Authority (LPA) will make the final decision with regard to any planning application.

2.3 Environmental Setting

LKC has undertaken a review of public domain information including British Geological Survey data, Environment Agency data, historical mapping, and aerial photography to provide a summary of the environmental setting of the site. This is summarised in Table 2-1 below.

Summary of the Environmental Setting			
Geology	Superficial		No BGS recorded superficial.
	Bedrock		Greenmoor Rock (Sandstone). Small area of Pennine Lower Coal Measures Formation (Mudstone, Siltstone and Sandstone) in the south of site close to southern boundary.
	BGS Boreholes		BH Ref: SE11NE393, 180m S: Made Ground (topsoil with occasional brick fill) to 0.80m, firm grey, brown mottled silty Clay to 2.00m, very compact grey brown weathered Sandstone to 2.90m. BH Ref: SE11NE635, 250m W: Made Ground (black Sand and Gravel) to 3.50m, brown sandy gravelly Clay to 4.50m and grey Mudstone with bands of grey siltstone to 20.00m (groundwater struck at 16.00mbgl). BH Ref: SE11NE353, 340m N: Topsoil to 0.15m, firm brown-grey silty Clay with occasional sandstone cobbles and fragments of shale to 0.70m and brown-grey fractured silty Shale with bands of iron stained shaly mudstone to 2.40m.
	Defra Soilscape Mapping		Type 6: Freely draining slightly acid loamy soils.
Hydro-geology	Aquifer Designation	Superficial	N/A.
		Bedrock	Secondary A Aquifer.
	Source Protection Zone (SPZ)		Site not within an SPZ.
Hydrology	All adjacent and internal surface water		The Fenay Brook is located approximately 260m south of the site. The Benholmley Beck is located approximately 750m west of the site. Historically there was an unnamed watercourse running through the south of the site its line ran through the location of the current pond along the southern boundary and continued running parallel to Eastlands Road flowing east.
	Flooding		Flood Zone 1.
Site History			Historical mapping indicates that the site consisted of pastureland from 1854 until 1948. A cricket ground is observed adjacent to the western boundary from 1908 and residential properties are observed towards the northern boundary from 1948. Between 1958 and 1968, 4 anti-aircraft guns with the ammunition stores are present on site in the west. These were demolished and replaced with a school and playing field and are still present in 2022 mapping. The main Almondbury County Secondary School building opened in 1964 on the site of a wartime anti-aircraft gun.

Table 2-1: Summary of the Environmental Setting.

2.4 Site Reconnaissance

A site reconnaissance was undertaken in January 2023 and further photographs are provided below. Hand dug trial holes were unable to be undertaken.

Relevant features identified on site are summarised below:

- The site buildings comprise a vacant school building of one to three storeys with a sports centre (swimming pool and sports hall) noted to be in use.
- A subterranean boiler room and substation is present south of the main school entrance.
- Car parks are present to the north and northwest of the school buildings.
- The northwestern area is grassed and ground levels rise to meet those of the adjacent cricket ground.
- To the south of the school buildings a hardstood playground is present, beyond which are three fenced hardstood tennis and sports courts on three different terraces.
- A path leads southeast from the school and tennis courts to a blocked off pedestrian access off Eastlands. Site levels fall to the southern boundary.
- To the west of the pedestrian path an overgrown area with standing water is present. At the time of the site reconnaissance the water was breaking out to an ACO drain on Eastlands.
- To the east of the school and north of the pedestrian path a grassed playing field is present. The playing field slopes down to the east, beyond which is housing.
- Manholes and surface drains were noted across the site, specifically around the school building.
- There is a line of drains running towards the pond on the southern boundary of the site it is believed that the surface water from the existing school flows towards the pond and the culverted watercourse.

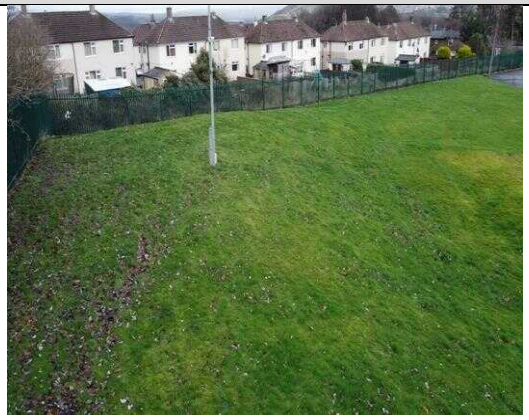
The surrounding area comprises residential houses to the north, east and southeast. An electrical substation and primary school are present adjacent to the northeast and a cricket ground is present adjacent the west of site.

Relevant photographs are provided in Plate 2-1.

Photograph 1: View of the school and sports centre (ligher colour building).

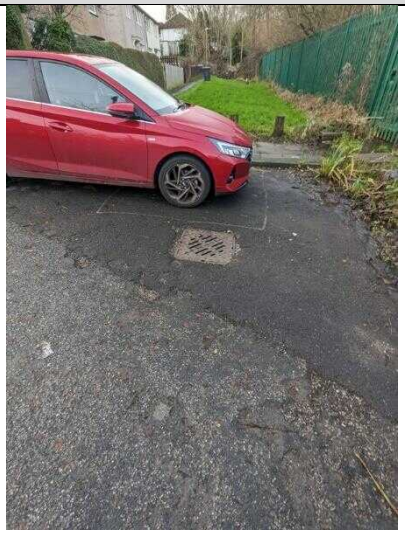
Photograph 2: Site sloping down towards south.

Photograph 3: Hard surface play area towards south and sloping land.



Photograph 4: View adjacent western boundary.

Photograph 5: Surface water flowing down Eastlands Street adjacent southern boundary.



Photograph 6: Manhole cover in Eastlands Street adjacent southern boundary.

Plate 2-1: Site photographs.

Photograph 7: Pooling surface water adjacent southern boundary.

Photograph 8: Overflowing drainage gully adjacent southern boundary.

Photograph 9: Highway gullies present on site adjacent existing school building.

Photograph 10: Existing drainage gutters on school building.

Photograph 11: Existing drainage gutters and downpipe on sports centre.

Photograph 12: Wooded area and pond in the south of the site.

Plate 2-1 (continued): Site photographs.

2.5 Site and Access Levels

A topographic survey of the site has been provided and a copy is provided in Appendix B. The site elevation ranges from 120m AOD in the southeast of site and 138.4m AOD in the northwest. Ground levels around the existing buildings are generally 135-131mAOD, three hardstood courts are present to the south of the school buildings are on plateaus at 134-130mAOD.

The site then slopes down steeply towards the southeast. The final site levels and ground floor levels of the sports centre will remain the same as the existing building. The access will not change and will join Fernside Avenue at approximately 129.95m AOD.

3 Consultation

Information from all relevant consultees is summarised in Table 3-1 below.

Relevant correspondence is provided in Appendices C (EA) and D (others).

For modelled levels refer to extracted Level table and node location map in Appendix C.

Source	Details	
Environment Agency (EA)	Flood Zone 1: Very Low risk, with annual probability of flooding from rivers and the sea of less than 0.1% (1 in 1000).	
	Modelled River Levels	No information available as the site does not fall within 150m of an area at risk of flooding from rivers or the sea.
	Records of Flooding	No information available.
	Records of Flood Warning Service	Not within a flood warning service area.
	Surface Water Flooding	Very low risk of surface water flooding across the site excepting a low risk up to a depth of 300mm adjacent to some of the existing buildings if there was a drainage failure. There is a low risk of flooding towards the west and adjacent to the southern boundaries, this appears to follow the culverted historical watercourse route which is a natural depression. There is a very small area of medium surface water flood risk associated with the existing pond.
	Flooding from reservoirs	No risk from reservoirs.
	Groundwater Source Protection Zone	Not within Source Protection Zone.
Kirklees Council (LLFA)	No information provided at the time of writing.	
	Possible or known incidents of highway flooding	Unaware of any current flooding problems associated with Fernside Avenue.

Table 3-1: Summary consultee information

Source	Details	
Yorkshire Water (YW)	Likely conditions for connecting into their sewerage system	Yorkshire Water would request conditions for a separate system with only foul draining to foul / combined sewers and surface water draining to soakaway/SuDS, watercourse or surface water sewer. All surface water flow from the proposed development should drain in-line with the drainage hierarchy, as outlined in Paragraph 80 of the National Planning Practice Guidance. Yorkshire Water request that no buildings, or other obstructions, are to be erected within 3 metres and no trees planted within 5 metres of the public sewers in the southeastern corner of the site. If other methods of surface water disposal are not viable, Yorkshire Water will consider a connection to the 300mm diameter public surface water sewer recorded on site to the southeast. Yorkshire Water request that any agreed rate does not exceed 3.5 l/s. Foul flow from the site will be allowed to drain into the 300mm diameter public combined sewer recorded on site to the southeast at an unrestricted rate. Yorkshire Water Wastewater Developer department was contacted regarding sewer flooding history for the site. Yorkshire Water confirmed that they did not have records of internal or external sewer flooding of properties in the vicinity of the site as a result of overloaded sewers.
	Sewer map	There is a 300mm diameter public combined and a 300mm diameter surface water sewer recorded crossing the site towards the southeastern corner. There is a 300mm diameter public combined sewer recorded adjacent to the northern site boundary within Fernside Avenue.
Strategic Flood Risk Assessment (SFRA)	Level 1 SFRA[3]	The site has no history of flooding from any source.
Preliminary Flood Risk Assessment (PFRA)[4]	The Preliminary Flood Risk Assessment (PFRA)[3] for the area indicates that there are no records of flooding for the area which conforms with information supplied by the EA.	

Table 3-1: Summary consultee information (continued).

[3] Strategic Flood Risk Assessment Level 1: Kirklees Council; 'Kirklees Local Flood Risk Management Strategy' (2012), Kirklees Council.

[4] Preliminary Flood Risk Assessment: Kirklees Council; 'Flood Risk Regulations 2009 Preliminary Assessment Report for Kirklees' (2009), Kirklees Council.

4 Assessment of Flood Risk

4.1 Flood Zones

The detailed flood map provided by the EA indicates that the site is in Flood Zone 1. (see Appendix C).

The EA did not have any modelled levels for the stretch of the River Irwell closest to the site. Therefore, the comparison data was extracted by comparison with the flood map extents and the available topographical data provided.

The extents of the 0.1% (1000-year) flood level remain outside of the development area (see Appendix C).

4.2 Sources of Flooding

The risk of flooding from the following flood sources has been considered:

Fluvial – The EA has confirmed the study area is within Flood Zone 1. Therefore, the flood risk associated with this source is considered Very Low.

Tidal – The study area is remote from the sea and tidally influenced water bodies. Therefore, the flood risk associated with this source is considered Negligible.

Pluvial (Rainfall) – The surface water flood risk maps show areas adjacent the southern boundary of the site and within the paved area of the sports centre that have the potential to flood during prolonged heavy rainfall. These areas need consideration within the detailed design or there is the potential to have areas of standing water in gardens and landscaped areas not positively drained if overland flow routes are not considered. Therefore, the risk of flooding from surface water flooding is Low but should be considered further during the detailed design.

Surface Water (Overland flow) – This relates to surface water entering the site. Surface water arising from the north of the study area is likely to be intercepted by the highway drains and therefore pose no threat to the development. If there was a drainage failure causing overland flow, it would flow towards the southeastern boundary. Therefore, the flood risk associated with this source is considered Low.

Groundwater – The BGS has groundwater records for the study area in the form of borehole records. The records show the water table is recorded at 16.00mbgl. This makes it unlikely for groundwater flooding to occur. No evidence of shallow groundwater was observed during the walkover. Therefore, the flood risk associated with this source is considered Very Low.

Sewers – Yorkshire Water sewer records show combined and surface water sewers within the surrounding housing developments. The Pre-development Enquiry states that no property within the vicinity of the study area or within the surrounding housing developments is at risk of internal flooding due to overloaded public sewers. Therefore, the flood risk associated with this source is considered Very Low.

Artificial sources – According to the EA online maps, the study area is not at risk from reservoir flooding. Therefore, the flood risk associated with this source is considered Negligible.

4.3 Summary of Flood Risk

Source of Flooding	Risk Assessment Level
Fluvial	Very Low
Pluvial (Rainfall)	Low
Surface Water	Low
Tidal	Negligible
Groundwater	Very Low
Sewers	Very Low
Artificial Sources	Negligible

Table 4-1: Summary of Existing Risk Level.

The site is located within Flood Zone 1 and a Negligible to Low risk of flooding from all sources have been identified for the site. LKC consider that a strategy for surface water management will be required at the site to mitigate the risk to others. The assessments of a range of measures that are feasible for the site are outlined in Section 5.

5 Surface Water Management

The NPPF recognises that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface run-off from development sites through the use of Sustainable Drainage Systems (SuDS), this being complementary to the control of development within the floodplain.

SuDS will not alleviate flooding in an area prone to flooding; however, properly designed SuDS have the potential to prevent the surface water runoff from new development worsening the flood risk. The effective disposal of surface water from any new development is a material planning consideration in determining if the proposals for the development and use of land are acceptable.

The accepted principles are that surface water arising from a developed area should, as far as practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

The Building Regulations Requirement H3[5] stipulates that rainwater from roofs and paved areas is carried away from the surface to discharge to one of the following, listed in order of priority:

- an adequate soakaway or other adequate infiltration system,
- a watercourse or, where that is not practicable,
- a sewer.

The concept of a sustainable drainage system has been incorporated into the outline drainage strategy for the study area in order to comply with the Flood and Water Management Act 2010[6].

Suitability of different SuDS will be governed by prevailing site conditions, such as the type and scale of development, topography, ground conditions (soil permeability, ground stability, depth to water table), local hydrogeology and risk of groundwater contamination (presence of sensitive aquifers and source protection zones) etc.

5.1 Infiltration

The Groundwater Source Protection Zone mapping from the EA website shows that the site is not within any identified protection zones. A summary of the British Geological Survey superficial and bedrock aquifer descriptions and classifications supplemented by local records is shown in Table 5-1 below:

Classification	Description	Aquifer Classification	Recorded Water Table Depth	Soakaway Potential
N/A	Silty Clay and sandy gravelly Clay	N/A	16.0mbgl	Poor
Greenmoor Rock	Sandstone	Secondary A	N/A	Moderate

Table 5-1: Geological and Hydrogeological Setting.

[5] Building Regulations part H3 2010: Approved Document, Drainage and Waste Disposal.
[6] Flood and Water Management Act 2010: UK Government.

Nearby boreholes suggest that the ground consists of silty Clay and sandy gravelly Clay and surface water was observed flowing down from the site across the adjacent road in the south. Therefore, infiltration methods such as soakaways are unlikely to be feasible, but this may be investigated further at the detailed design stage if required.

5.2 Surface Water Drainage Strategy

There is a slope over the site and surrounding area which indicates that groundwater in the vicinity of the site would drain towards the southeast.

There is a small pond towards the southern boundary.

Currently surface water from the site runs overland to the southeastern boundary.

There is a surface water sewer within the vicinity of the site towards the southeastern boundary.

The drainage options relating to the final discharge of surface water for this section of the site are listed in Table 5-2 in order of priority within the NPPF:

Option No:	Drainage Solution	Most feasible solution	Comments
a	Soakaway/Infiltration	3	Not likely to be feasible due to the impermeable ground conditions recorded in nearby borehole records.
b	Connection to Watercourse	2	There appears to be an unnamed watercourse flowing through the site and the pond on the southern boundary. Historical evidence shows the watercourse flowing to the east. It is believed that this has been picked up at the YWL 300mm diameter surface water sewer at chamber 1709. The condition of the culvert is unknown.
c	Discharge into a sewer	1	A connection into the 300mm diameter surface water sewer in the southeast of the site would be possible – subject to approval from the LLFA and connection consent from Yorkshire Water.

Table 5-2: Drainage options.

Table 5-3 provides a summary of the SuDS options appraisal with consideration of CIRIA C753 (The SUDS Manual)[7] for the development:

SuDS Option	Appropriate to Development	Comments
Soakaways	X	Due to the nature of the ground conditions, the use of infiltration systems may not be feasible.
Infiltration basin	X	Depressions that store and dispose of water via infiltration. May not be appropriate given the ground conditions.
Sand filter	✓	Treatment devices using sand beds as filter media.
Filter drains	✓	Linear trenches filled with a permeable granular material, often with a perforated pipe in the base of the trench.
Detention basin	✓	Dry depressions designed to hold water for a specific retention time.
Swales	*	Swales are shallow grass-lined channels that provide capacity for conveying flows at a controlled rate into ponds and watercourses. The slopes across the site are steep.
Rainwater harvesting	*	Rainwater harvesting collects the rain which falls onto roofs, then stores it in a tank until required for a non-potable use. When required, the water is pumped to the point of use, thus displacing what would otherwise be a demand for mains-water. In the process, a volume of water is kept out of the storm-water management system, thereby helping to reduce flooding risks. Rainwater harvesting systems are currently not included in the development proposals.
Green/blue roofs	*	Green roof installations can help to reduce surface water runoff from roof areas depending on the system specified. Green roofs are not currently included in the development proposals.
Geo-cellular storage systems	✓	Modular block systems can be used to provide an underground storage facility. Any geo-cellular storage systems should be lined with a geo-membrane to provide attenuation storage.
Permeable Pavements – with granular and geo-cellular storage systems	✓	Permeable pavements allow inflow of rainwater into underlying construction. Any geo-cellular storage systems would have to be lined with an impermeable membrane to provide storage rather than infiltration for runoff from highways.
Ponds	✓	Attenuation ponds can be used to offset the increase in surface water flows attributable to increased area of hard standing, in order to minimise the risk of flooding to and from the proposed development. Ponds will attenuate the surface water flow prior to discharging to the public surface water sewers. The storage volume afforded by these features should not include any permanent water in the pond.
Oversized Pipes	✓	Oversizing the pipes that make up the on-site drainage network is a cost-effective method for providing attenuation storage within the network. Such systems could be considered on the parts of the development where gradients are relatively flat.
Tanks	✓	Prefabricated underground tanks could be considered at the detailed design stage in order to provide storage to attenuate surface water runoff.
Flow control devices	✓	The peak flow rates will be controlled by flow control devices e.g. hydrobrake style flow control systems, and restricted orifices. Flow control devices enable the discharge to be restricted to a constant rate from the development.

Table 5-3: Summary of the SuDS options appraisal.

Notes

✓ Suitable for use given the nature and scale of the development.
* Possibly suitable for use – not included in the client and architect design proposal at present
X Not suitable

[7] CIRIA C753 - The SUDS Manual. London 2015.

5.3 Surface Water Attenuation Requirements

In line with Yorkshire Water, the flow from this development should be reduced by the minimum of 30% from the existing runoff rates for estimating the attenuation volumes required.

It is estimated from the supplied plan (see Appendix A) that the site will have the following designated areas (Table 5-4). Table 5-4 shows the assumed split in area included within the calculations.

Designated Areas	Plot Area
Total area (ha)	8.09
Development Area (ha)	2.60
Impermeable Area (ha)	1.90
Green Infrastructure (ha)	0.70
Contributing Catchment	
Catchment Area (ha)	2.60
Impermeable split (ha)	1.90
Permeable split (ha)	0.70

Table 5-4: Assumed plot areas.

As no proposed plans are available it has been assumed that there is no change in impermeable area from the existing usage to the proposed. This is likely to require attenuation to reduce the existing flow off site to a level which is acceptable to the LLFA and to YW.

5.3.1 Attenuation Estimate

Surface water storage and existing runoff estimations based on the HR Wallingford procedure have been undertaken for the development and the output report is presented in Appendix E.

- Q_{bar}: 253.10 l/s
- 1 in 1-year existing runoff rate: 177.60 l/s
- 1 in 30-year existing runoff rate: 449.80 l/s
- 1 in 100-year existing runoff rate: 570.40 l/s

This reduced by 30% would give the following rates:

- Q_{bar}: 177.17 l/s
- 1 in 1-year existing runoff rate: 124.32 l/s
- 1 in 30-year existing runoff rate: 134.94 l/s
- 1 in 100-year existing runoff rate: 399.28 l/s

Yorkshire Water has specified an allowable discharge rate of 3.5l/s to the onsite surface water sewer.

All runoff estimates, and subsequent storage estimates are included in Appendix E.

The following attenuation has been estimated for the development using 3.5l/s runoff rates and utilises the FSR methodology[8] as:

[8] Flood Studies Report Wallingford NERC 1975.

- Attenuation storage volume: **779.4 m³** (1 in 30-year event)
- Retention on site volume: **1334.2 m³** (1 in 100 year + 20% Climate Change)
- Retention on site volume: **1626.2 m³** (1 in 100 year + 40% Climate Change)

Attenuation storage aims to limit the peak rate of runoff from the development to the corresponding 3.5l/s runoff for a range of annual flow rate probabilities before discharging into the surface water sewer. As the flow from the development would be restricted there should be little change in the flows that enter the public sewer and thus the risk of flooding as a result from the development should be negligible.

The attenuation required for a 1 in 30-year storm event, requires a storage volume of **779.4 m³**. For the 1 in 100-year event, a storage capacity of between **1334.2 m³** and **1626.2 m³** will be required from on-site storage as well as SuDS systems. All volumes can be stored within the site boundary and discharges will be limited by flow control devices to the adjacent surface water sewer.

5.4 Site Specific SuDS

The use of an attenuation tank or similar is deemed to be the most feasible and practical option for the development. The attenuation tank will provide required storage volume to limit peak runoff arising from the development.

Utilisation of a flow control device at the end of the system will control the peak flow rates.

The use of permeable paving may be viable dependant on the detailed design of the proposed development. If this drainage technique is considered to be feasible then it will reduce the requirement for attenuation as it will reduce the contributing impermeable area. The permeable paving will also provide some level of water treatment reducing effects of pollution in runoff on the environment.

Assuming that the outline drainage strategy is acceptable to the Local Authority, a more detailed design can be presented and agreed with the appropriate regulatory bodies during the detailed design phase.

5.5 Foul Drainage

The foul water could be discharged into the 300mm diameter public combined sewer recorded on site to the southeast at an unrestricted rate.

6 Mitigation Measures

6.1 Proposed Site levels and Developments Level

Current Environment Agency guidance recommends that the minimum ground floor levels of developments are set at a minimum of 600mm above the 1% annual probability (1 in 100 year) flood level including an additional fluvial allowance for climate change. It is generally accepted that vehicle parking can be accommodated within the flood zone with suitable safeguards. The 'design' flood level for the site should therefore be the 1% annual probability event with allowance for climate change.

The 0.1% annual probability (1 in 1000-year) flood extents are below the existing ground level on site. As this report is for an existing property the finished floor levels (FFL) should be set as no lower than the existing floor level and as a nominal height above the finalised ground levels to allow for any overland flow from a drainage failure, so as not to increase the risk of flooding.

6.2 Safe Access

Safe and dry access is available to the north of the site above the 1% annual probability event via Fernside Avenue. Therefore, no mitigation is proposed.

6.3 Flood Resistance and Resilience

The development proposed may be subject to flooding at more extreme events than those considered. However, the risk appears to be sufficiently low that flood resilience measures need not be included into ground floor construction to aid recovery after any event. If utilised, typical measures would include solid floors, use of suitable materials and services fed from upper floors with outlets at high level. The need can be discussed and agreed with building control officers during detailed design.

6.4 Residual Risk

It is impossible to completely guard against flooding since extreme events greater than the design standard event are always possible. However, it is likely that with the 1% annual probability flood event with an allowance for climate change significantly below the lowest site levels, the relatively elevated position of the development will safeguard it from localised fluvial flooding during extreme rainfall events and fluvial flooding events outside the scope of this assessment. However, ground floor levels should be set above proposed levels across the site and provide a nominal freeboard to allow overland flow under exceptional conditions. Overland flow routes should be considered in case of drainage failure and the extreme events.

7 Conclusions

The site currently consists of the Almondbury Sports Centre and the former Almondbury High School. It is understood the development will comprise proposals to retain the swimming pool and sports centre following the demolition of the existing school building. The detail of future development at the school site has yet to be determined. It has been assumed that the area of the development will be similar to the existing for the purposes of this assessment.

The site is shown on published mapping to be located within the Environment Agency's Flood Zone 1. Comparison of topographical data with the EA modelled flood level data indicates that the whole site is in Flood Zone 1 – Very Low Risk of fluvial flooding.

Negligible to Low Risks of flooding from all sources have been identified from information provided by the EA and BGS.

An assessment of these risks in conjunction with the development proposals have resulted in the following recommendations for the safe development of the site:

- The finished floor level should be set at a nominal height above the finished ground levels to allow for overland flow routes in extreme events and drainage failures.
- Pedestrian and vehicular safe access to and from the site is achievable under all conditions via the access road off Fernside Avenue.
- Potential for soakaway use for rainwater disposal is low; however, this could be investigated further at the detailed design phase if required.
- Surface water flow will likely need to be attenuated to a reduced rate to be agreed with the LLFA. The attenuation estimates are based upon the 3.5l/s requested by YW.
- Surface water arising from the site could potentially discharge into the surface water sewer located within the south of the site.
- Foul sewage could be discharged into the existing combined sewer to the southeast subject to the agreement of Yorkshire Water.
- A formal evacuation plan is not considered to be required.

Further details on the proposed mitigation measures are provided in Section 6. All proposed measures should be agreed with the Local Authority prior to commencement of the development.

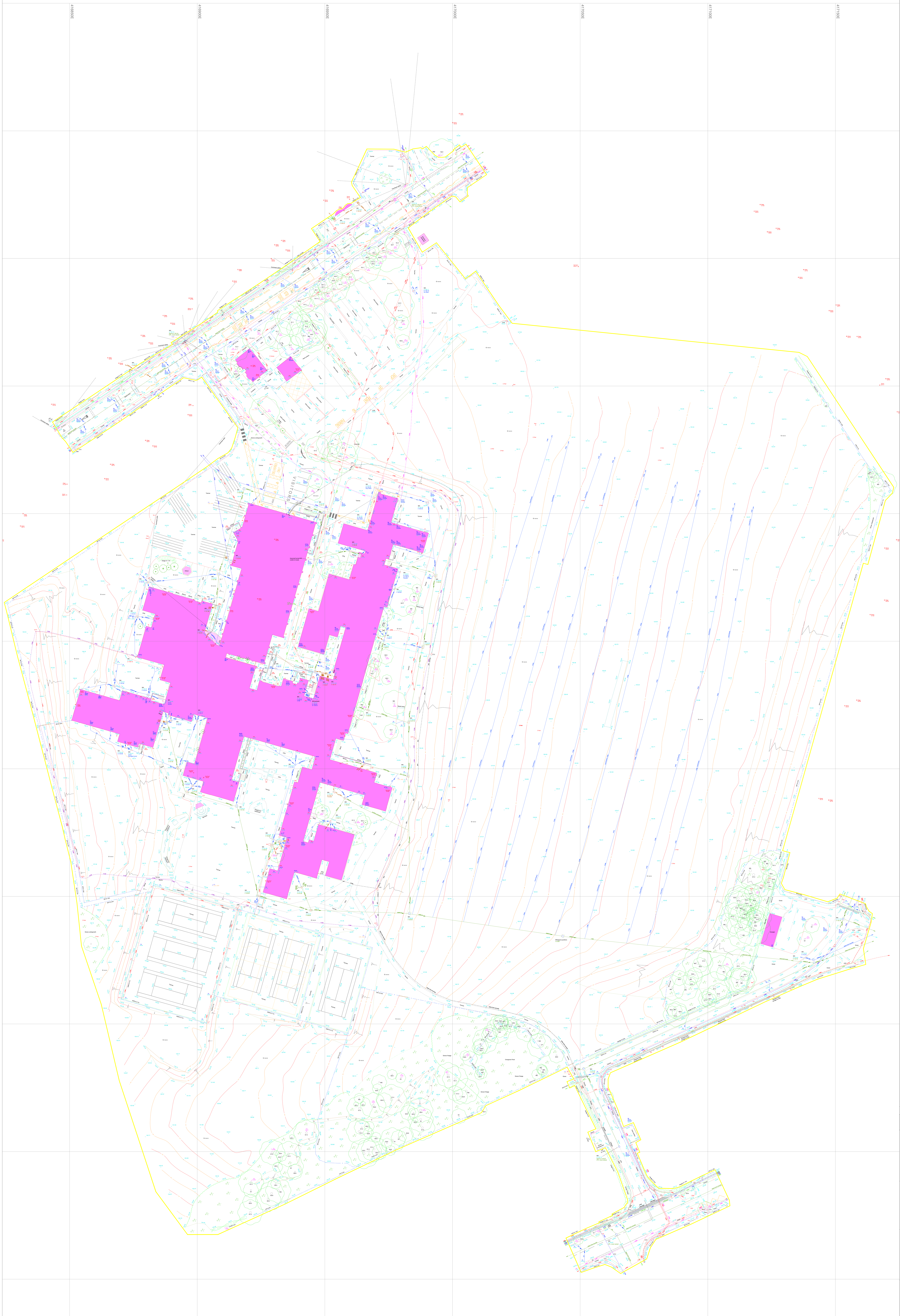
Appendix A

Figures, Plans and Drawings

Client: Wilde Consulting Engineers				Title: Site Location & Boundary Plan	LK CONSULT
Site: Almondbury SEND School				Scale (see scale bar): 1:25,000 & 1:6,000 @ A4	Figure: 1 / Revision:
Job No.: FRA 22 1180	Drawn By: JL	Checked By: MJ	Drawn: Jan 2023		

Appendix B

Site Information



GENERAL NOTES

1. Do not scale.

2. This drawing is to be read in conjunction with all other relevant drawings.

3. Should there be any discrepancy between details indicated on this drawing and those indicated on other drawings the Engineer should be informed PRIOR to construction on site.

4. Until technical approval has been obtained from the relevant Authorities it should be understood that all drawings issued are preliminary and NOT for construction. Should the contractor start site work prior to approval been given, it is entirely at his own risk.

5. All dimensions shown are in metres unless noted otherwise.

6. This drawing is based on Mapmatic Drawing Number, Sc500@A0_Topo & Utility Survey, dated 13.01.23.

7. All survey information is provided by the surveying company and HSP cannot accept any liability for any discrepancies there in. All survey information to be verified on site by contractor. Should discrepancies be identified, HSP to be notified immediately.

Station	Easting (m)	Northing (m)	Level (m)
S1	416906.387	415903.391	132.921
S1A	416923.892	415940.963	131.236
S1B	416895.463	415967.836	130.195
S2	416969.716	415944.575	129.668
S3	416997.226	415893.507	130.809
S4	416981.910	415795.937	130.848
S5	416965.917	415734.086	130.360
S6	416906.012	415754.445	132.609
M1	417048.122	415681.870	123.442

REV	DATE	DESCRIPTION OF WORK	SURVEYOR	CHECKED BY

ABBREVIATION KEY

AR	Assumed Route	PTG	Pipe to Ground	Av	Air valve	G:	Girth circumference	Sv	Stop valve
BD	Base Bend	PTS	Pipe to Surface	Bg	Back gully	Gy	Gully	TCB	Telephone call box
BD	Backdrop	RE	Rodding Eye	BH	Borehole	Ht.	Height	TTL:	Tree top level
BL	Bed Level	RWP	Rainwater Pipe	BM	Benchmark	IC	Inspection cover	THL	Threshold level
CL	Cover Level	SV	Stop Valve	Boll	Bollard	IFL	Internal floor level	TCB	Telephone call box
CR	Cable Riser	SVP	Soil Vent Pipe	Bs	Bus stop	IL	Invert level	TL	Traffic light
DP	Down Pipe	TE	Trapped Exit	BT	British Telecom	Lb	Letter box	THL	Threshold level
EOT	End of Trace	TFR	Taken From Records	Bg	Back Gully	Lp	Lamp Post	Tp	Telegraph post
EP	Electricity Pole	TP	Telegraph Pole	CL	Cover Level	MG	Multigirth	Ts	Traffic signal
FH	Fire Hydrant	UTF	Unable to Find	CBX	Control box	MH	Manhole	TT	Tactile paving
G	Gully	UTL	Unable to Lift	CPS	Concrete paving slab	Mkr	Marker post	Twl:	Top of wall level
GV	Gas Valve	UTS	Unable to Survey	CTV	Cable TV cover	NVP	No visible pipes	UTL	Unable to lift
HOR	Head of Run	UTT	Unable to Trace	Elc	Electric cover	PInv	Pipe invert	WL	Water level
HL	High Level	VP	Vent Pipe	Ep	Electricity post	Pb	Post box	Wm	Water meter
IC	Inspection Chamber	WL	Water Level	Er	Earth rod	Re	Rodding eye	Wo	Wash out
IL	Invert Level	WM	Water Meter	Fh	Fire hydrant	Sp	Sign post		
MH	Manhole	WO	Wash Out Valve	Fs	Flagstaff	St	Stop tap		
PR	Pipe Riser	D	Depth						

Ordnance Survey information is provided for a guide only.
OS BUILDING OUTLINE
OS DETAIL

Road
Drop Kerb
Verge Tarmac
Verge Concrete
Verge Grass
Verge
Tops
Bottoms

KEY

FL: Floor level
CL: Ceiling level
SusCL: Suspended ceiling level
U/S: Underside level
SHL: Sill height level
HHL: Head height level
SPR: Spring Point
Heater / radiator
Ground light
Door / sliding door
Inspection cover
Building line
Beam
Window
Dimension

UTILITY SURVEY NOTES

Electromagnetic and/or ground penetrating radar techniques have been used to locate and map underground utilities and features on this drawing. HSP have made every endeavour to make sure that the information contained within this drawing is accurate and of the highest quality. However, the results from these types of surveys are not infallible and should the location or depth of services/features be of particular importance to a project, then it is strongly advised that trial excavations should be undertaken to confirm survey results.

HSP have used all record drawings that were available to us by the client or by the statutory utility providers at the time of the survey. Any information taken from these drawings (ie pipe sizes, material) is not guaranteed. Services located from record drawings will be shown and annotated as taken from records (tfr). Historic record information is often incomplete/inaccurate and cannot be relied upon.

A single line indicating a utility may indicate the presence of multiple services within close proximity to each other. Where a single line type is shown we recommend hand digging within 0.5m, to expose hidden services.

Where quoted, depth information of underground services/features is stated. Depths are generally +/- 10% accurate, but cannot be guaranteed. Any depths shown are usually to the top of the service/feature. Gravity sewers and drains are usually to invert (base of drainage channel) unless otherwise stated.

Site specific notes:

Utility survey boundary is indicated on the drawing within the layer UG - Survey Boundary.

HSP strongly recommend all silted or surcharged drainage runs, manholes and gullies be jetted, cleraed and re-surveyed thereafter.

HSP strongly recommend having a CCTV survey to obtain a more complete picture of the system including the location of possible buried manholes and the position of lateral connections.

Any service annotated (TFR) for taken from records are to be used as a guide only and not to be considered accurate.

Any service annotated (a/r) for assumed route are to be used as a guide only and not to be considered accurate.

KEY FOR UNDERGROUND SERVICES

Foul water
Surface water
Other
Gas — GAS
Electric — E
Telephone — BT
Cable TV — CATV
Unidentified — U
Water — W
Closed Circuit TV — CCTV
Communications — COM
Heating Pipe — HP
Empty Duct — ED
Fibre Optics — FO
Vents — V
Pipe — PIPE
Traffic Signal — TS
Gauge Lines — G
Vapor Recovery — VR
Offsets — O
Fuel — F

Where chamber extents are significantly greater than the cover size, their approximate extents are shown thus;

REV	BY	DATE	DETAILS	CKD
-	-	-	-	P01

STATUS: For Information

CLIENT: Frank Shaw Associates

PROJECT: Almondbury, Heckmondwike

TITLE: Topographical & Utilities Survey

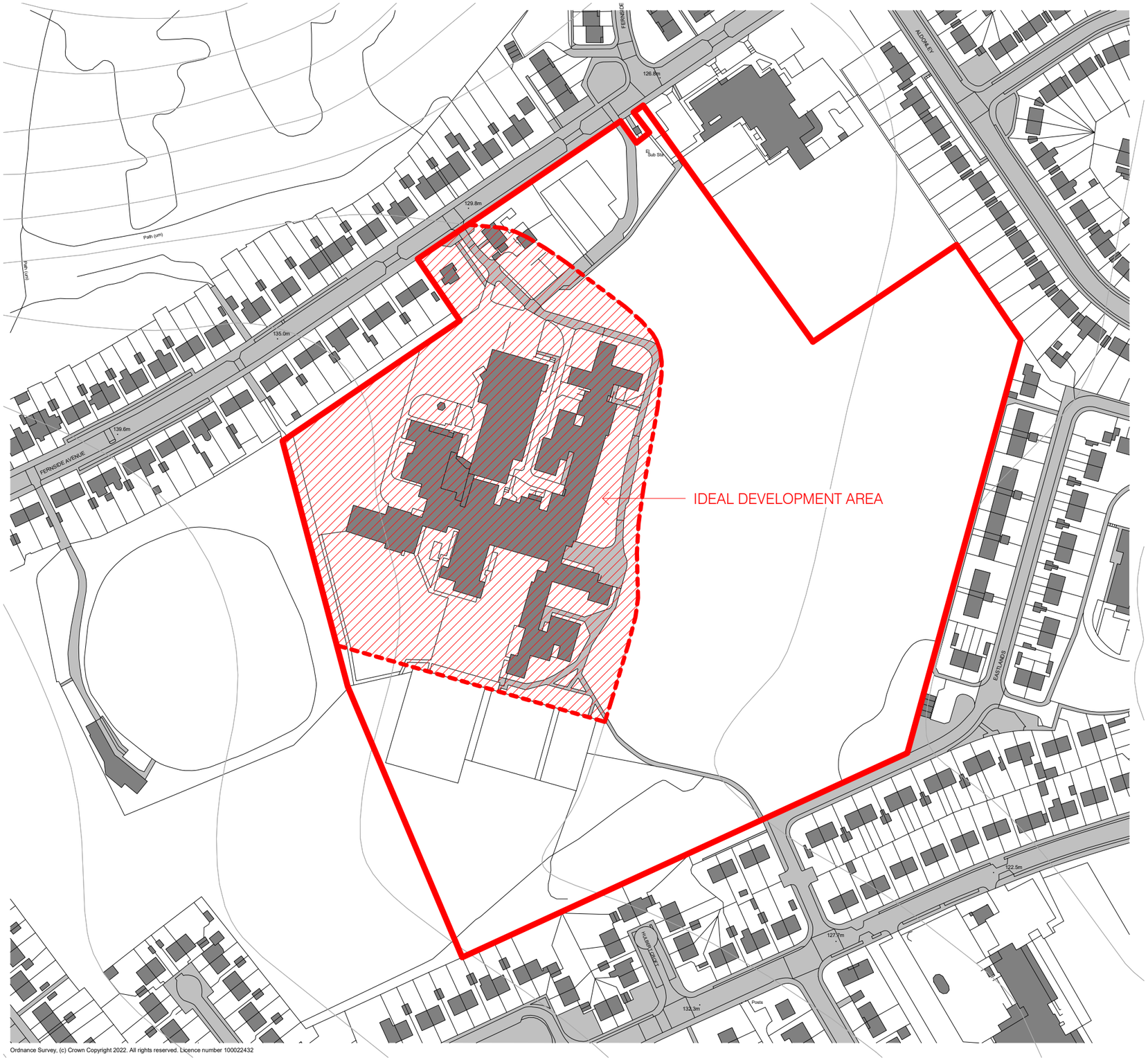
hsp consulting

Lawrence House, 6 Meadowbank Way, Eastwood, Nottingham, NG16 3SB
Tel: 01773 535555 www.hspconsulting.com

SCALE	PROJECT NO.	SHEET SIZE A0
1:500	C4202	

DATE	DRAWN	CHECKED
13.01.23	LK	LAB

DRAWING NO.: C4202-HSP-00-00-DR--C-500
REV: P01



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LOCATION: HOLME AVENUE, HUDDERSFIELD

TP 1 AND 2

Method: Excavated by JCB

Date: 9.7.87

Casing:

Sheet 1 of 2

R.L. m A.O.D.	DEPTH m	SOIL DESCRIPTION 416360 / VERTICAL SCALE 1:25 416241	SAMPLING No.	SAMPLING Depth	TEST	RESULT
	0.0	TRIAL PIT 1 G.L.				
	0.15	Topsoil.				
	0.7	Firm brown-grey silty CLAY with occasional sandstone cobbles and fragments of shale.				
	2.4	Brown-grey fractured silty SHALE with bands of ironstained shaly mudstone.				
		End of trial pit : dry.				
	0.0	TRIAL PIT 2 416344 / 416259 G.L.				
	0.1	Topsoil.				
	0.7	Firm light brown and grey silty CLAY, grey-brown with depth.				
	1.0	Blue-grey very clayey SHALE.				
	2.15	Blue-black thinly bedded SHALE, iron-stained and fractured, occasional thin partings of carbonaceous SHALE.				
		End of trial pit : trace of water.				

Dunelm
GEOTECHNICAL • ENVIRONMENTAL

BOREHOLE RECORD

BH No. **R4**
Sheet 1 of 1

Site: Somerset Road, Huddersfield

Contract No: Q1119

Client: JCT 600 (Properties) Ltd

Dates: 29/03/2003

Method: Rotary openhole boring.

Scale 1:100

Driller: Drilltec

Logged By: DB

SAMPLE DETAILS						Groundwater (Casing)	STRATA RECORD				
Type	Depth From - To (m)	TCR (%)	SCR (%)	RQD (%)	N (FI)		Description	Depth (m)	Level (mAOD)	Legend	Well
							MADE GROUND: Black SAND and GRAVEL. Sand includes ash.				
							Brown sandy gravelly CLAY.	3.50			
							Grey MUDSTONE with bands of grey siltstone noted.	4.50			

Remarks and Water Observations
1. Groundwater encountered at 16.0m depth.
2. No evidence of broken ground or loss of flush returns.

End of Borehole at 20.00 m

GL (m AOD) -
Easting: -
Northing: -

Fig. No. R 4

Geology 1:50,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	MGR	Made Ground (Undivided)	Artificial Deposit	Not Supplied - Holocene
	WMGR	Infilled Ground	Artificial Deposit	Not Supplied - Holocene
	SLIP	Landslide Deposit	Unknown/Unclassified Entry	Not Supplied - Quaternary

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
		Rock Segments		

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Not Supplied - Holocene
	GFDMP	Glaciofluvial Deposits, Mid Pleistocene	Sand and Gravel	Not Supplied - Cromerian
	LDE	Lacustrine Deposits	Clay and Silt	Not Supplied - Quaternary
	HEAD	Head	Clay, Silt, Sand and Gravel	Not Supplied - Quaternary

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	PLCM	Pennine Lower Coal Measures Formation	Mudstone, Siltstone and Sandstone	Not Supplied - Westphalian
	GM	Greenmoor Rock	Sandstone	Not Supplied - Westphalian
	GR	Grenoside Sandstone	Sandstone	Not Supplied - Westphalian
	EF	Elland Flags	Sandstone	Not Supplied - Westphalian
	EYR	80 Yard Rock	Sandstone	Not Supplied - Westphalian
	PLCM	Pennine Lower Coal Measures Formation	Sandstone	Not Supplied - Westphalian
	KKBS	Kirkburton Sandstone	Sandstone	Not Supplied - Westphalian
	STNR	Stanningley Rock	Sandstone	Not Supplied - Westphalian
	TKS	Thick Stone	Sandstone	Not Supplied - Westphalian
	CLRK	Clifton Rock	Sandstone	Not Supplied - Westphalian
		Faults		

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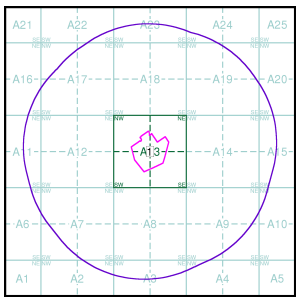
Geology 1:50,000 Maps

This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published paper maps.
The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page. Not all layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:50,000 Maps Coverage

Map ID:	**1**
Map Sheet No:	**077**
Map Name:	**Huddersfield**
Map Date:	**2003**
Bedrock Geology:	**Available**
Superficial Geology:	**Available**
Artificial Geology:	**Available**
Faults:	**Not Supplied**
Landslip:	**Available**
Rock Segments:	**Not Supplied**

Geology 1:50,000 Maps - Slice A



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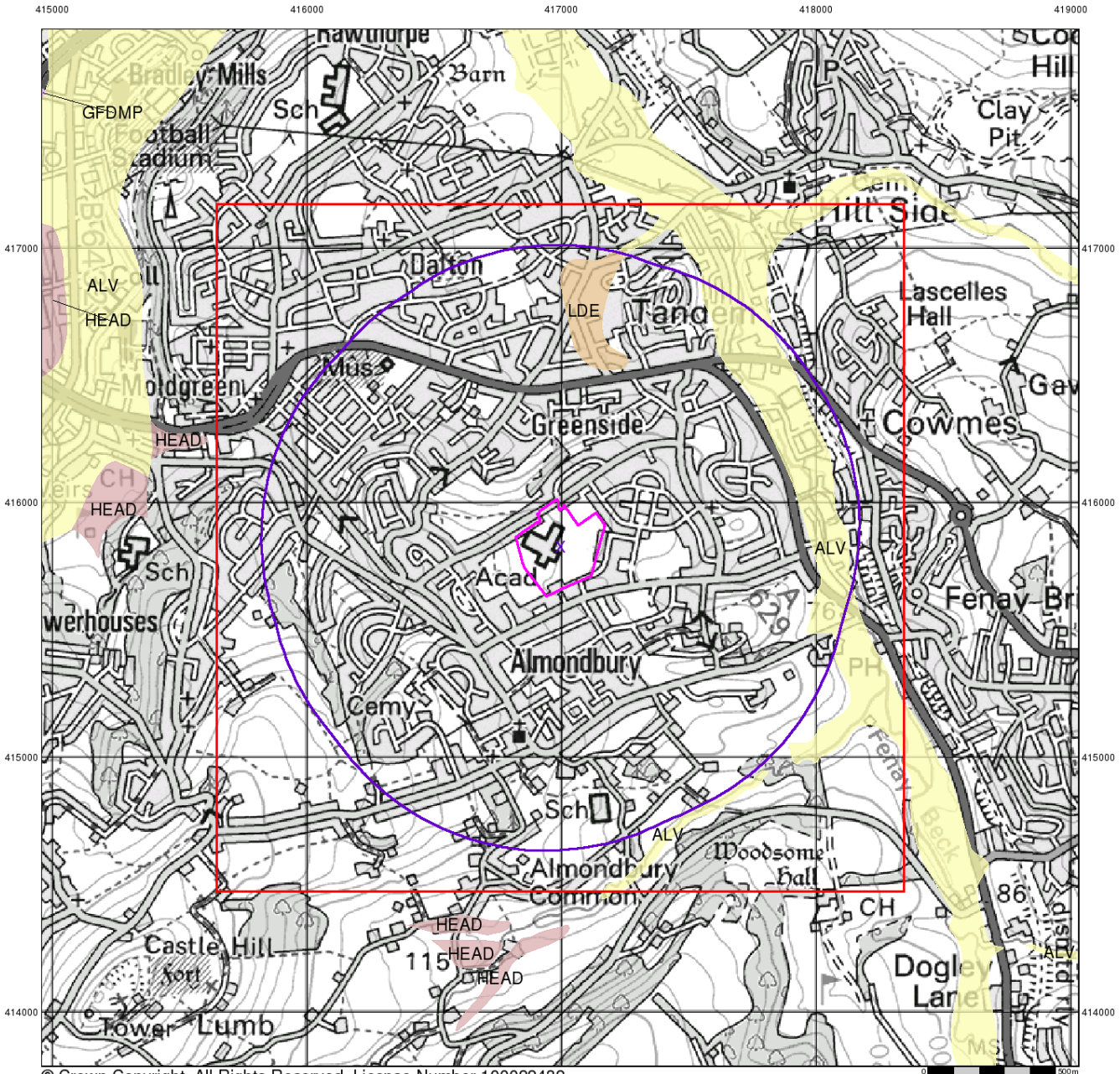
Search Buffer (m):	1000

Site Details:

Almondbury SEND School, Fernside Avenue, Huddersfield, HD5 8PG



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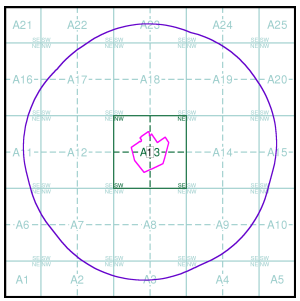
Superficial Geology

Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, the Quaternary, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A



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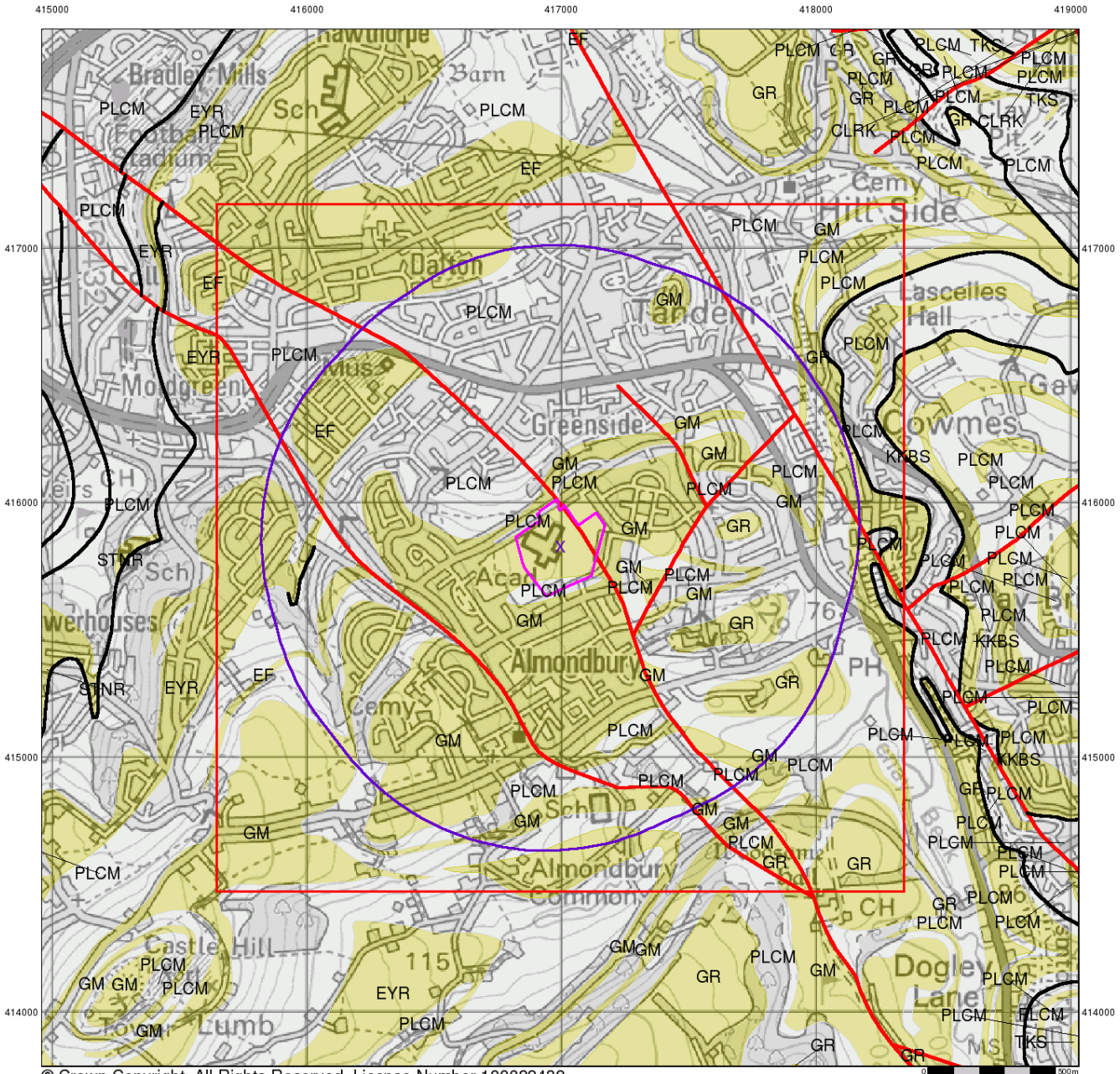
Web: www.envirocheck.co.uk



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Bedrock and Faults

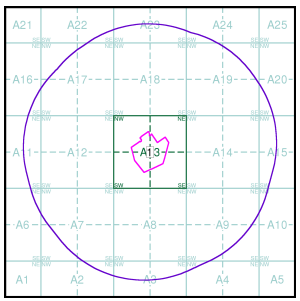
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults (e.g. normal, thrust), and thin beds mapped as lines (e.g. coal seam, gypsum bed). Some of these are linked to other particular 1:50,000 Geology datasets, for example, coal seams are part of the bedrock sequence, most faults and mineral veins primarily affect the bedrock but cut across the strata and post date its deposition.

Bedrock and Faults Map - Slice A



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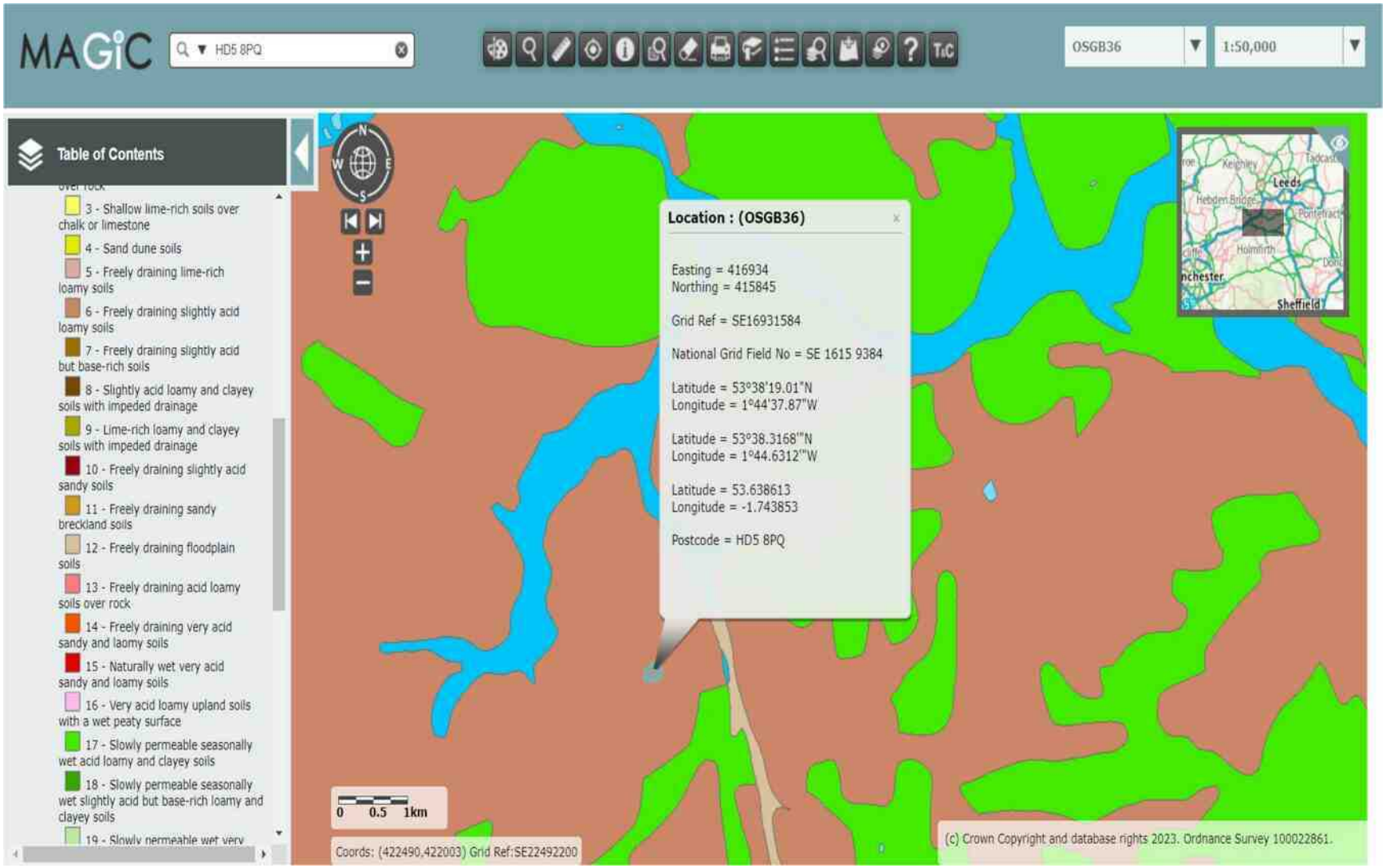
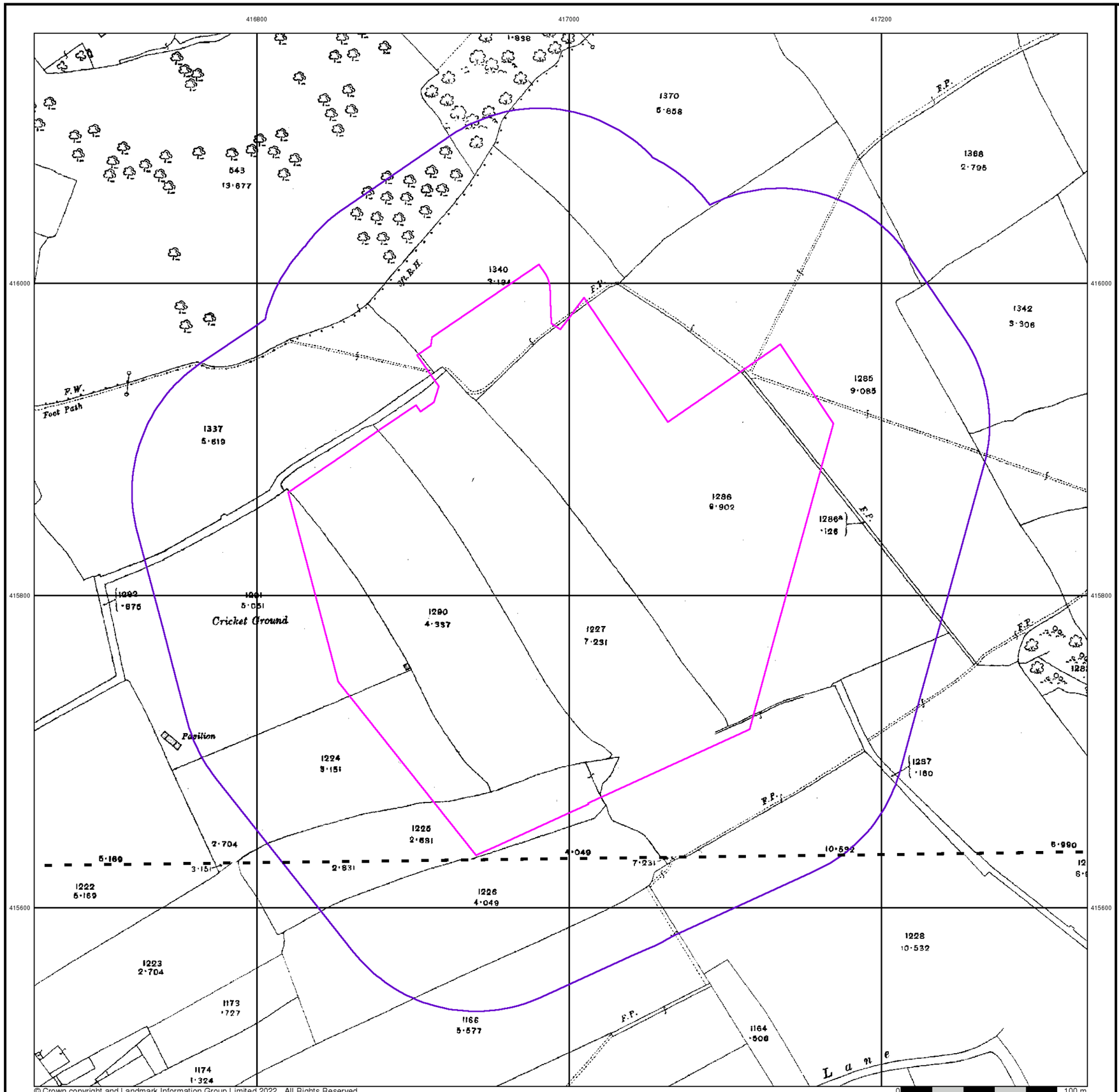


Defra Soilscape Mapping - (c) Crown Copyright and database rights 2023. Ordnance Survey 100022861



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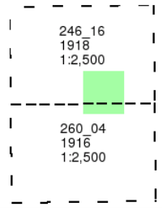
Yorkshire

Published 1916 - 1918

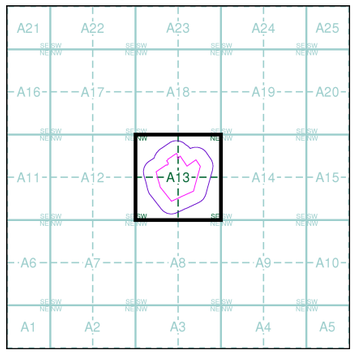
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



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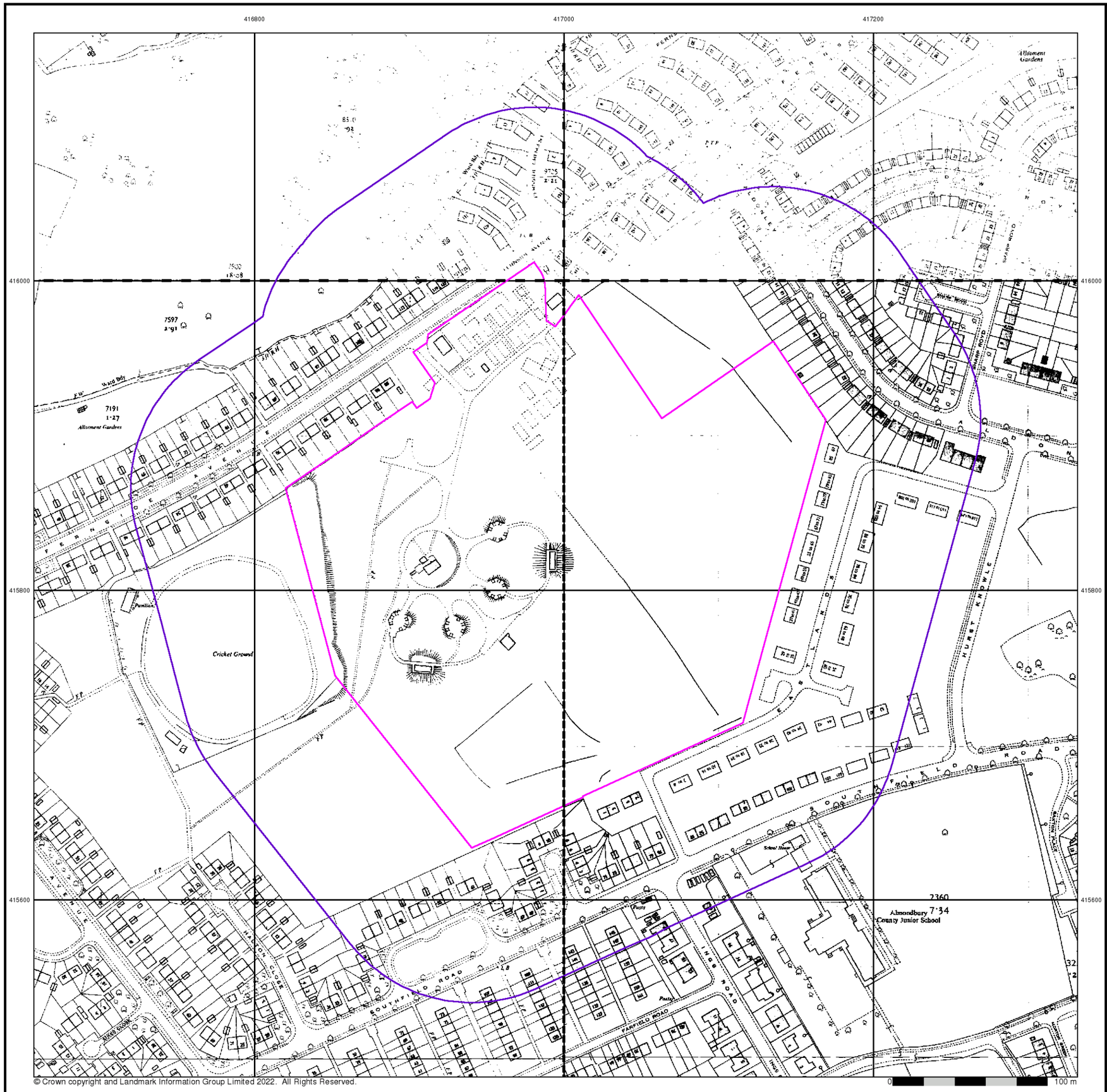
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LK GROUP

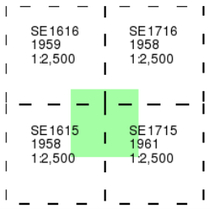
Ordnance Survey Plan

Published 1958 - 1961

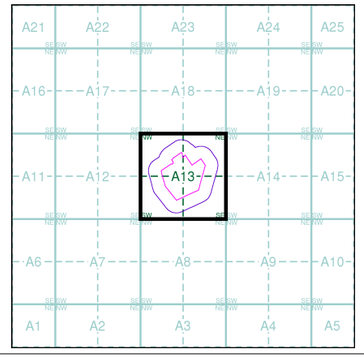
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

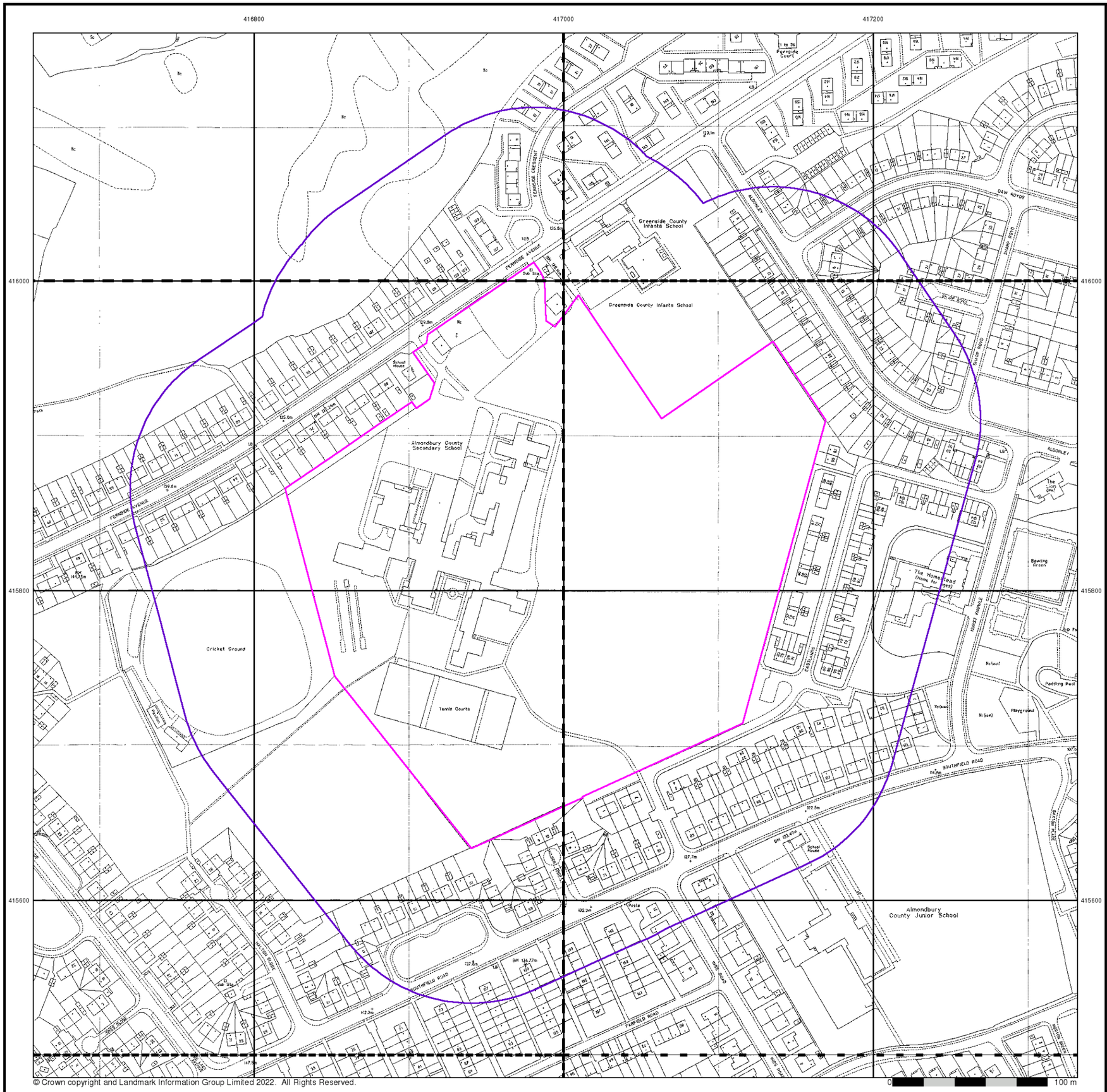
Order Number:	304844380_1_1
Customer Ref:	LKC 22 1679
National Grid Reference:	417000, 415830
Slice:	A
Site Area (Ha):	8.09
Search Buffer (m):	100

Site Details

Almondbury SEND School, Fernside Avenue, Huddersfield, HD5 8PG

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LK GROUP

Large-Scale National Grid Data

Published 1993

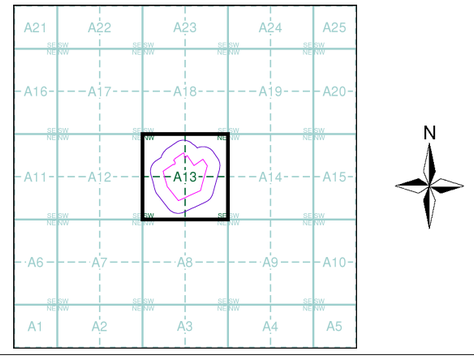
Source map scale - 1:1,250

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)

SE1616SE 1993 1:1,250
SE1716SW 1993 1:1,250
SE1615NE 1993 1:1,250
SE1715NW 1993 1:1,250
SE1615SE 1993 1:1,250
SE1715SW 1993 1:1,250

Historical Map - Segment A13

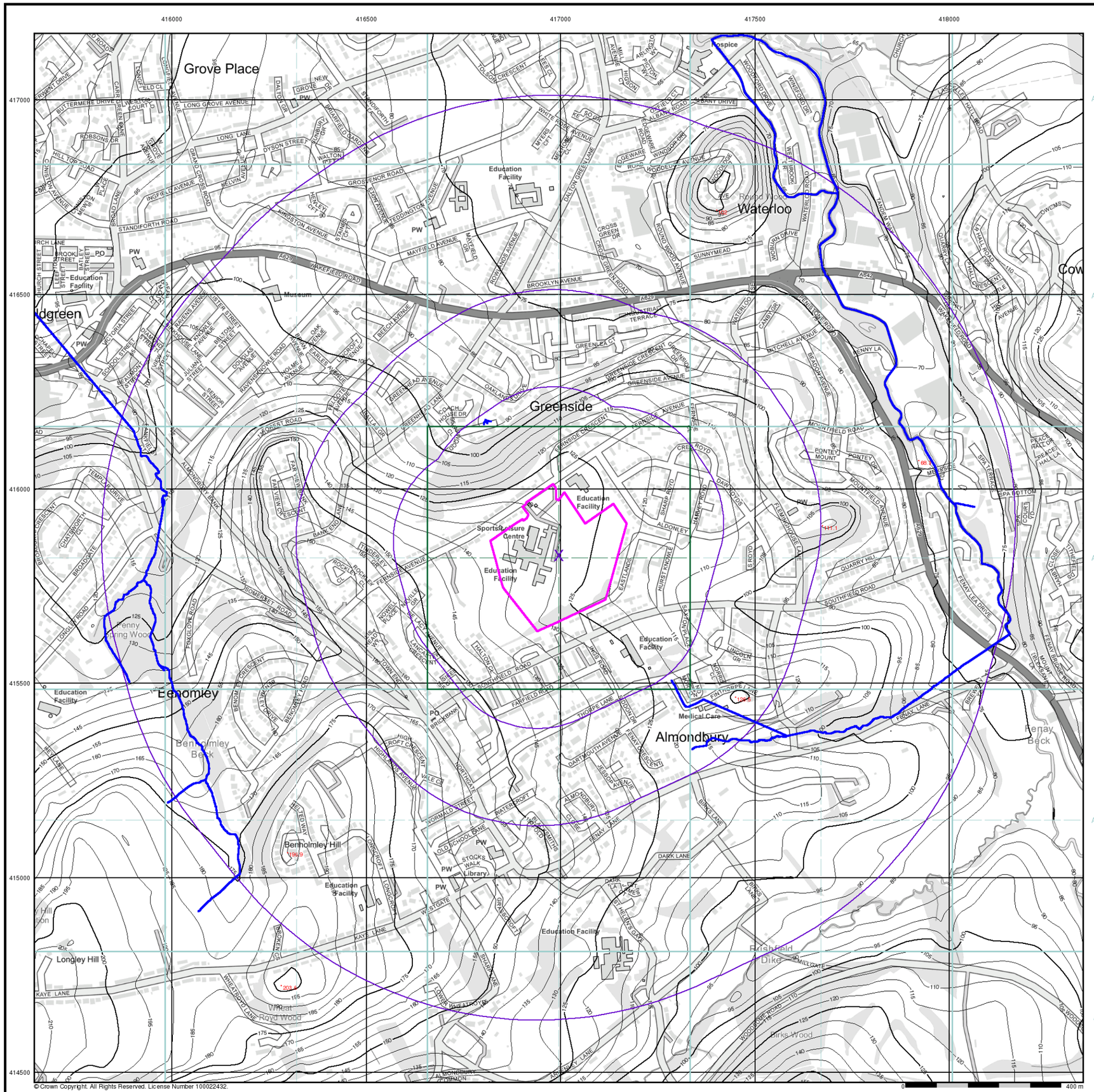


Order Details

Order Number:	304844380_1_1
Customer Ref:	LKC 22 1679
National Grid Reference:	417000, 415830
Slice:	A
Site Area (Ha):	8.09
Search Buffer (m):	100

Site Details

Almondbury SEND School, Fernside Avenue, Huddersfield, HD5 8PG



LK GROUP

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

OS Water Network Data

- Canal
- Reservoir
- Foreshore
- Marsh
- Tidal River
- Inland River
- Drain
- Other
- Lake
- Transfer
- Lock Or Flight Of Locks
- Sea

Contours (height in meters)

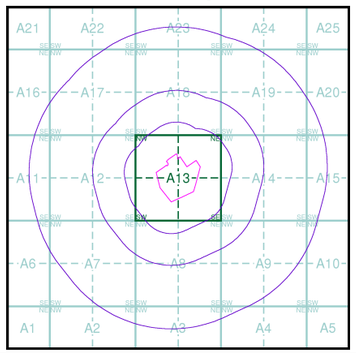
Standard Contour 105 100 95

Master Contour

Spot Height 167.3

- MLW Mean Low Water
- MHW Mean High Water

OS Water Network Map - Slice A



Order Details

Order Number:	304844380_1_1
Customer Ref:	LKC 22 1679
National Grid Reference:	417000, 415830
Slice:	A
Site Area (Ha):	8.09
Search Buffer (m):	1000

Site Details

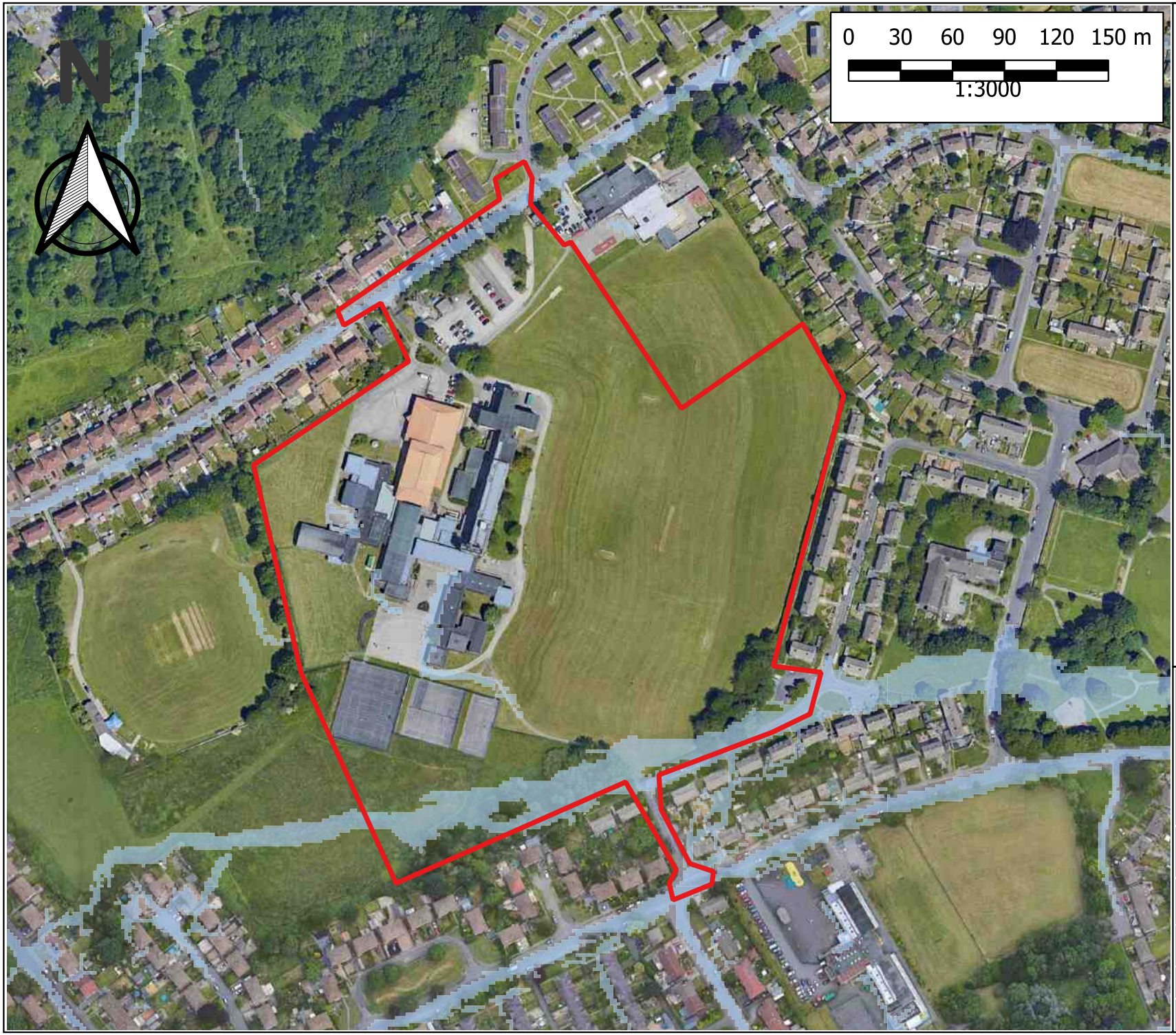
Almondbury SEND School, Fernside Avenue, Huddersfield, HD5 8PG

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix C

Environment Agency Data



KEY

Site Location

Sampling locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provbided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.

LK CONSULT LIMITED

Client: Wilde Consulting Engineers

Site: Almondbury SEND

Title: Low Surface Water Risk

Job No.:	Scale (see scale bar):	Figure:	Rev:
FRA 22 1180	1:3000 @ A4	1	

Drawn By:	Checked By:	Drawn:
JL	MJ	Feb 2023

KEY

Site Location

Medium Risk

High Risk

Sampling locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.

LK CONSULT LIMITED

Client: Wilde Consulting Engineers

Site: Almondbury SEND School

Title: Medium& High Surface Water Risk

Job No.	Scale (max paper size)	Figure	Rev.
FRA 22 1180	1:3000 @ A4	1	

Drawn By	Checked By	Drawn
JL	MJ	Feb 2023

Flood map for planning

Your reference	Location (easting/northing)	Created
ALMONDBURY	**416997/415820**	**3 Feb 2023 12:38**

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

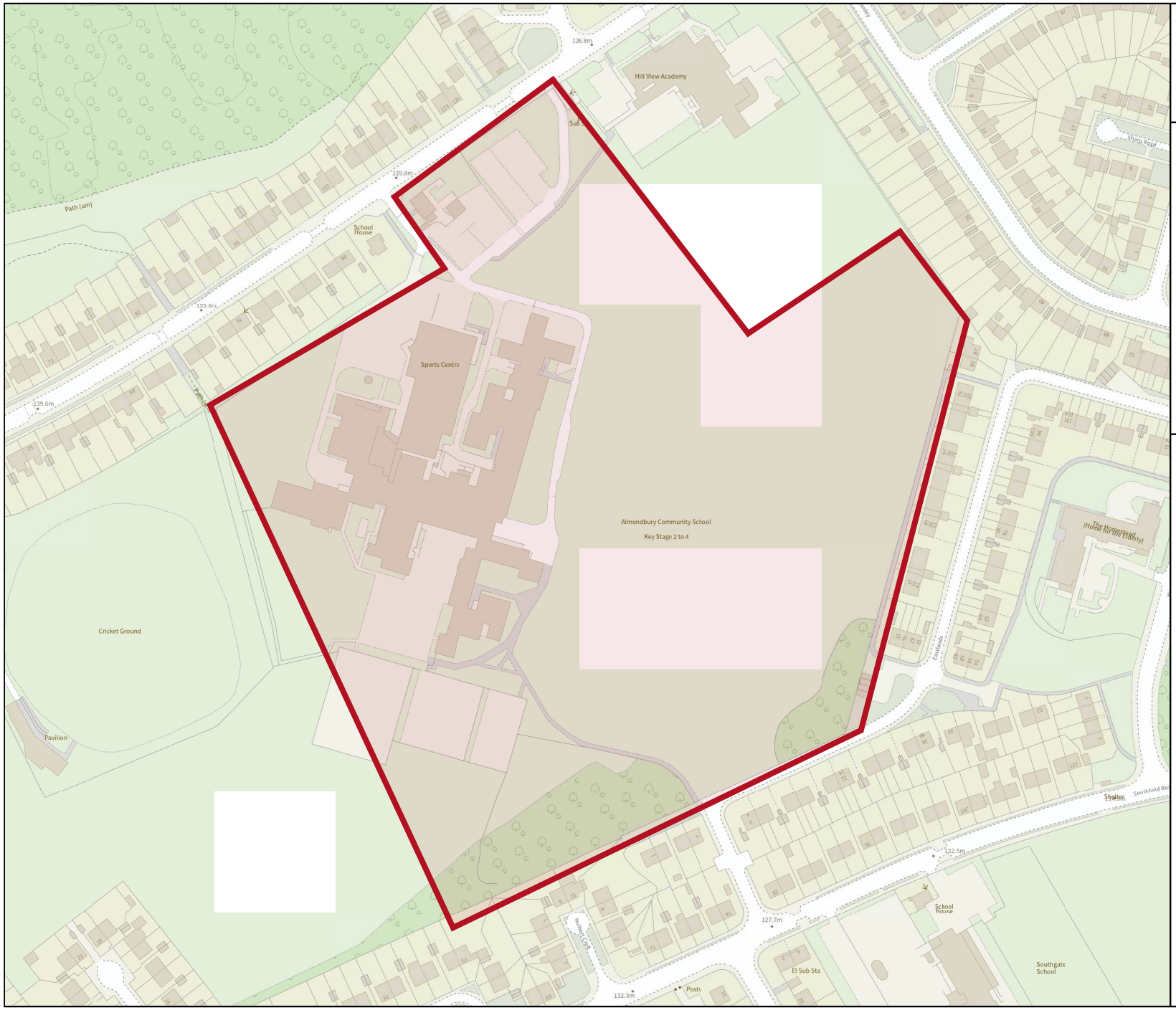
Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence **which** sets out the terms and conditions for using government data. https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2022 OS 100024198. https://flood-map-for-planning.service.gov.uk/os-terms



Environment Agency

Flood map for planning

Your reference
ALMONDBURY

Location (easting/northing)
416997/415820

Scale
1:2500

Created
3 Feb 2023 12:38

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

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Appendix D

Consultee Correspondence

Yorkshire Water Services
Developer Services
Pre-Development Team
PO BOX 52
Bradford
BD3 7AY

Tel: 0345 120 8482
Fax:

Email:
technical.sewerage@yorkshirewater.co.uk

For telephone enquiries ring:
George Mullaney on 0345 120 8482

15th December 2022

LK Group
Eton Business Park; Eton Hill Road
Radcliffe
M26 2ZS
flooding@thelkgroup.com

Your Ref:
Our Ref: Y014431

Dear Ms Lowe,

Almondbury SEND School, Fernside Avenue, Huddersfield, HD5 8PQ - Pre-Planning Enquiry U871250

Thank you for your recent enquiry and remittance. Our official VAT receipt has been sent to you under separate cover. Please find enclosed a complimentary extract from the Statutory Sewer Map which indicates the recorded position of the public sewers. Please note that as of October 2011 and the private to public sewer transfer, there are many uncharted Yorkshire Water assets currently not shown on our records.

The following comments reflect our view, with regard to the public sewer network only, based on a 'desk top' study of the site and are valid for a maximum period of twelve months:

Existing Infrastructure

There is a 300mm diameter public combined and a 300mm diameter surface water sewer recorded crossing the site. No buildings, or other obstructions, are to be erected within 3 (three) metres is required at each side of the sewer centre-line, no trees planted within 5 (five) metres of this public sewer. It may not be acceptable to raise or lower ground levels over the sewer, nor to restrict access to the manholes on the sewer. If you wish to have this sewer diverted under Section 185 of the Water Industry Act 1991 an

application should be made in writing. To discuss this matter, please telephone 0345 120 84 82.

Foul Water

Development of the site should take place with separate systems for foul and surface water drainage. The separate systems should extend to the points of discharge to be agreed.

Foul water domestic waste can discharge to the 300 mm diameter public combined sewer recorded on site to the southeast.

Surface Water

The developer's attention is drawn to Requirement H3 of the Building Regulations 2010. This establishes a preferred hierarchy for surface water disposal. Consideration should firstly be given to discharge to soakaway, infiltration system and watercourse in that priority order.

Sustainable Drainage Systems (SuDS), for example the use of soakaways and/or permeable hardstanding etc, may be a suitable solution for surface water disposal appropriate in this situation. You are advised to seek comments on the suitability of SuDS in this instance from the appropriate authorities.

If other methods of surface water disposal are not viable and subject to providing satisfactory evidence as to why they have been discounted, curtilage surface water discharges to the public sewer will be restricted to the level of run-off - i.e. same rate of discharge - to that from the existing use of the site less a 30% reduction in the existing discharge. Any discharge of surface water from the site should discharge to similar points of connection to that of the existing use of the site. You will need to demonstrate positive drainage, based on a 1 in 1 year storm, to the public sewer to Yorkshire Water by means of investigation and calculation carried out at your expense.

To do this, Yorkshire Water requires to see existing and proposed drainage layouts with pipe sizes, gradients, gullies, downpipes and connection points, measured impermeable areas of the present and proposed use of the site, along with the calculations that show the existing and proposed discharge rate from the site to the public sewer.

As a last resort and subject to providing satisfactory evidence as to why the other methods of surface water disposal have been discounted, curtilage surface water may discharge to the 300 mm diameter public surface water sewer recorded on site to the southeast. The surface water discharge from the site to be restricted to not greater than 3.5 (three point five) litres/second. This permission is not an acceptance in respect to any planning conditions imposed under the Grant of Planning Permission.

Please note further restrictions on surface water disposal from the site may be imposed

by other parties. You are strongly advised to seek advice/comments from the Environment Agency/Land Drainage Authority/Internal Drainage Board, with regard to surface water disposal from the site.

Surface water run-off from communal parking (greater than 800 sq metres or more than 50 car parking spaces) and hardstanding must pass through an oil, petrol and grit interceptor/separator of adequate design before any discharge to the public sewer network. Roof water should not pass through the traditional 'stage' or full retention type of interceptor/separator. It is good drainage practice for any interceptor/separator to be located upstream of any on-site balancing, storage or other means of flow attenuation that may be required.

Other Observations

Any new connection to an existing public sewer will require the prior approval of Yorkshire Water. You may apply on line or obtain an application form from our website (www.yorkshirewater.com) or by telephoning 0345 120 84 82.

Under the provisions of section 111 of the Water Industry Act 1991 it is unlawful to pass into any public sewer (or into any drain or private sewer communicating with the public sewer network) any items likely to cause damage to the public sewer network interfere with the free flow of its contents or affect the treatment and disposal of its contents. Amongst other things this includes fat, oil, nappies, bandages, syringes, medicines, sanitary towels and incontinence pants. Contravention of the provisions of section 111 is a criminal offence.

An off-site foul and surface water sewer may be required which may be provided by the developer and considered for Code for Adoption under Section 104 of the Water Industry Act 1991. Please telephone 0345 120 84 82 for advice on sewer adoptions. Alternatively, the developer may in certain circumstances be able to requisition off-site sewers under Section 98 of the Water Industry Act 1991 for which an application must be made in writing. For further information, please telephone 0345 120 84 82.

Yorkshire Water's Trade Effluent team must be consulted in respect of any proposed trade effluent discharge to the public sewer. Please visit - https://www.yorkshirewater.com/business/trade-effluent/

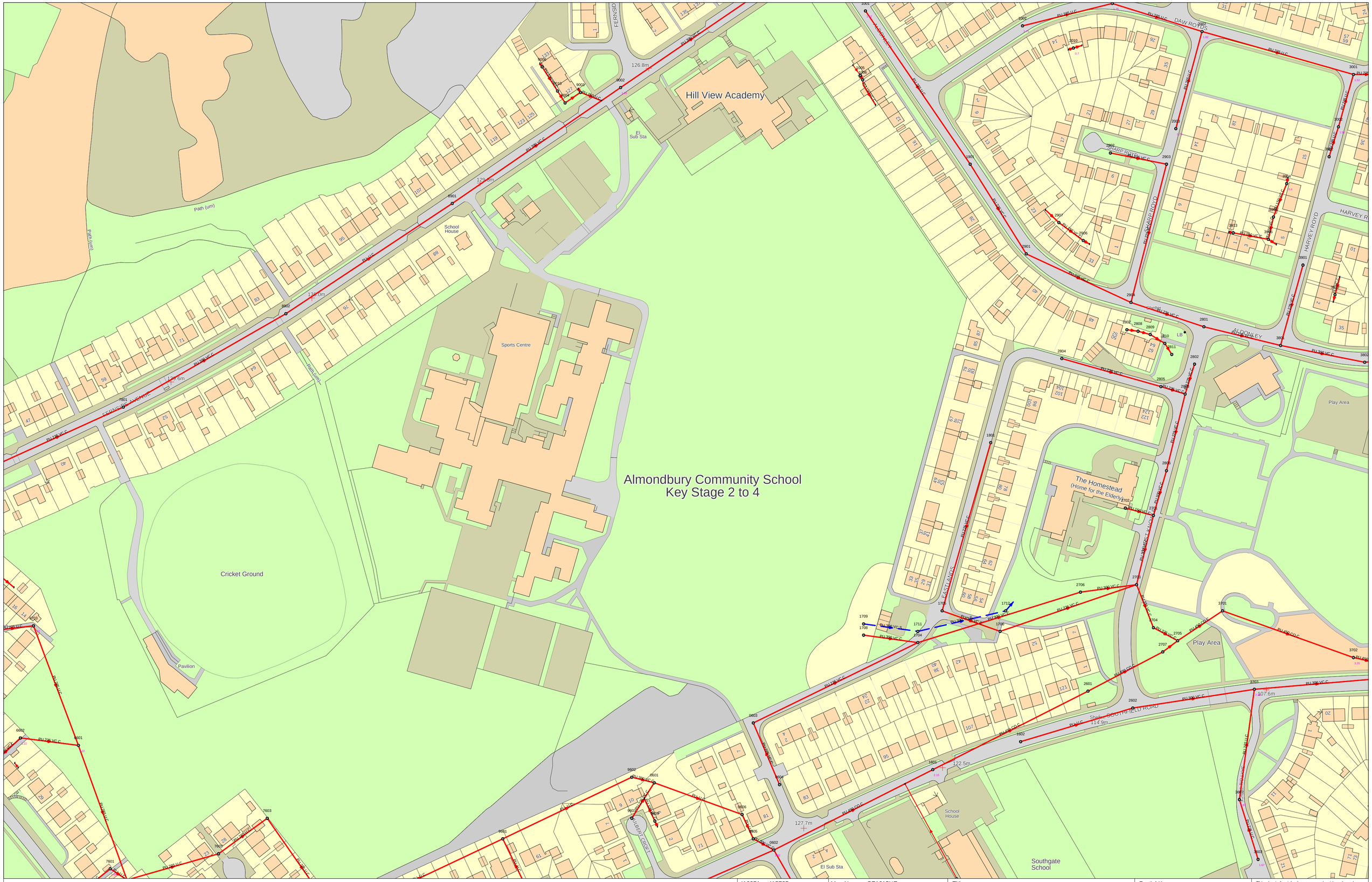
All the above comments are based upon the information and records available at the present time and is subject to formal planning approval agreement. The information contained in this letter together with that shown on any extract from the Statutory Sewer Map that may be enclosed is believed to be correct and is supplied in good faith. Please note that capacity in the public sewer network is not reserved for specific future development. It is used up on a 'first come, first served' basis. You should visit the site and establish the line and level of any public sewers affecting your proposals before the commencement of any design work.

YorkshireWater

Yours sincerely

George Mullaney
Development Services Technician

INVESTING IN VOLUNTEERS FOR EMPLOYERS
CUSTOMER SERVICE EXCELLENCE CSE



416851 : 415725	Map Name : SE1615NE	Title	Partial Key
YorkshireWater	Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : G Mullaney Contact Tel :	Notes	Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS
		(Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2014. All rights reserved Ordnance Survey Licence number 100022432	This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown.
			Date Req : 15/12/2022, 10:26:19 — Date Gen : 15/12/2022, 10:26:28
			Source : Sewer Network Enquiry

UPN: Undefined Originator: G Mullaney, ,

Jenna Lowe

From: Jenna Lowe
Sent: 02 December 2022 10:23
To: local.development@kirklees.gov.uk
Subject: FRA QUERY - FRA 22 1180 - Land off Fernside Avenue, Huddersfield (Almondbury SEND School)
Attachments: TOPO,_Phase_1_and_Utilities_Scope.jpg

Dear Sir/Madam,

LK Consult Ltd. has been commissioned to undertake a Flood Risk Assessment (FRA) and Sustainable Drainage Strategy (SuDS), for a site located off Fernside Avenue, Huddersfield, HD5 8PQ, centred at approximate National Grid Reference 417034E, 415889N.

The area of interest appears to be within Flood Zone 1.

BGS data indicates that the site is within an area underlain by N/A superficial deposits and Greenmoor Rock - Sandstone bedrock.

The site location is attached to this email.

To complete the FRA and SuDs, we would be grateful if you could supply us with the following, if available, for the vicinity of the site:

- Details of any flood defences in the immediate area, including their extent, crest levels (and datum), assumed level of standard, construction and maintenance regime, as well as any other structures which may influence the local hydraulics.
- Records of any historic flood events and potential sources of flooding from rivers, land drainage, groundwater, foul and surface water sewers on site and in the area.
- Any restrictions applied to ordinary watercourses and sewers in the area.
- Highway drainage restrictions and records.
- Indications if the site is within the Critical Drainage Area.
- Policies that may relate to Sustainable Drainage Systems (SuDS).

If you have any queries, please do not hesitate to get in touch.

We are, of course, happy to pay your reasonable charge for this service. Please let me know by return what information is available, what the charge will be, and we will pay the relevant fees by debit card as soon as possible.

Any advice or recommendations you may have regarding the potential discharges from the development of this site would also be appreciated.

We will be in contact with all other relevant authorities to get a more complete understanding of the issues in the area.

Regards,
Jenna

Appendix E

Calculations

MasterDrain SW

The LK Group
www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.			
Sheet no.	1		
Date	03/02/23		
Project	Qbar Existing Runoff Almondbury School	By	Checked / Reviewed
Title	Qbar Existing Runoff Almondbury School		

Area data:-

FSR data

M5-60 = 19.8
Soil index = 0.40
WRAP value = 3

r = 0.34
SAAR = 890
Nat grid = SE1616

Site data:-

Ret. period (yrs) = 2.33
Time of entry = 7.00
Impervious area drained = 19000 m²
Site slope = Mild <2% (1:50)
Length of overland flow = 0.00

ToC = 7.0 mins
Overland flow time = 0.0 mins
Pervious area drained = 7000 m²
Soil type = Fine textured
Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 57.0%
Rainfall rate= 61.5 mm/Hr

UCWI = 93.0
Runoff rate (gross)= 253.1 l/s

Methods

Runoff factor (RF) = 57.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7

where

PIMP = Impervious Area*100/(Impervious Area+Pervious Area)

UCWI = Calculated value for Wetness Index

MasterDrain SW

The LK Group
www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.			
Sheet no.	1		
Date	03/02/23		
Project	1 Year Existing Runoff Almondbury School	By	Checked / Reviewed
Title	1 Year Existing Runoff Almondbury School		

Area data:-

FSR data

M5-60 = 19.8
Soil index = 0.40
WRAP value = 3

r = 0.34
SAAR = 890
Nat grid = SE1616

Site data:-

Ret. period (yrs) = 1
Time of entry = 10.00
Impervious area drained = 19000 m²
Site slope = Mild <2% (1:50)
Length of overland flow = 0.00

ToC = 10.0 mins
Overland flow time = 0.0 mins
Pervious area drained = 7000 m²
Soil type = Fine textured
Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 57.0%
Rainfall rate= 43.1 mm/Hr

UCWI = 93.0
Runoff rate (gross)= 177.6 l/s

Methods

Runoff factor (RF) = 57.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7

where

PIMP = Impervious Area*100/(Impervious Area+Pervious Area)

UCWI = Calculated value for Wetness Index

MasterDrain SW

The LK Group

www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.			
Sheet no.	1		
Date	03/02/23		
Project	30 Years Existing Runoff Almondbury School	By	Checked / Reviewed
Title	30 Years Existing Runoff Almondbury School		

Area data:-

FSR data

M5-60 = 19.8
r = 0.34
Soil index = 0.40
SAAR = 890
WRAP value = 3
Nat grid = SE1616

Site data:-

Ret. period (yrs) = 30
ToC = 6.0 mins
Time of entry = 6.00
Overland flow time = 0.0 mins
Impervious area drained = 19000 m²
Pervious area drained = 7000 m²
Site slope = Mild <2% (1:50)
Soil type = Fine textured
Length of overland flow = 0.00
Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 57.0%
UCWI = 93.0
Rainfall rate= 109.3 mm/Hr
Runoff rate (gross)= 449.8 l/s

Methods

Runoff factor (RF) = 57.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7

where

PIMP = Impervious Area*100/(Impervious Area+Pervious Area)

UCWI = Calculated value for Wetness Index

MasterDrain SW

The LK Group

www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.			
Sheet no.	1		
Date	03/02/23		
Project	100 Years Existing Runoff Almondbury School	By	Checked / Reviewed
Title	100 Years Existing Runoff Almondbury School		

Area data:-

FSR data

M5-60 = 19.8
Soil index = 0.40
WRAP value = 3

r = 0.34
SAAR = 890
Nat grid = SE1616

Site data:-

Ret. period (yrs) = 100
Time of entry = 6.00
Impervious area drained = 19000 m²
Site slope = Mild <2% (1:50)
Length of overland flow = 0.00

ToC = 6.0 mins
Overland flow time = 0.0 mins
Pervious area drained = 7000 m²
Soil type = Fine textured
Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 57.0%
Rainfall rate= 138.6 mm/Hr

UCWI = 93.0
Runoff rate (gross)= 570.4 l/s

Methods

Runoff factor (RF) = 57.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7

where

PIMP = Impervious Area*100/(Impervious Area+Pervious Area)

UCWI = Calculated value for Wetness Index

MasterDrain SW

The LK Group
www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.			
Sheet no.	1		
Date	15/02/23		
Project	30 Years Storage Event Almondbury School	By	Checked / Reviewed
Title	30 Years Storage Event Almondbury School		

Data:-

FSR Hydrology:-

Location = ALMONDBURY
M5-60 (mm) = 19.8
Soil index = 0.40
Return period = 30
UCWI = 95.2

Grid reference = SE1616
r = 0.34
SAAR (mm/yr) = 890
WRAP = 3
Climate change = 0

i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
ii) Permeable soils with shallow ground water in low-lying areas;
iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Runoff factor (RF) = 57.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7

where

PIMP = Impervious Area*100/(Impervious Area+Pervious Area)

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 19000 m²
Total area (TA) = 26000 m²
Mean disch. rate = 3.500 l/s
Additional flow = 0.00 l/s

Pervious area = 7000 m²
Equiv area = 14820 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 0

Calculated data:-

Time to max = 1236.0 mins
Rainfall at max = 3.40 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 779.4 m³
Allowed discharge rate = 3.500 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 8.00 mm/hr

Calculated storage volume = 694.7 m³
Allowed discharge rate = 3.500 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len
100	99257.0	1125	784.3
150	44114.2	1200	689.3
225	19606.3	1275	610.6
300	11028.6	1350	544.6
375	7058.3	1425	488.8
450	4901.6	1500	441.1
525	3601.2	1575	400.1
600	2757.1	1650	364.6
675	2178.5	1725	333.6
750	1764.6	1800	306.3
825	1458.3	1875	282.3
900	1225.4	1950	261.0
975	1044.1	2025	242.1
1050	900.3	2100	225.1

Ovoid	Len
400 x 600	4330.1
600 x 900	1885.4
800 x 1200	1060.4

Box culvert	Len
500 x 500	3117.7
500 x 750	2078.4
500 x 1000	1558.8
750 x 1000	1039.2
750 x 1200	866.0
750 x 1500	692.8
1000 x 1000	779.4
1000 x 1200	649.5
1000 x 1500	519.6
1000 x 1800	433.0
1000 x 2000	389.7
1500 x 1500	346.4
1500 x 1800	288.7
1500 x 2000	259.8

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Job No.	
Sheet no.	2
Date	15/02/23
Project	30 Years Storage Event Almondbury School
Title	30 Years Storage Event Almondbury School
By	
Checked	
Reviewed	

MasterDrain SW

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
40	40.0	392.716	8.400	384.316
80	25.0	496.203	16.800	479.403
120	19.0	561.517	25.200	536.317
160	15.0	609.703	33.600	576.103
200	13.0	647.864	42.000	605.864
240	11.0	679.858	50.400	629.458
280	10.0	708.568	58.800	649.768
320	9.0	734.198	67.200	666.998
360	9.0	757.413	75.600	681.813
400	8.0	778.675	84.000	694.675
440	7.0	798.324	92.400	705.924
480	7.0	816.613	100.800	715.813
520	6.0	833.741	109.200	724.541
560	6.0	849.862	117.600	732.262
600	6.0	865.101	126.000	739.101
640	6.0	879.561	134.400	745.161
680	5.0	893.327	142.800	750.527
720	5.0	906.471	151.200	755.271
760	5.0	919.052	159.600	759.452
800	5.0	931.123	168.000	763.123
840	5.0	942.728	176.400	766.328
880	4.0	953.906	184.800	769.106
920	4.0	964.691	193.200	771.491
960	4.0	975.114	201.600	773.514
1000	4.0	985.199	210.000	775.199
1040	4.0	994.972	218.400	776.572
1080	4.0	1004.453	226.800	777.653
1120	4.0	1013.662	235.200	778.462
1160	4.0	1022.615	243.600	779.015
1200	3.0	1031.328	252.000	779.328
1240	3.0	1039.814	260.400	779.414
1280	3.0	1048.088	268.800	779.288
1320	3.0	1056.160	277.200	778.960
1360	3.0	1064.041	285.600	778.441
1400	3.0	1071.742	294.000	777.742
1440	3.0	1079.271	302.400	776.871
1480	3.0	1086.636	310.800	775.836
1520	3.0	1093.846	319.200	774.646
1560	3.0	1100.908	327.600	773.308
1600	3.0	1107.828	336.000	771.828
1640	3.0	1114.613	344.400	770.213
1680	3.0	1121.268	352.800	768.468
1720	3.0	1127.799	361.200	766.599
1760	3.0	1134.211	369.600	764.611
1800	3.0	1140.509	378.000	762.509
1840	3.0	1146.697	386.400	760.297
1880	2.0	1152.780	394.800	757.980
1920	2.0	1158.761	403.200	755.561
1960	2.0	1164.644	411.600	753.044
2000	2.0	1170.434	420.000	750.434
2040	2.0	1176.132	428.400	747.732
2080	2.0	1181.742	436.800	744.942
2120	2.0	1187.267	445.200	742.067
2160	2.0	1192.711	453.600	739.111
2200	2.0	1198.075	462.000	736.075
2240	2.0	1203.363	470.400	732.963
2280	2.0	1208.576	478.800	729.776
2320	2.0	1213.718	487.200	726.518
2360	2.0	1218.789	495.600	723.189
2400	2.0	1223.793	504.000	719.793

Storage volume (m^3) = 779.4 m^3

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Job No.	
Sheet no.	3
Date	15/02/23

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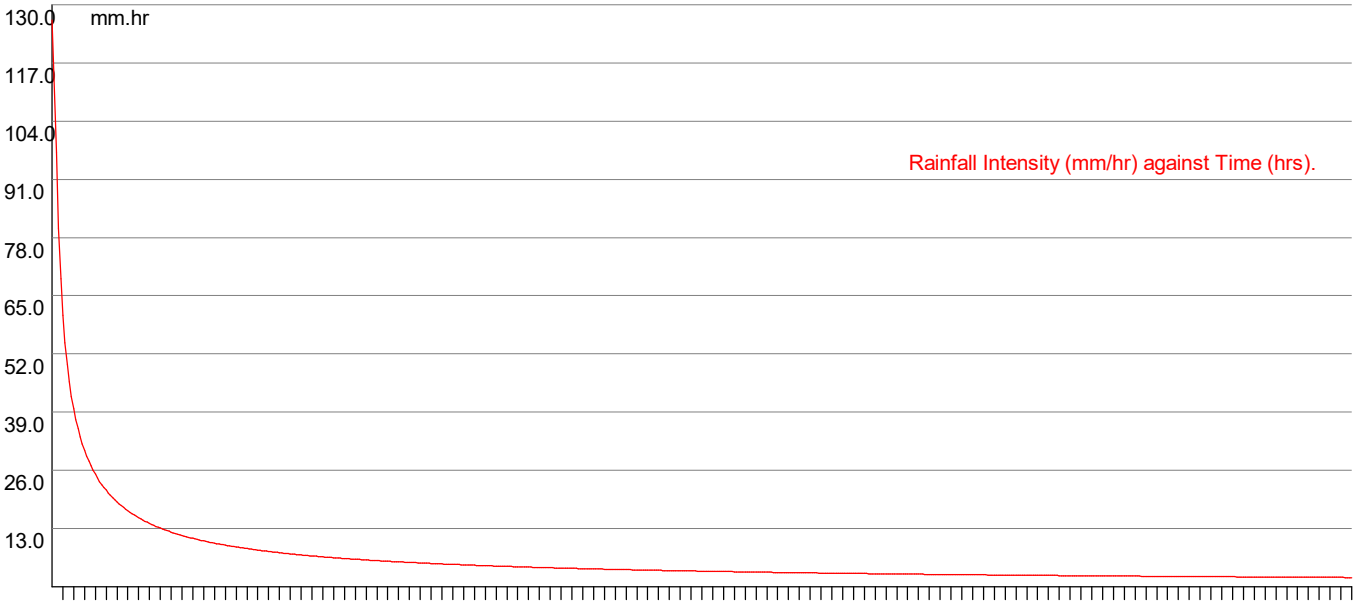
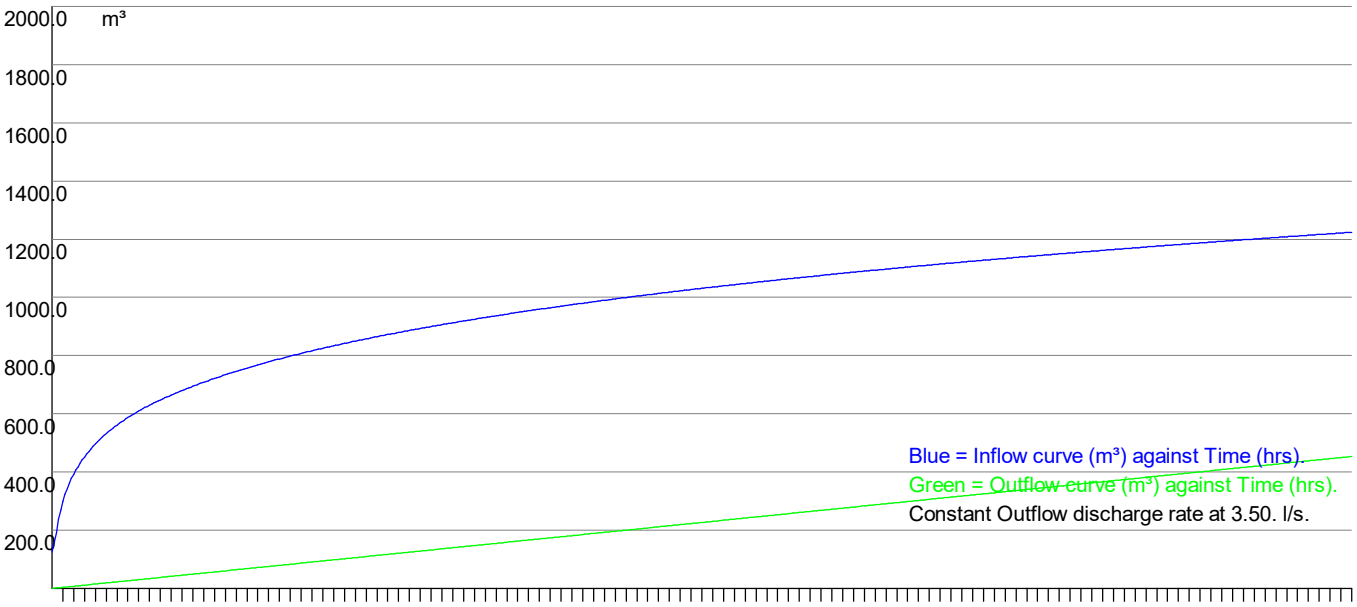
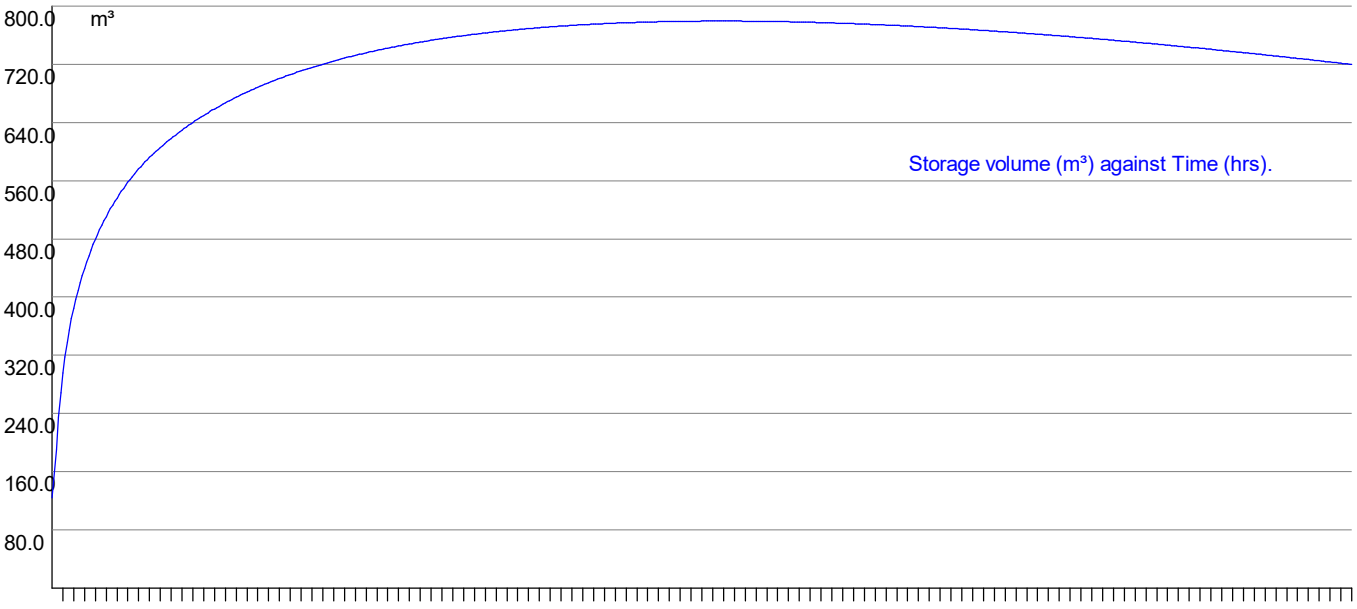
Project	30 Years Storage Event Almondbury School	By	Checked / Reviewed
Title	30 Years Storage Event Almondbury School		







Explanatory notes for Peak Flow Storage

1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
2) The balance is calculated from the inflow minus the outflow.
3) The storage volume is the maximum value of the balance curve.
4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
5) References to 'storm duration' relate only to the hydrograph method (qv).
6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

1) The user has the choice of Summer or Winter curves
2) The mean intensity varies with the duration of the storm curve
3) There are always 120 steps in the calculation process, irrespective of storm duration.
4) The balance is calculated from the inflow minus the outflow.
5) The storage volume is the sum of the balance values for each step.
6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage. The outflow volume is constant throughout the process at the specified discharge rate.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.The outflow volume varies with the hydraulic head on the control device using flow equations provided by the control manufacturer. This is a far more accurate method than the peak flow method and often results in bigger storage volumes.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.

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Job No.			
Sheet no.	1		
Date	15/02/23		
Project	100 Years + 20% CC Storage Event Almondbury School	By	Checked / Reviewed
Title	100 Years + 20% CC Storage Event Almondbury School		

Data:-

FSR Hydrology:-

Location = ALMONDBURY
M5-60 (mm) = 19.8
Soil index = 0.40
Return period = 100
UCWI = 95.2

Grid reference = SE1616
r = 0.34
SAAR (mm/yr) = 890
WRAP = 3
Climate change = 20

i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
ii) Permeable soils with shallow ground water in low-lying areas;
iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Runoff factor (RF) = 57.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7

where

PIMP = Impervious Area*100/(Impervious Area+Pervious Area)

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 19000 m²
Total area (TA) = 26000 m²
Mean disch. rate = 3.500 l/s
Additional flow = 0.00 l/s

Pervious area = 7000 m²
Equiv area = 14820 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 20

Calculated data:-

Time to max = 1820.0 mins
Rainfall at max = 3.82 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 1334.2 m³
Allowed discharge rate = 3.500 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 12.00 mm/hr

Calculated storage volume = 1121.1 m³
Allowed discharge rate = 3.500 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len
100	169902.2	1125	1342.4
150	75512.1	1200	1179.9
225	33560.9	1275	1045.2
300	18878.0	1350	932.2
375	12081.9	1425	836.7
450	8390.2	1500	755.1
525	6164.3	1575	684.9
600	4719.5	1650	624.1
675	3729.0	1725	571.0
750	3020.5	1800	524.4
825	2496.3	1875	483.3
900	2097.6	1950	446.8
975	1787.3	2025	414.3
1050	1541.1	2100	385.3

Ovoid	Len
400 x 600	7412.0
600 x 900	3227.3
800 x 1200	1815.1

Box culvert	Len
500 x 500	5336.6
500 x 750	3557.8
500 x 1000	2668.3
750 x 1000	1778.9
750 x 1200	1482.4
750 x 1500	1185.9
1000 x 1000	1334.2
1000 x 1200	1111.8
1000 x 1500	889.4
1000 x 1800	741.2
1000 x 2000	667.1
1500 x 1500	593.0
1500 x 1800	494.1
1500 x 2000	444.7

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Job No.	
Sheet no.	2
Date	15/02/23
By	
Checked	
Reviewed	

MasterDrain SW

Project: 100 Years + 20% CC Storage Event Almondbury School

Title: 100 Years + 20% CC Storage Event Almondbury School

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
40	63.0	617.923	8.400	609.523
80	40.0	783.242	16.800	766.442
120	30.0	885.117	25.200	859.917
160	24.0	958.267	33.600	924.667
200	21.0	1014.555	42.000	972.555
240	18.0	1060.913	50.400	1010.513
280	16.0	1103.062	58.800	1044.262
320	14.0	1140.511	67.200	1073.311
360	13.0	1174.284	75.600	1098.684
400	12.0	1205.097	84.000	1121.097
440	11.0	1233.470	92.400	1141.070
480	11.0	1259.792	100.800	1158.992
520	10.0	1284.364	109.200	1175.164
560	9.0	1307.424	117.600	1189.824
600	9.0	1329.164	126.000	1203.164
640	9.0	1349.738	134.400	1215.338
680	8.0	1369.276	142.800	1226.476
720	8.0	1387.886	151.200	1236.686
760	7.0	1405.659	159.600	1246.059
800	7.0	1422.674	168.000	1254.674
840	7.0	1438.999	176.400	1262.599
880	7.0	1454.691	184.800	1269.891
920	6.0	1469.802	193.200	1276.602
960	6.0	1484.378	201.600	1282.778
1000	6.0	1498.457	210.000	1288.457
1040	6.0	1512.076	218.400	1293.676
1080	6.0	1525.266	226.800	1298.466
1120	6.0	1538.056	235.200	1302.856
1160	5.0	1550.470	243.600	1306.870
1200	5.0	1562.533	252.000	1310.533
1240	5.0	1574.266	260.400	1313.866
1280	5.0	1585.686	268.800	1316.886
1320	5.0	1596.813	277.200	1319.613
1360	5.0	1607.661	285.600	1322.061
1400	5.0	1618.246	294.000	1324.246
1440	5.0	1628.582	302.400	1326.182
1480	4.0	1638.679	310.800	1327.879
1520	4.0	1648.551	319.200	1329.351
1560	4.0	1658.208	327.600	1330.608
1600	4.0	1667.660	336.000	1331.660
1640	4.0	1676.915	344.400	1332.515
1680	4.0	1685.983	352.800	1333.183
1720	4.0	1694.872	361.200	1333.672
1760	4.0	1703.589	369.600	1333.989
1800	4.0	1712.141	378.000	1334.141
1840	4.0	1720.535	386.400	1334.135
1880	4.0	1728.777	394.800	1333.977
1920	4.0	1736.873	403.200	1333.673
1960	4.0	1744.828	411.600	1333.229
2000	4.0	1752.649	420.000	1332.649
2040	3.0	1760.338	428.400	1331.938
2080	3.0	1767.901	436.800	1331.101
2120	3.0	1775.343	445.200	1330.143
2160	3.0	1782.668	453.600	1329.068
2200	3.0	1789.879	462.000	1327.879
2240	3.0	1796.981	470.400	1326.581
2280	3.0	1803.976	478.800	1325.176
2320	3.0	1810.869	487.200	1323.668
2360	3.0	1817.662	495.600	1322.062
2400	3.0	1824.358	504.000	1320.358

Storage volume (m^3) = 1334.2 m^3

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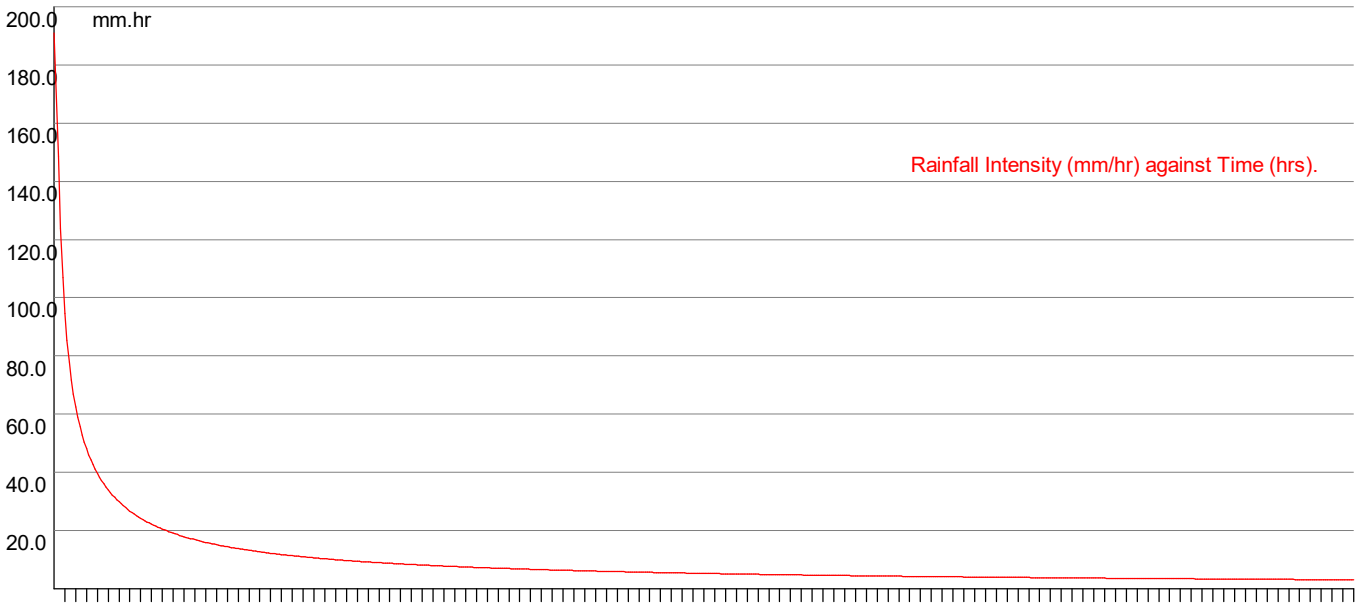
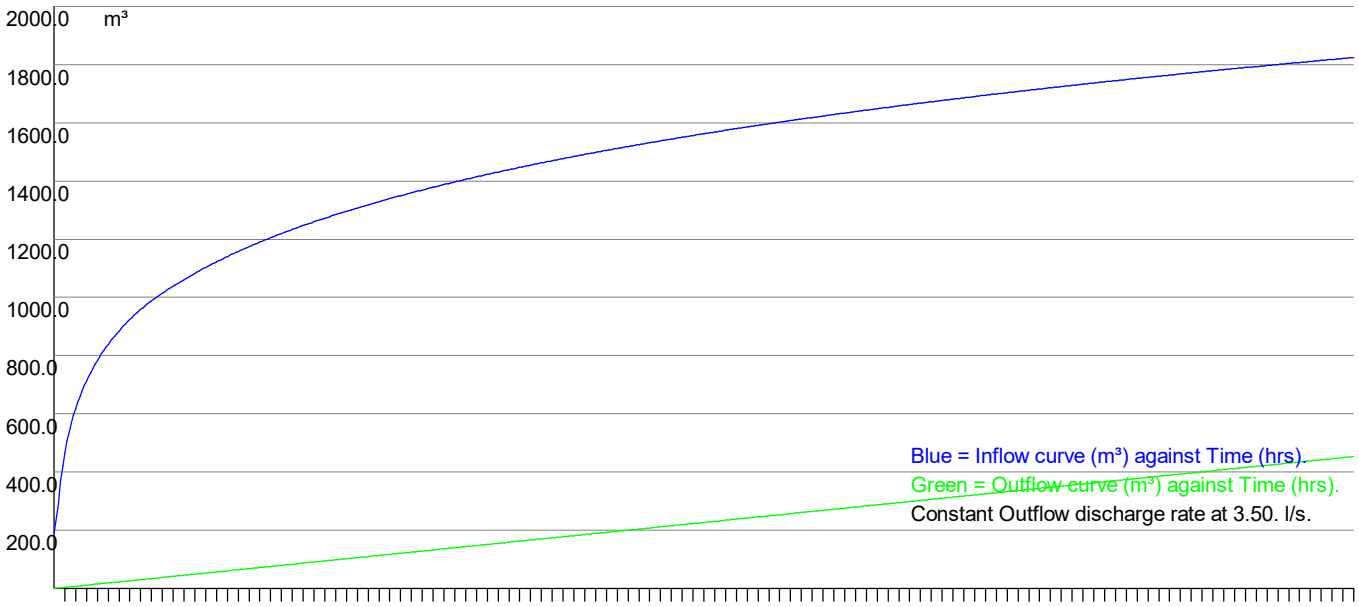
Job No.			
Sheet no.	3		
Date	15/02/23		
By	Checked	Reviewed	

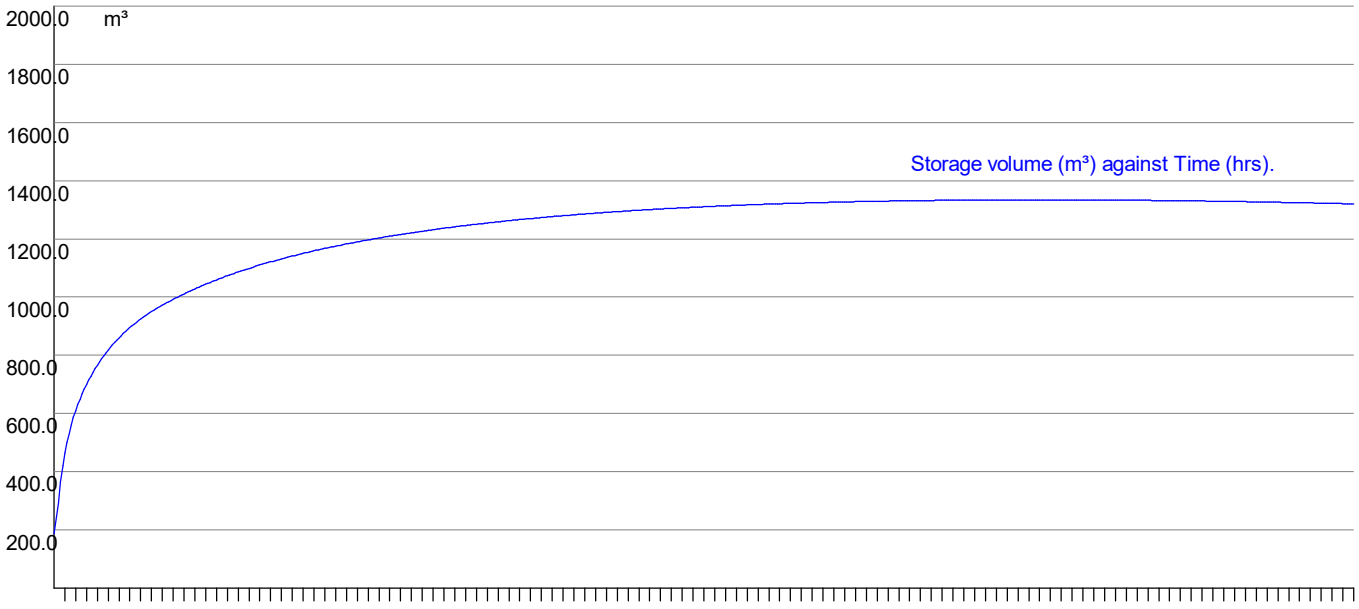
MasterDrain SW

Project **100 Years + 20% CC Storage Event Almondbury School**

Title **100 Years + 20% CC Storage Event Almondbury School**







Explanatory notes for Peak Flow Storage

1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
2) The balance is calculated from the inflow minus the outflow.
3) The storage volume is the maximum value of the balance curve.
4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
5) References to 'storm duration' relate only to the hydrograph method (qv).
6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

1) The user has the choice of Summer or Winter curves
2) The mean intensity varies with the duration of the storm curve
3) There are always 120 steps in the calculation process, irrespective of storm duration.
4) The balance is calculated from the inflow minus the outflow.
5) The storage volume is the sum of the balance values for each step.
6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage. The outflow volume is constant throughout the process at the specified discharge rate.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.The outflow volume varies with the hydraulic head on the control device using flow equations provided by the control manufacturer. This is a far more accurate method than the peak flow method and often results in bigger storage volumes.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.

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www.thelkgroup.com		Sheet no.	1	
		Date	15/02/23	
Project 100 Years + 40% CC Storage Event Almondbury School		By	Checked	Reviewed
Title 100 Years + 40% CC Storage Event Almondbury School				

Data:-

FSR Hydrology:-

Location = ALMONDBURY
M5-60 (mm) = 19.8
Soil index = 0.40
Return period = 100
UCWI = 95.2

Grid reference = SE1616
r = 0.34
SAAR (mm/yr) = 890
WRAP = 3
Climate change = 40

i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
ii) Permeable soils with shallow ground water in low-lying areas;
iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Runoff factor (RF) = 57.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7

where

PIMP = Impervious Area*100/(Impervious Area+Pervious Area)

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 19000 m²
Total area (TA) = 26000 m²
Mean disch. rate = 3.500 l/s
Additional flow = 0.00 l/s

Pervious area = 7000 m²
Equiv area = 14820 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 40

Calculated data:-

Time to max = 2184.0 mins
Rainfall at max = 3.86 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 1626.2 m³
Allowed discharge rate = 3.500 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 14.00 mm/hr

Calculated storage volume = 1321.9 m³
Allowed discharge rate = 3.500 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len
100	207093.6	1125	1636.3
150	92041.6	1200	1438.2
225	40907.4	1275	1273.9
300	23010.4	1350	1136.3
375	14726.7	1425	1019.9
450	10226.8	1500	920.4
525	7513.6	1575	834.8
600	5752.6	1650	760.7
675	4545.3	1725	696.0
750	3681.7	1800	639.2
825	3042.7	1875	589.1
900	2556.7	1950	544.6
975	2178.5	2025	505.0
1050	1878.4	2100	469.6

Ovoid	Len
400 x 600	9034.5
600 x 900	3933.7
800 x 1200	2212.4

Box culvert	Len
500 x 500	6504.8
500 x 750	4336.5
500 x 1000	3252.4
750 x 1000	2168.3
750 x 1200	1806.9
750 x 1500	1445.5
1000 x 1000	1626.2
1000 x 1200	1355.2
1000 x 1500	1084.1
1000 x 1800	903.4
1000 x 2000	813.1
1500 x 1500	722.8
1500 x 1800	602.3
1500 x 2000	542.1

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Job No.	
Sheet no.	2
Date	15/02/23

MasterDrain SW

Project	100 Years + 40% CC Storage Event Almondbury School	By	Checked / Reviewed
Title	100 Years + 40% CC Storage Event Almondbury School		

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
40	73.0	720.910	8.400	712.510
80	46.0	913.782	16.800	896.982
120	35.0	1032.636	25.200	1007.436
160	28.0	1117.978	33.600	1084.378
200	24.0	1183.648	42.000	1141.648
240	21.0	1237.732	50.400	1187.332
280	19.0	1286.906	58.800	1228.106
320	17.0	1330.596	67.200	1263.396
360	15.0	1369.998	75.600	1294.398
400	14.0	1405.947	84.000	1321.947
440	13.0	1439.048	92.400	1346.648
480	12.0	1469.757	100.800	1368.957
520	12.0	1498.424	109.200	1389.224
560	11.0	1525.328	117.600	1407.728
600	10.0	1550.691	126.000	1424.691
640	10.0	1574.694	134.400	1440.294
680	10.0	1597.488	142.800	1454.688
720	9.0	1619.200	151.200	1468.000
760	9.0	1639.936	159.600	1480.336
800	8.0	1659.786	168.000	1491.786
840	8.0	1678.832	176.400	1502.432
880	8.0	1697.139	184.800	1512.339
920	8.0	1714.769	193.200	1521.569
960	7.0	1731.774	201.600	1530.174
1000	7.0	1748.200	210.000	1538.200
1040	7.0	1764.089	218.400	1545.689
1080	7.0	1779.477	226.800	1552.677
1120	6.0	1794.398	235.200	1559.198
1160	6.0	1808.882	243.600	1565.282
1200	6.0	1822.955	252.000	1570.955
1240	6.0	1836.643	260.400	1576.243
1280	6.0	1849.967	268.800	1581.167
1320	6.0	1862.948	277.200	1585.748
1360	6.0	1875.605	285.600	1590.005
1400	5.0	1887.954	294.000	1593.954
1440	5.0	1900.012	302.400	1597.612
1480	5.0	1911.792	310.800	1600.992
1520	5.0	1923.310	319.200	1604.110
1560	5.0	1934.576	327.600	1606.976
1600	5.0	1945.603	336.000	1609.603
1640	5.0	1956.401	344.400	1612.001
1680	5.0	1966.980	352.800	1614.180
1720	5.0	1977.350	361.200	1616.150
1760	5.0	1987.520	369.600	1617.920
1800	4.0	1997.498	378.000	1619.498
1840	4.0	2007.291	386.400	1620.891
1880	4.0	2016.907	394.800	1622.107
1920	4.0	2026.352	403.200	1623.152
1960	4.0	2035.633	411.600	1624.033
2000	4.0	2044.757	420.000	1624.757
2040	4.0	2053.728	428.400	1625.328
2080	4.0	2062.551	436.800	1625.751
2120	4.0	2071.234	445.200	1626.034
2160	4.0	2079.779	453.600	1626.179
2200	4.0	2088.192	462.000	1626.192
2240	4.0	2096.477	470.400	1626.077
2280	4.0	2104.638	478.800	1625.838
2320	4.0	2112.680	487.200	1625.480
2360	4.0	2120.605	495.600	1625.005
2400	4.0	2128.417	504.000	1624.417

Storage volume (m^3) = 1626.2 m^3

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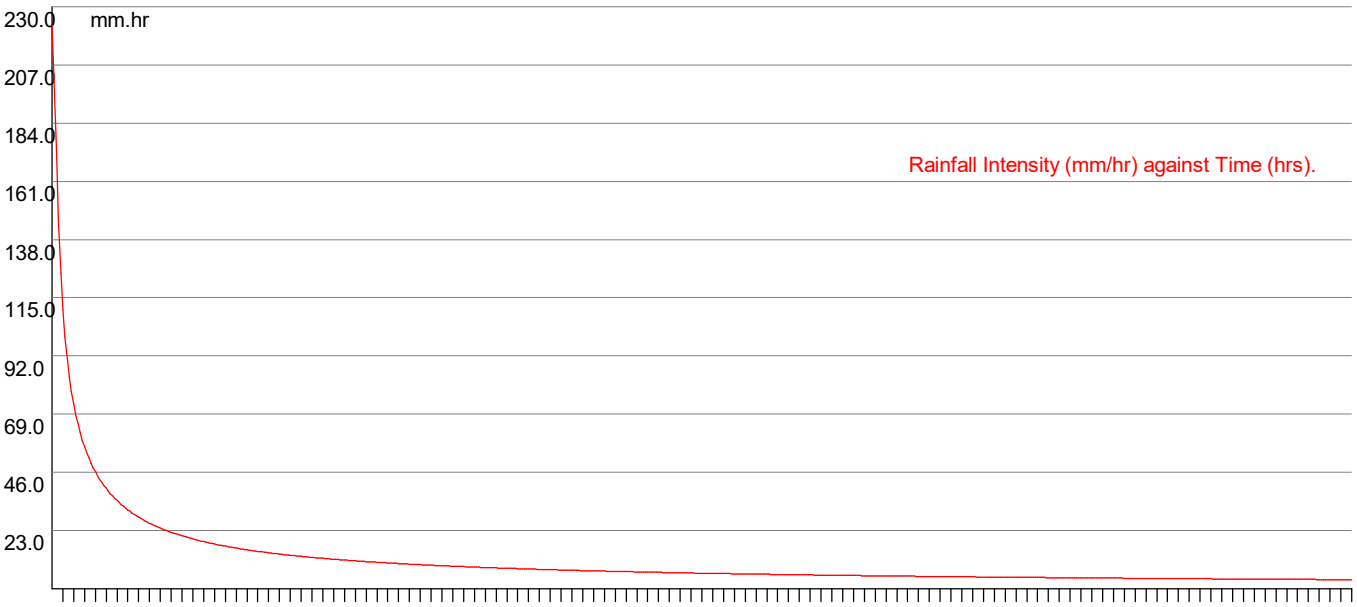
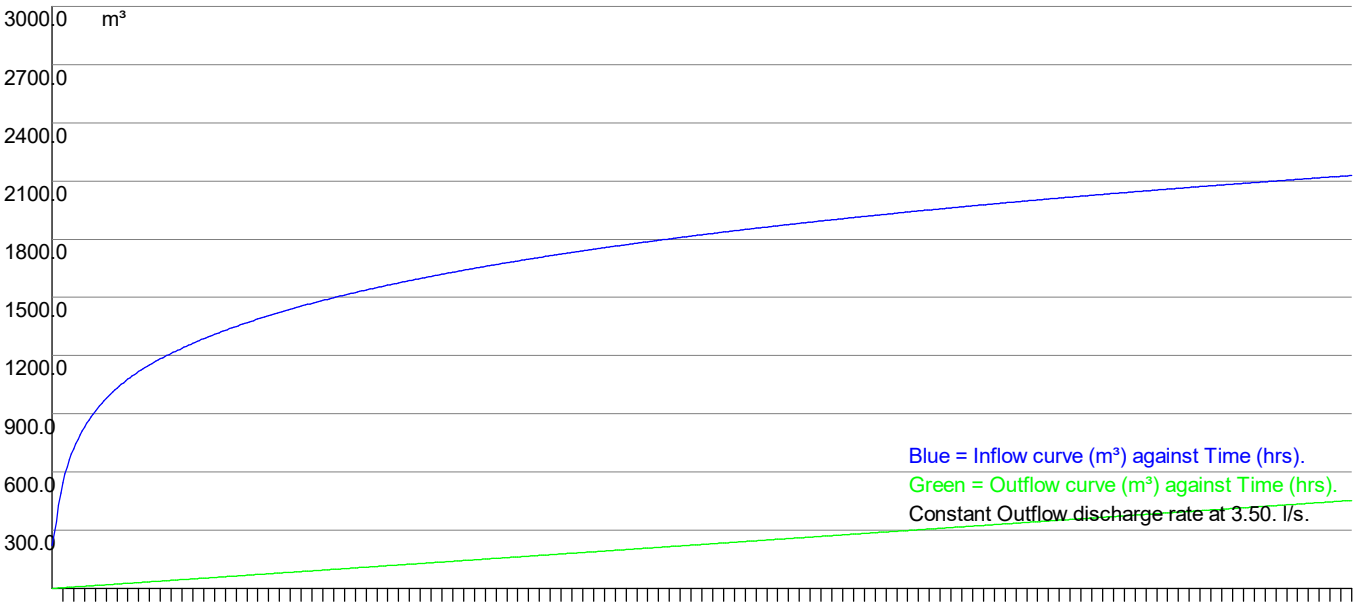
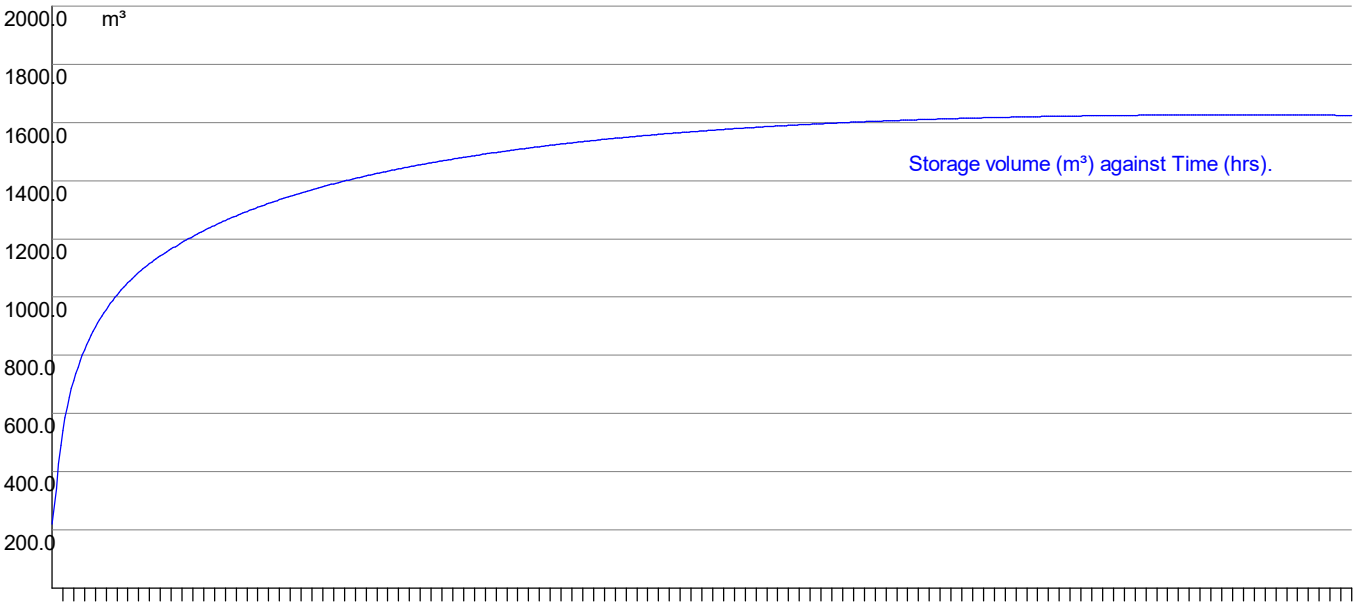
Job No.	
Sheet no.	3
Date	15/02/23

MasterDrain SW

Project	100 Years + 40% CC Storage Event Almondbury School	By	Checked / Reviewed
Title	100 Years + 40% CC Storage Event Almondbury School		







Explanatory notes for Peak Flow Storage

1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
2) The balance is calculated from the inflow minus the outflow.
3) The storage volume is the maximum value of the balance curve.
4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
5) References to 'storm duration' relate only to the hydrograph method (qv).
6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

1) The user has the choice of Summer or Winter curves
2) The mean intensity varies with the duration of the storm curve
3) There are always 120 steps in the calculation process, irrespective of storm duration.
4) The balance is calculated from the inflow minus the outflow.
5) The storage volume is the sum of the balance values for each step.
6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage. The outflow volume is constant throughout the process at the specified discharge rate.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.The outflow volume varies with the hydraulic head on the control device using flow equations provided by the control manufacturer. This is a far more accurate method than the peak flow method and often results in bigger storage volumes.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.

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