

Drainage Strategy Report (DSR) For:
6 Criccieth Grove,
Merthyr Tydfil,
CF48 1JY

Prepared for:

Lee Pickett

REF: 11817-DSR

DATE: January 2021

Document Control

Project	6 Criccieth Grove, Merthyr Tydfil, CF48 1JY
Client	Lee Pickett
Vale Consultancy Ref:	11817-DSR

Document Checking:

Prepared By: F Payne

Signed:



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Issue	Date	Status
01	January 2021	First issue
02		
03		

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1 INTRODUCTION

1.1 Site Location

Vale Consultancy has been instructed by Lee Pickett (*the client*) to undertake a drainage strategy report (DSR) for the proposed development at 6 Criccieth Grove, Merthyr Tydfil, CF48 1JY. The site is located approximately 600m south of the A465 Heads of the Valleys road in Clwydyfagwyr at NGR: SO 02057 06784. **Ref: Appendix A**

The proposed development is to be located between 6 Criccieth Grove and 42 Kidwelly Grove within the existing site boundary of 6 Criccieth Grove. The site lies within a residential area with existing dwellings located on the north, east and south boundaries of the site. The site connects to Criccieth Grove road which lies along the western boundary.

The existing site forms part of the garden of 6 Criccieth Grove and was partly formerly occupied by a conservatory which has been relocated to the rear of the existing house. The site is relatively flat and gently falls away from Criccieth Grove road and the house of 6 Criccieth Grove towards the north eastern corner of the site. Sloping more steeply at the eastern site boundary.

The proposed development site is within the constraints of the existing dwelling which is already developed land and is therefore classified as **"Brownfield"**. The following drainage strategy will cover the hydraulic design criteria of the surface water drainage network only.



Figure 1: Site Location Satellite Plan

1.2 Proposed Development

The intention of the proposed project is to construct a new 4 bedroom detached dwelling with associated garden and car parking areas. Full planning permission has been granted by Merthyr Tydfil County Borough Council (Ref: P/20/0130).

The development area is approximately 260m².

Refer to **Appendix B** – Proposed Plans

1.3 Existing Geology

Initial site investigations which included three boreholes were undertaken by Blandford Consulting in February 2020 later followed by soakaway testing carried out by Matt Jones of Vale Consultancy in December 2020.

As part of the site investigations by Blandford Consulting three 30m deep boreholes were drilled and in summary concluded that the site is underlain by 6-7m boulder clay followed by bands of Mudstone and Sandstone with Ironstone bands found deeper down. Groundwater was not encountered in any of the boreholes.

Refer to **Appendix C** – Site Investigation Report

Soakaway tests were attempted in accordance with BRE365 Digest Standards in two trial pits. As anticipated, due to the clay soil, tests failed in both trial pits as water levels changed insignificantly during the 24 hours after commencement of testing. Images of the trial pits can be seen in Figures 2 and 3.



Figure 2: Trial Pit 1



Figure 3: Trial Pit 2

British Geological Survey records note that the site is listed to have the following:

Superficial deposits: Till, Devensian - Diamicton. Sedimentary superficial deposit formed between 116 and 11.8 thousand years ago during the Quaternary period.

Bedrock geology: South Wales Lower Coal Measures Formation - Mudstone, siltstone and sandstone. Sedimentary bedrock formed between 319 and 318 million years ago during the Carboniferous period.

1.4 Flood Risk

Flood risk has been assessed using the NRW development advice map and detailed view map. The site is located within Zone A of the DAM, so is therefore considered to be at little or no risk of fluvial or tidal/coastal flooding. Furthermore, upon review of the detailed view map the site is not located with an area at risk from flooding from the sea and rivers. The site is also outside the high, medium and low extents for flood risk from surface water and small watercourses meaning that it has a less than 0.1% chance of flooding from this. Further flood risk assessment is not considered necessary.

Refer to **Appendix E** – Natural Resource Wales Development Advice Map & Detailed View Map

2 SURFACE WATER

2.1 Existing Drainage Systems

Within the proposed site boundary there is no existing surface water drainage as the site is and has been part of the garden of 6 Cricceith Grove. An existing 150mm combined sewer is present on the eastern side of the site, running in a south to north direction.

Within Criccieth Grove road there is a 225mm surface water sewer.

2.2 Proposed Drainage Systems

2.2.1 **S1:** SuDS hierarchy of surface water discharge locations

The following receptors have been considered for surface water runoff on site, in order of SuDS preference. The aim of SuDS Standards is to ensuring that the most effective drainage scheme is delivered with the most preferred levels of surface water destination, where the design can move to the next means of discharge only under exception criteria.

1. Surface water collection for reuse.
2. Discharge by infiltration into ground
3. Discharge into open surface water body
4. Discharge into surface water sewer, highway drain, or other drainage system
5. Discharge into combined sewer.

Priority Level 1 - Surface water collected for reuse:

The use of a proprietary rainwater harvesting system has been considered for the respective development and disconnected due to the disadvantage of capital cost/installation and maintenance requirement that a specialist system would impose on the site owner and in addition following reasons also have an influence on the level of service that could be expected from the provision of a RWH system, as there is no foreseeable demand for non- potable water within the development proposals. There is no foreseeable need to harvest water at the site as DCWW has not identified any potential stresses on the mains water supply.

The use of rainwater harvesting is not a cost-effective / viable option for managing surface water runoff in comparison to the water supply benefit by installing/maintaining such a system. Indicative costs estimate for a capture-store-pump-use based on a 2,000 (2m³) litre tank serving development (Technical source University of Exeter/STW):

Onsite installation costs (Inc of exaction/backfill, pipework, electrical supply etc) = £1,300.00
RWH system with a 2m³ tank delivered to site =£2,500-£3,000.00
Capital Costs circa =£4,000.00

Average water potable/domestic consumption = 197m³/annum
DCWW Standard volumetric measured rate = £1.36/m³

Typical water bill /annum=£1.36 x 197m³ =£268.00

House with RWH system would provide a 25% reduction on water demand:

$\pounds 268.00 \times 25\% = \pounds 68.00/\text{annum}$

Therefore a 25% saving set against the capital investment cost would result in a 58-year break even recovery of costs.

The obligation to provide such a system is not a mandatory requirement in so far as reuse/recycling has been given due consideration.

No solution, move to next Priority Level

Priority Level 2 – Discharge via infiltration:

As per section 1.3 of this report a site investigation was undertaken by Matt Jones of Vale Consultancy in December 2020 where infiltration testing was attempted in accordance with BRE365 Digest Standards for two trial pits. Tests failed in both trial pits as water levels changed insignificantly during the 24 hours after commencement of testing.

Therefore, discharging surface water via infiltration is not viable.

No solution, move to next Priority Level

Priority Level 3 - Discharge into open surface water body:

The nearest open surface water body identified is Nant Fwrdd stream, approximately 600m north of the site. Connecting to the stream is not viable as it would involve crossing multiple third-party land ownerships and major infrastructure which would be difficult to resolve and overcome.

No solution, move to next Priority Level

Priority Level 4 – Discharge into surface water sewer, highway drain, or other drainage system:

DCWW asset maps confirm there is a 225mm surface water sewer in Criccieth Grove road which is the proposed and most appropriate surface water discharge location, subject to invert levels and agreement from DCWW. Initial investigations undertaken to establish cover and invert levels of the upstream and downstream manholes of the surface water sewer suggest that the sewer is deep enough to allow for connection under gravity.

Priority Level 4 solution, priority level 5 is less desirable so is therefore not explored or required.

2.2.2 S2: Surface Water Runoff Hydraulic Control.

Proposed SuDS drainage system

The proposed SuDS drainage system will use a combination of porous asphalt with a course graded aggregate (CGA) sub-base storage layer and bioretention raingarden areas to collect and attenuate surface water runoff. Attenuation will be designed such that no flooding will occur for a 1 in 100-year storm event plus 40% climate change and a flow control device will be installed downstream of the attenuation systems to control discharge into the combined sewer.

Hydraulic Control

As per the Statutory Standard for sustainable drainage systems and The Flood and Water Management Act 2010 for previously developed sites, site runoff rates should be reduced to the greenfield rates wherever possible. Because the critical duration for the attenuation storage system for the proposed development will be much longer than the storm duration used for sizing pipework for the previously developed site, there is a risk that, by allowing previously developed runoff rates to occur (for a much longer duration) receiving watercourse damage and flood risk could be made considerably worse. Thus, betterment of at least 30% should be considered as a minimum requirement and strong consideration should still be given to controlling volumes of runoff to greenfield equivalents.

Thus, for this development a betterment of 43% to the existing brownfield run-off rate is proposed, which has been calculated based on the Modified Rational Method as follows:

$$Q = 2.78 \times Cr \times Cv \times i \times A$$
$$Q = 2.78 \times 1.3 \times 0.75 \times 50 \times 0.026 = 3.52 \text{ l/s}$$
$$43\% \text{ betterment} = 3.52 \times (1 - 0.43) = 2.00 \text{ l/s}$$

Therefore, a surface water discharge rate of 2.0 l/s is proposed subject to the agreement and approval of Dwr Cymru Welsh Water (DCWW).

The CGA sub-base storage layer will provide sufficient storage volumes such that no flooding will occur for a 1 in 100-year storm event plus 40% climate change. The proposed bioretention raingardens will provide interception and biodiversity benefits. Although they will also have a positive contribution towards hydraulic control, they have not been designed into the attenuation system. The CGA sub-base will provide sufficient attenuation storage alone.

The total catchment area for the proposed SuDS which includes the house, surrounding footpaths and driveway is approximately 154m².

The 38m² area of porous asphalt driveway will require a minimum 70mm porous asphalt surface course underlain by a CGA sub-base. As shown on drawing 11817_500, it is proposed that a 4m x 3.5m area of the porous asphalt will have a deep CGA sub-base, with minimum depth of 590mm to provide sufficient storage volume. The remaining area of porous asphalt will require the minimum sub-base depth for intended traffic loading, equating to a sub-base depth of 150mm.

For hydraulic calculations of the porous asphalt refer to **Appendix D – Design Calculations**.

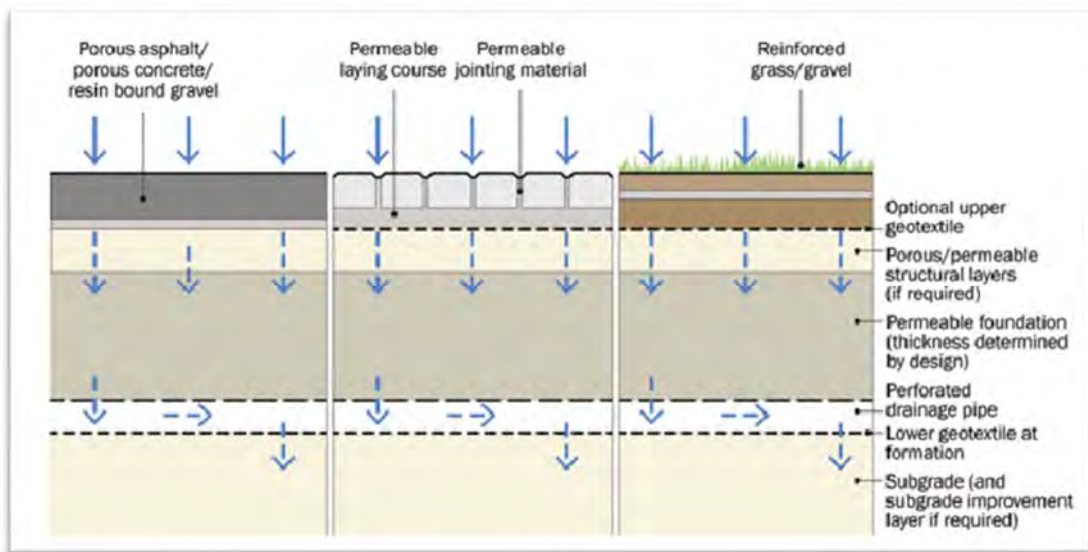


Figure 4: CIRIA C753 Figure 20.13 – Pervious pavements (partial infiltration)

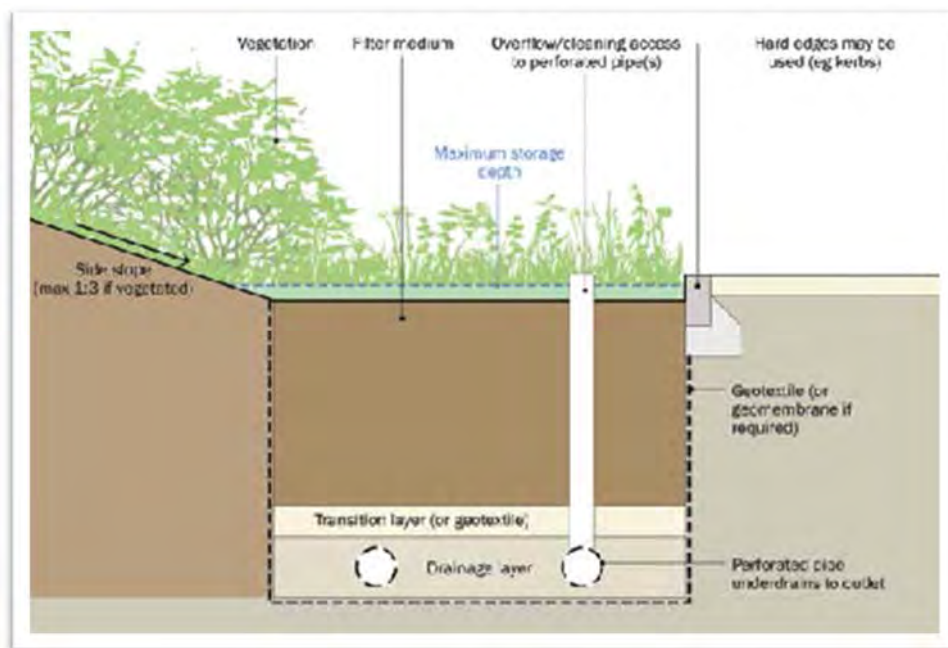


Figure 5: CIRIA C753 Figure 18.1 – Components of a bioretention raingarden

Refer to **Appendix B** – Proposed Site Plans, for drainage plans and design.

Interception of runoff

For greenfield sites the majority of rainfall events during the year create no noticeable surface water runoff, the rainwater will normally evapotranspire or recharge groundwater. Whereas, impermeable surfaces generate runoff from virtually all rainfall events. Therefore, the development of greenfield sites changes its surface water runoff characteristics and can have a negative impact on the morphology and ecology of receiving watercourses.

By providing interception of runoff through SuDS systems developed sites can be designed so to have zero runoff for most small rainfall events and more closely replicate the surface water characteristics of its former greenfield state.

As per Box 24.3 of the CIRIA SuDS Manual 2015. For a site where infiltration is poor, interception can only be delivered through the process of evapotranspiration. On this basis, it is considered that 1m² of vegetated or permeable area (porous asphalt) can provide interception for up to 3m² of impermeable area.

The proposed sites total impermeable area which includes the building, surrounding footpaths and some of the driveway is 111m². Therefore, a minimum of 37m² of vegetated or impermeable area is required to intercept the runoff. The proposed porous asphalt driveway is 38m² and the bioretention raingardens total an area of 5m², therefore the total impermeable area provided of 43m² is more than the required 37m².

Exceedance Flows

It is necessary to assess the risk and consequence of flooding for exceedance events. This is to determine the likely water flow paths and destinations that would be caused by a storm event that exceeds the critical 1 in 100-year + 40% climate change allowance that the surface water drainage system is designed for.

In these very unlikely events, it is possible that the surface water system will surcharge and fail. For the proposed site in particular surface water is discharged at a controlled rate via a flow control chamber. An overflow will be provided within the flow control chamber to allow surface water to discharge at an unfettered rate in an exceedance event.

2.2.3 S3: Water Quality

For roof and pedestrian areas water quality isn't considered such an issue as pollutant levels are expected to be low. However, in car parking areas where fuel and oil may be emitted from vehicles it would be beneficial to treat runoff before it discharges from the site.

To assess that the water quality being provided by the proposed SuDS solution is sufficient, the simple index approach as per section 26.7.1 of the CIRIA SuDS Manual 2015 is applied.

To deliver adequate water quality treatment the total SuDS mitigation index must be more than the pollution hazard index for each contaminant type. The pollution hazard and mitigation indices have been taken from tables 26.2 and 26.3 of the CIRIA SuDS Manual 2015.

Water quality - Simple Index Approach

Land Use	Pollution Hazard Level	Pollution hazard index			SuDS Components for land use	Mitigation Index			Mitigation hazard index > Pollution hazard index (for each contaminant type)
		Total Suspended Solids (TSS)	Metals	Hydro-carbons		Total Suspended Solids (TSS)	Metals	Hydro-carbons	
Residential roof	Very low	0.2	0.2	0.05	Bioretention Raingarden	0.8	0.8	0.8	Yes
Residential car park	Low	0.5	0.4	0.4	Porous asphalt	0.7	0.6	0.7	Yes

The proposed design will ensure that surface water runoff will either pass through the bioretention raingardens or porous asphalt before discharging from site. These SuDS components will separate the smaller particles and chemicals from the surface water discharge as it filters through providing sufficient water quality treatment to any discharging water.

Bioretention raingardens can provide effective water treatment such as the removal of fine sediments and associated pollutants which are trapped within the surface vegetation and groundcover. As surface water passes through the filter medium beneath further removal of fine particles and contaminants takes place.

The proposed SuDS components will be sufficient in removing contaminants and pollutants for the proposed site and will only have a positive impact on the receiving water quality.

2.2.4 **S4:** Amenity

The use of raingardens and incorporating porous asphalt into the driveway will provide an attractive, high quality open space that will be used to serve the site, seamlessly integrating SuDS into the driveway and garden area. The SuDS components will effectively drain surface water as close to the source as possible. The use of raingardens can also provide significant aesthetic benefits and an opportunity to improve biodiversity.

Within the site constraints the proposed solution looks to maximise amenity benefits.

2.2.5 **S5:** Biodiversity

The use of raingardens can help to provide a new quality habitat for wildlife, having a positive contribution to biodiversity in the area. The use of planting native species can support local biodiversity by providing habitat and food for invertebrates and birds better integrating this development into the wider natural landscape surrounding the area of Merthyr Tydfil.

A planting schedule has been developed giving recommended plant species suitable to the environment which can be incorporated into the raingarden areas, refer to **Appendix F** – Planting Schedule.

2.2.6 **S6:** Operation and Maintenance Requirements

To ensure SuDS components continue to operate reliably regular inspection and maintenance should be carried out. In most cases, appropriate information should be provided by the relevant manufacturer on what has been installed, how it works, when to inspect it and whether maintenance will be required. CIRIA C753 The SuDS Manual also provides information on the operation and maintenance requirements for various SuDS components.

An inspection and maintenance plan has been produced for the site proposals, providing the site owner, who is responsible for the maintenance, guidance on the types and frequency of inspections and maintenance work that is required for the proposed SuDS elements. It also provides a cost estimate for the inspection and maintenance requirements over the development's lifetime.

Refer to **Appendix G – Management & Maintenance Plan**.

3 CONCLUSIONS

The existing 260m² brownfield site which is currently part of the garden of 6 Criccieth Grove is to be developed into a 4-bedroom detached house with garden and driveway. The proposed plot of land does not have an existing surface water drainage system but is crossed by a combined sewer.

The proposed development will provide the site with a new sustainable surface water drainage system that will incorporate SuDS features providing a solution that will manage surface water for storm events up to a 100-year return period plus 40% climate change whilst providing improved water quality, amenity and biodiversity.

The SuDS components considered suitable for this site are a porous asphalt driveway and bioretention raingardens. Surface water will be collected from roofs and impermeable areas and conveyed towards and discharged to either of the SuDS components via linear channels and piping before being discharged to a combined sewer at a controlled rate.

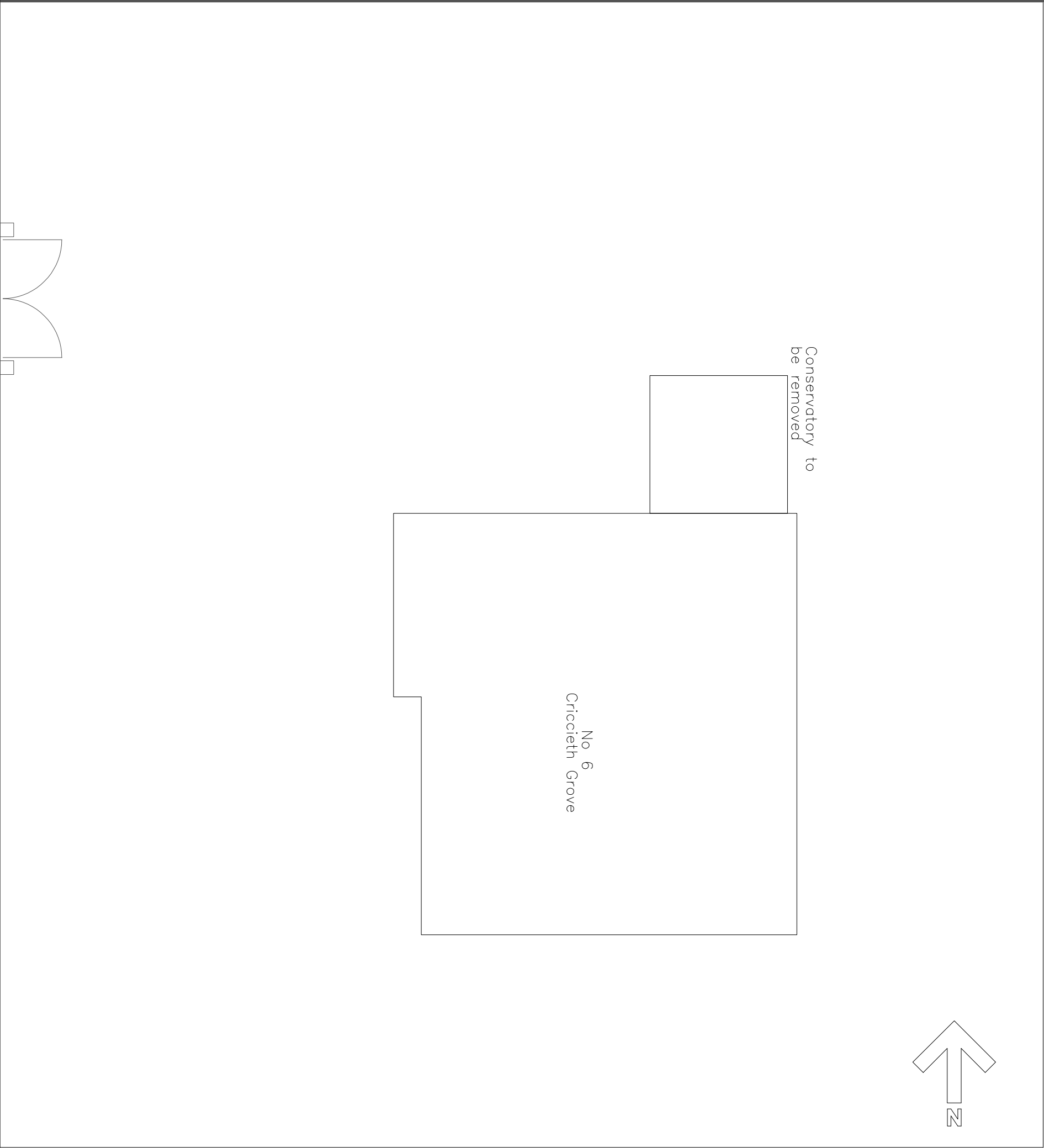
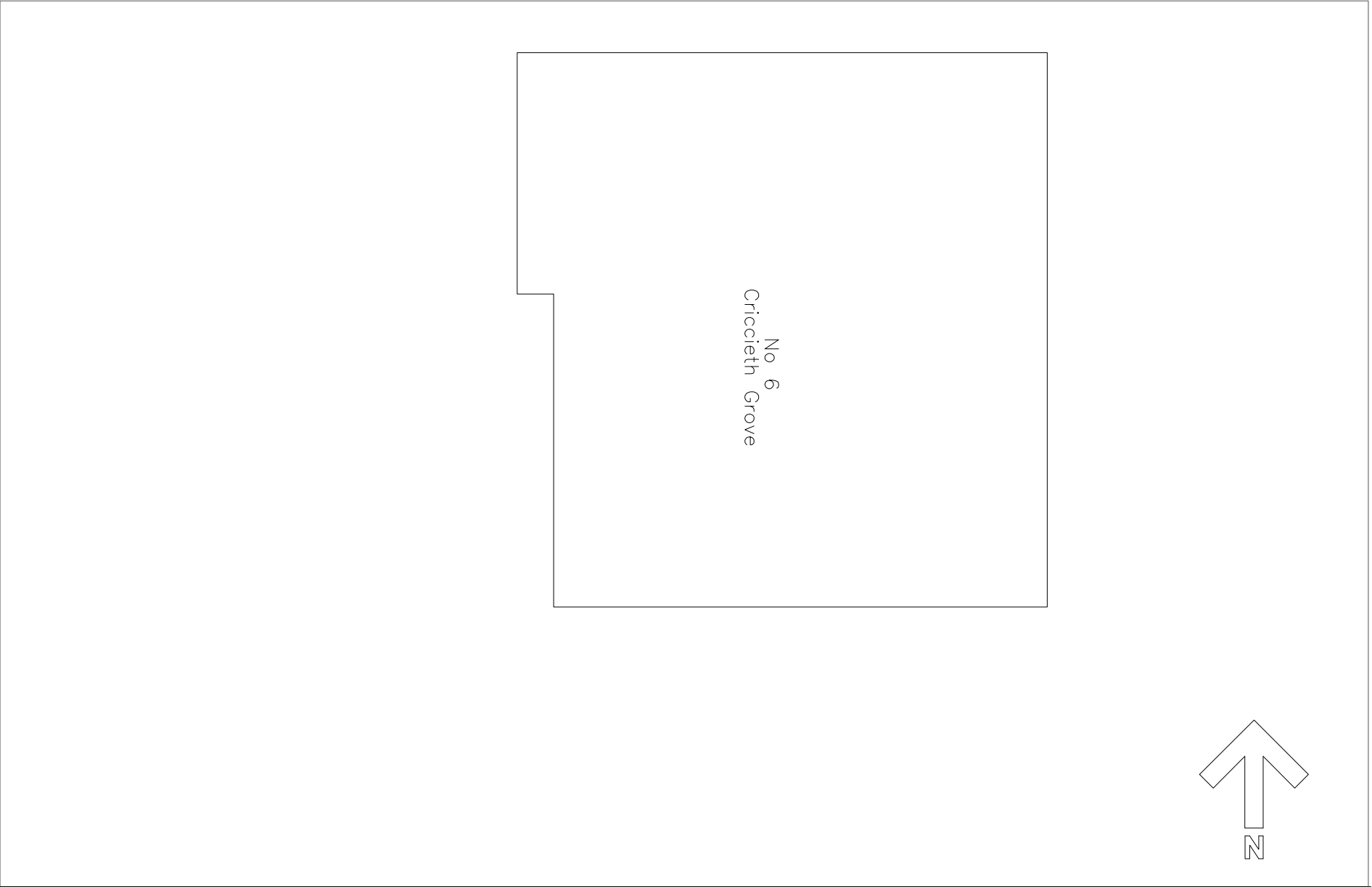
The storage volume of the porous asphalt course graded aggregate (CGA) sub-base has been calculated such that it will contain all surface water runoff from the site for a 1 in 100-year storm event plus 40% climate change for the critical storm duration, refer to **Appendix D** – Design Calculations.

*Foul water drainage to serve the site proposals has been considered and designed in accordance with Sewers for Adoption 7th edition, parts H1 and H2 of the Building Regulations and BS EN 752:2008. For co-ordination purposes foul water drainage has been shown on the proposed site plan, refer to **Appendix B**.*

Overall, the proposed surface water drainage system seeks to be a cost effective and easily maintainable sustainable drainage solution. The surface water discharge location is the most appropriate and preferred method within the sites constraints and the SuDS components incorporated in the design provide water quality, amenity and biodiversity benefits.

APPENDIX A: Existing Site Plans





Utopia Design
Architectural Services
Building Planning Application Support
Paul Thomas: BSc (Hons)
Tel: 01685 559230 Mob: 07908 725065

Issued Only for Purpose Indicated

Drawing Status: FOR PLANNING PURPOSES ONLY

Client	Site Address
<i>Phil Booth</i>	<i>Land Adjacent to 6, Criccieth Grove Castle Park Merthyr Tydfil CF48 1JY</i>

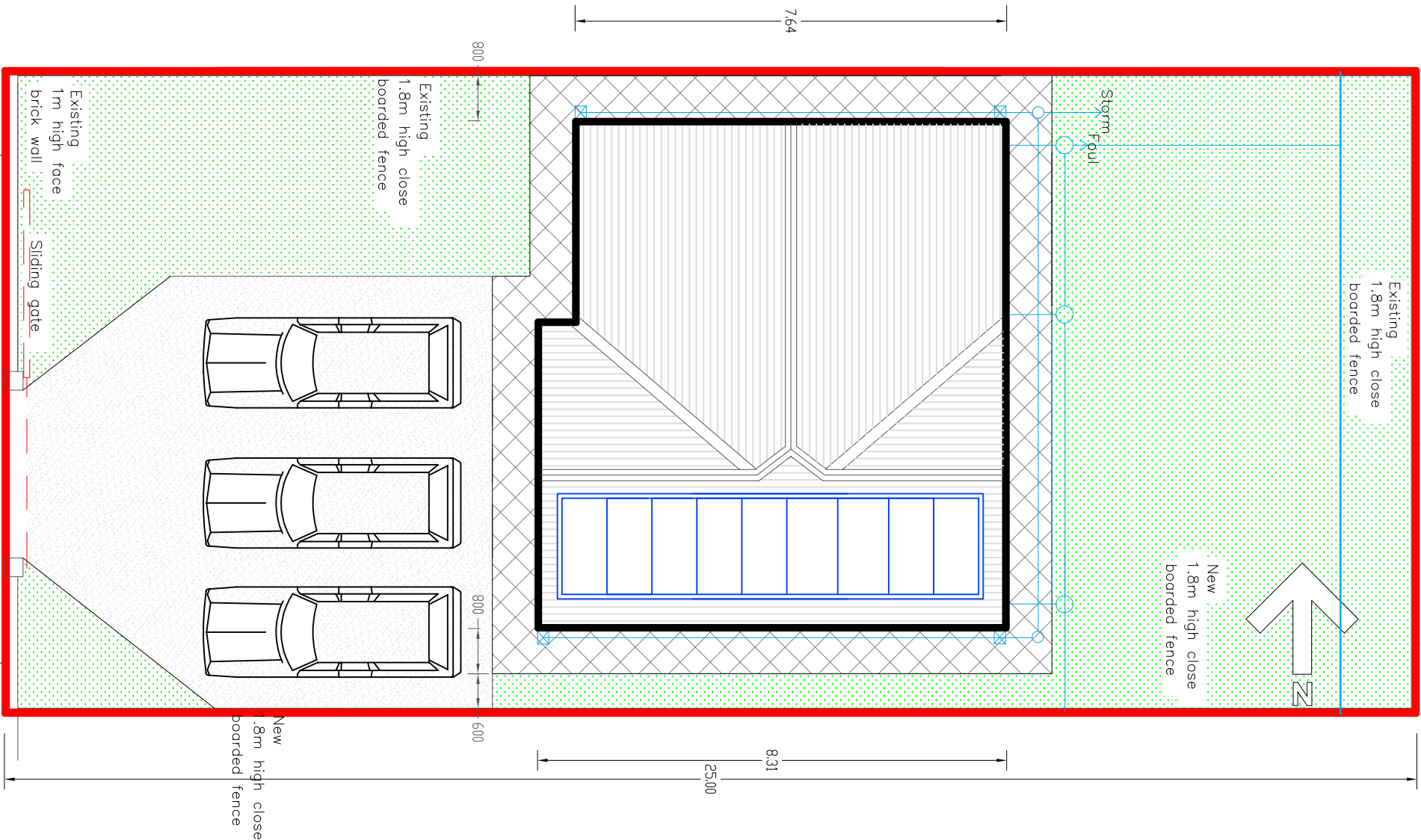
Project
Proposed 4 Bedroom Detached Dwelling

Drawn by	Date	Date	Approved	Date
<i>PT</i>	<i>22.06.2020</i>			
Title	Scale			
<i>Proposed Plans and Elevations</i>		<i>1:100</i>		
		Paper	<i>A2</i>	
		Dwg No	<i>P & C CRICC 05</i>	

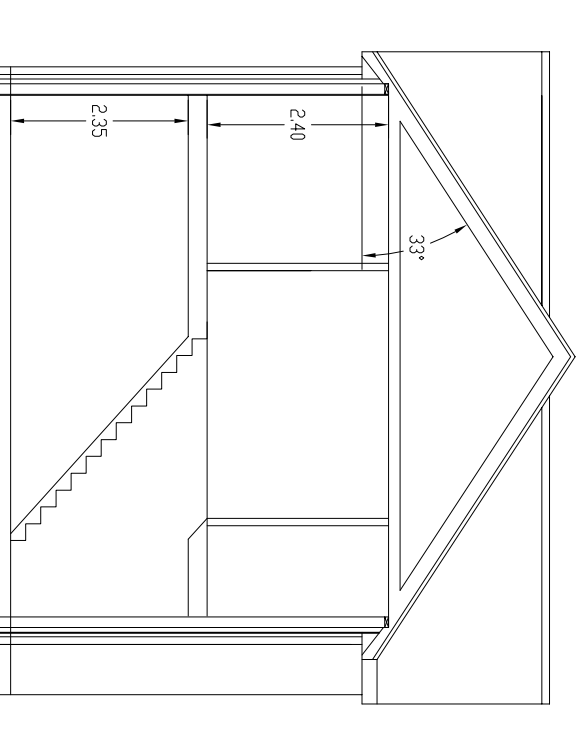
Retained Site Plan at 6 Criccieth

Existing Site Plan at 6 Criccieth

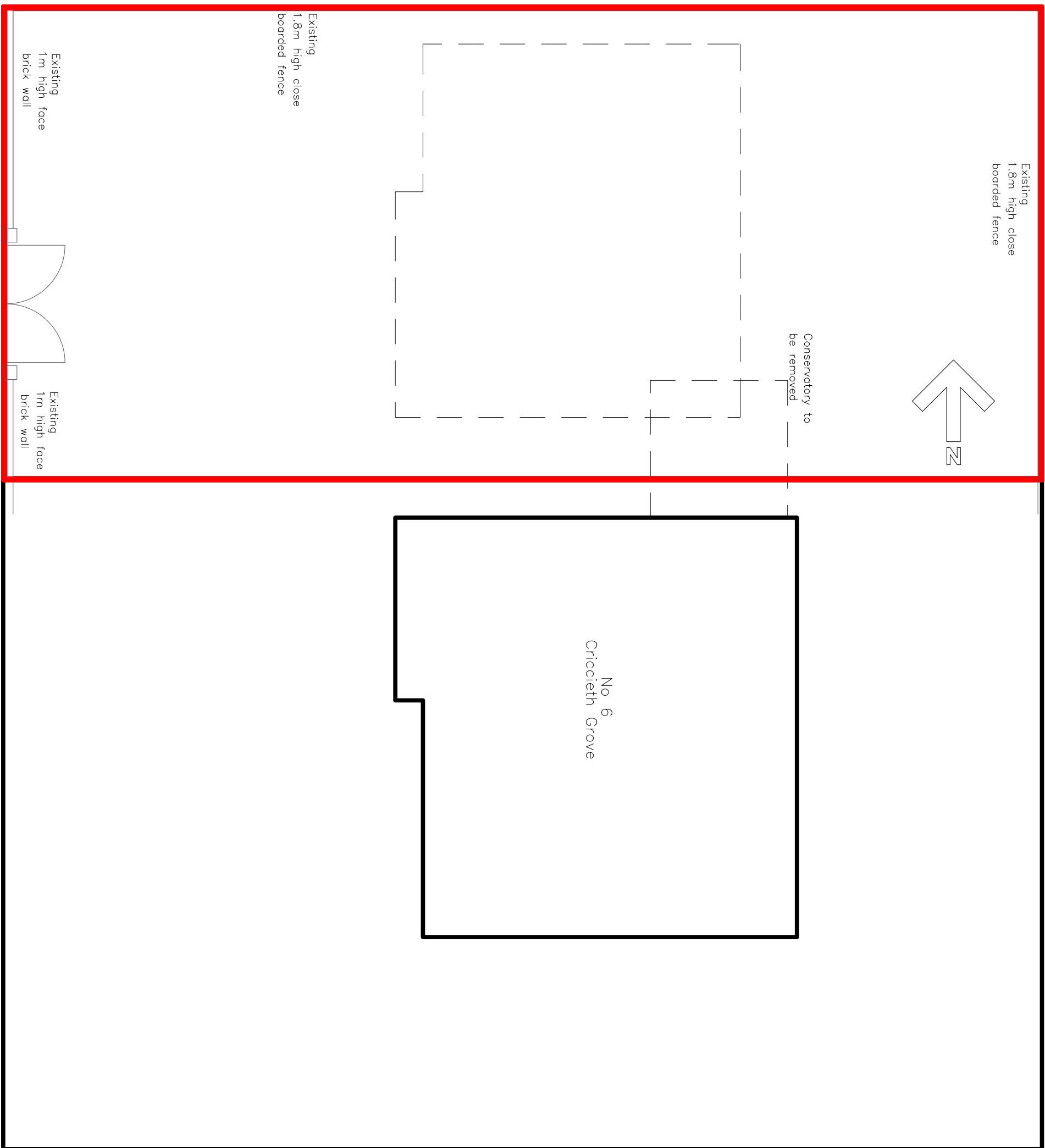
APPENDIX B: Proposed Site Plans



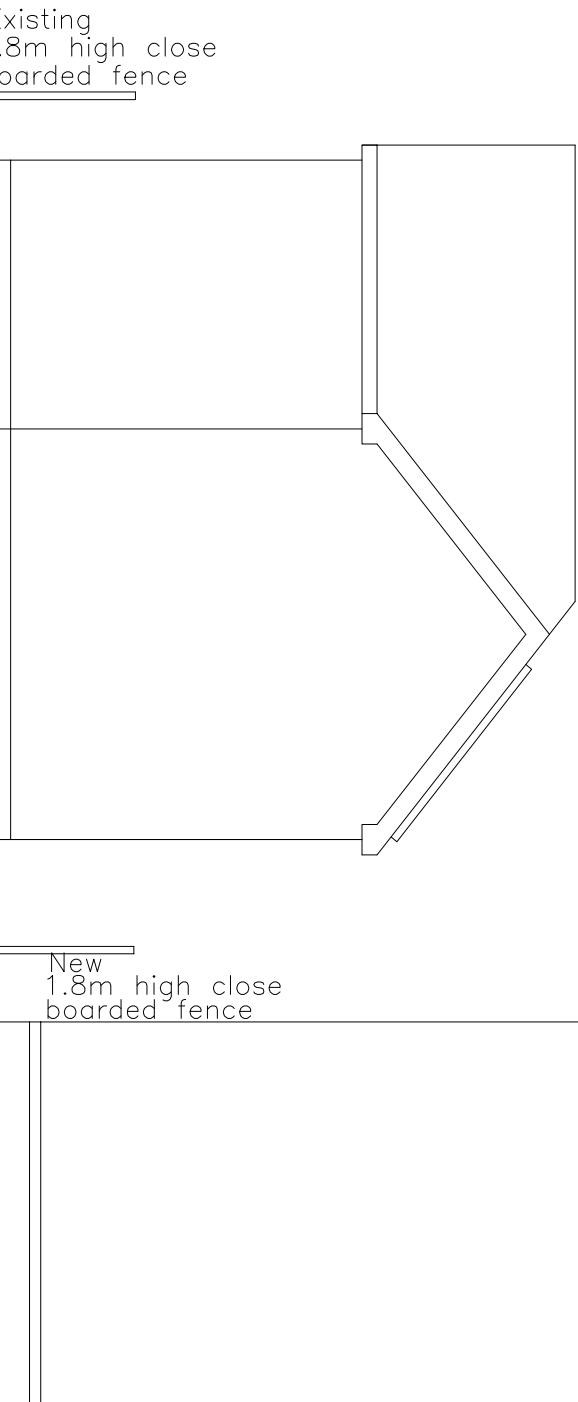
PROPOSED SITE PLAN



SECTION

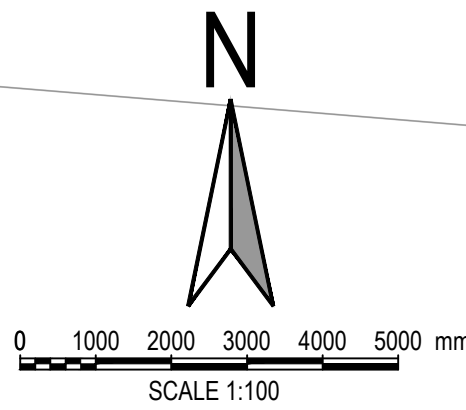


EXISTING BLOCK PLAN



SECTION

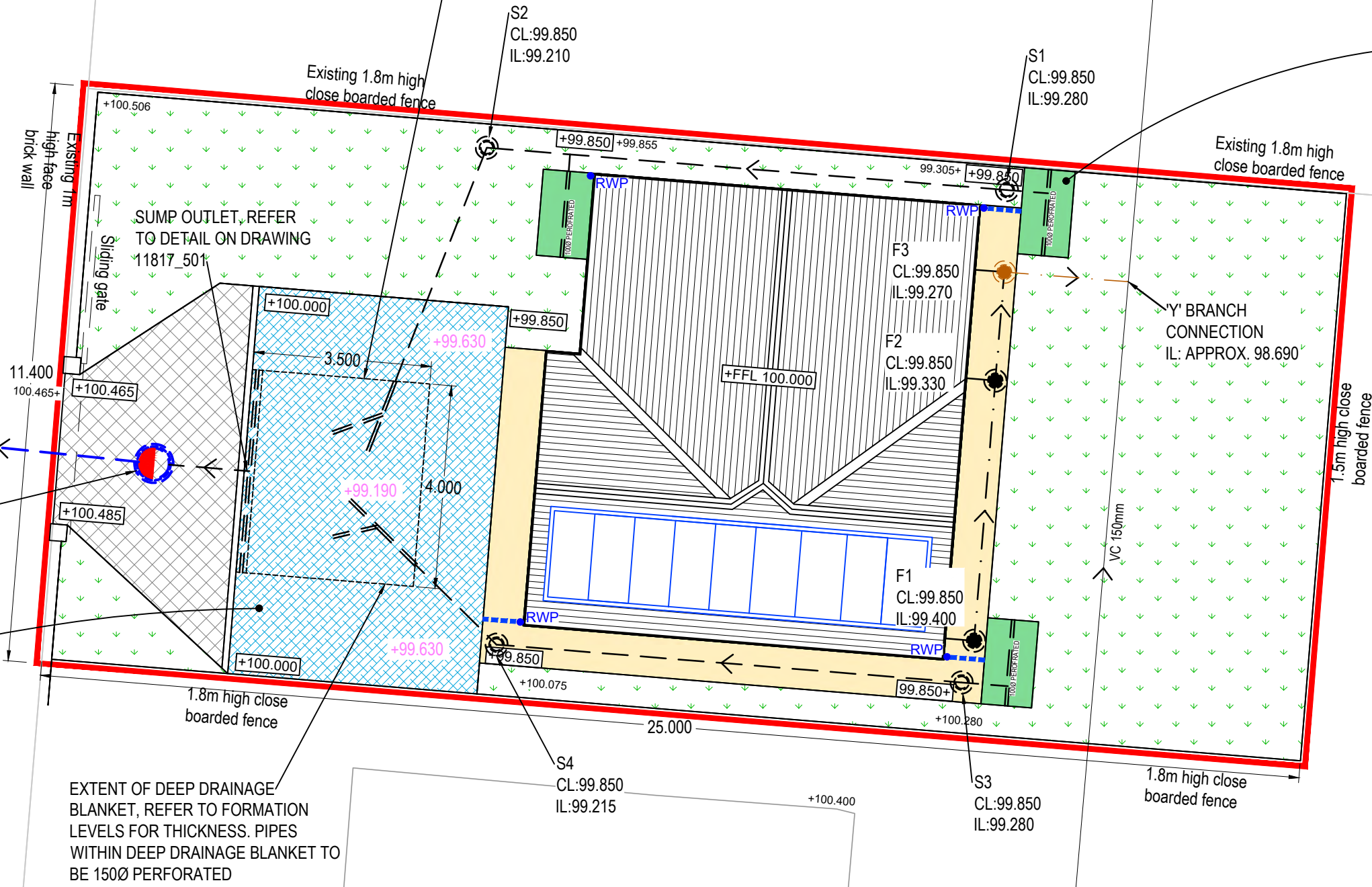
Utopia Design Architectural Services Building Regulation Application Support Paul Thomas BSc (Hons) MRICS Tel: 01685 559230 Mob: 07908 725065			
Intend Only for Purpose Indicated Drawing Status: FOR PLANNING PURPOSES ONLY			
Client	Site Address		
Phil Booth	7, Criccieth Grove Castle Park Merthyr Tydfil CF48 1JJ		
Project	Proposed 4 Bedroom Detached Dwelling		
Drawn by	Date	Date	Approved
PT	12.05.2020		
Title	Scale		Date
Proposed Plans and Sections		1:100	
	Page		
	Draw No		
			P & C CRIC 04



Criccieth Grove

VC 225mm

EXCEEDANCE FLOWS
THE DRAINAGE SYSTEM IS DESIGNED TO SURCHARGE DURING STORM EVENTS ALLOWING THE STORAGE VOLUME PROVIDED IN THE CGA SUB-BASE BENEATH THE POROUS ASPHALT DRIVEWAY TO ATTENUATE SURFACE WATER PRIOR TO DISCHARGE VIA THE FLOW CONTROL. THE SYSTEM IS DESIGNED FOR EVENTS UP TO AND INCLUDING THE CRITICAL 1 IN 100-YEAR STORM EVENT + 40% CLIMATE CHANGE ALLOWANCE. IN EVENTS EXCEEDING THIS THE SYSTEM COULD SURCHARGE BEYOND ITS DESIGN LIMIT. IN THIS CASE, AN OVERFLOW PROVIDED IN THE FLOW CONTROL CHAMBER WILL ALLOW FLOWS TO DISCHARGE TO THE SEWER AT AN UNFETTERED RATE.



TYPICAL IMAGE OF A POROUS ASPHALT DRIVEWAY



TYPICAL IMAGE OF A BIORETENTION RAINGARDEN

LEGEND

- POROUS ASPHALT
- TRADITIONAL ASPHALT CONSTRUCTION
- PAVING TO ARCHITECTS REQUIREMENTS
- GRASS / SOFT LANDSCAPING
- BIORETENTION RAINGARDEN
- EXISTING LEVEL
- PROPOSED LEVEL
- SITE BOUNDARY

DRAINAGE LEGEND

- PROPOSED ADOPTABLE SURFACE WATER DRAINAGE
- PROPOSED ADOPTABLE FOUL WATER DRAINAGE
- EXISTING COMBINED DRAINAGE
- EXISTING SURFACE WATER DRAINAGE
- DENOTES PRIVATE FW DRAINAGE
- DENOTES PRIVATE SW DRAINAGE
- DENOTES PRIVATE SW DRAINAGE - PERFORATED PIPE
- PROPOSED RAINWATER PIPE
- DENOTES FLOW CONTROL CHAMBER
- CONCRETE OR COBBLESTONE DISHED CHANNEL DRAIN
- DRAINAGE BLANKET FORMATION LEVEL

NOTES:

- MH COVERS AND FRAMES TO CONFORM TO BS EN 124:
 - HIGHWAYS AND PUBLIC CAR PARKS (D400)
 - LIGHTLY TRAFFICKED ROADS AND PRIVATE CAR PARKS (C250)
 - DOMESTIC DRIVEWAYS (B125)
- TYPE S BEDDING AND SURROUND TO ALL PIPES EXCEPT IN THE FOLLOWING CIRCUMSTANCES, IN WHICH TYPE Z BEDDING AND SURROUND ARE TO BE USED:
 - DOMESTIC GARDENS AND PATHWAYS WITHOUT ANY POSSIBILITY OF VEHICULAR ACCESS, 0.35m;
 - DOMESTIC DRIVEWAYS, PARKING AREAS AND YARDS WITH HEIGHT RESTRICTIONS TO PREVENT ENTRY BY VEHICLES WITH A GROSS VEHICLE WEIGHT IN EXCESS OF 7.5 TONNES, 0.5m;
 - DOMESTIC DRIVEWAYS, PARKING AREAS AND NARROW STREETS WITHOUT FOOTWAYS (E.G., MEWS DEVELOPMENTS) WITH LIMITED ACCESS FOR VEHICLES WITH A GROSS VEHICLE WEIGHT IN EXCESS OF 7.5 TONNES, 0.9m;
 - AGRICULTURAL LAND AND PUBLIC OPEN SPACE, 0.9m;
 - OTHER HIGHWAYS AND PARKING AREAS WITH UNRESTRICTED ACCESS TO VEHICLES WITH A GROSS VEHICLE WEIGHT IN EXCESS OF 7.5 TONNES, 1.2m.
- ALL EXISTING MANHOLE INVERTS TO BE CHECKED AND REPORTED TO THE ENGINEER PRIOR TO THE COMMENCEMENT OF DRAINAGE WORKS. EXISTING PIPE CONNECTIONS ARE TO BE CCTV SURVEYED AND INSPECTED. IF THE PIPE CONNECTION IS FOUND TO BE DAMAGED OR IN DISTRESS, THE CONTRACTOR IS TO CARRY OUT REMEDIAL WORKS OR PROVIDE A NEW CONNECTION TO THE EXISTING SEWER (PIPE SIZE AND GRADIENT TO BE DETERMINED BY THE ENGINEER).
- THE CONTRACTOR SHALL INSTALL DRAINS TO THE INVERT LEVELS SHOWN FOR EACH MANHOLE OR OTHER INDICATED POSITION.
- ALL FOUL DRAINAGE TO BE MINIMUM 100mm DIAMETER AND LAID TO THE INVERT LEVELS SHOWN OR A MINIMUM 1 IN 100 FALL, UNLESS OTHERWISE NOTED.
- ALL STORM WATER DRAINAGE TO BE A MINIMUM OF 150mm DIAMETER AND LAID TO THE INVERT LEVELS SHOWN OR A MINIMUM 1 IN 150 FALL, UNLESS OTHERWISE NOTED.
- ALL ADOPTABLE THERMOPLASTIC STRUCTURED WALL SEWER PIPE SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 13476-1 AND WIS 4-35-01 AND BS EN 13476-2 OR BS EN 13476-3. PIPES SHALL BE BSI KITEMARKED OR HAVE EQUIVALENT THIRD PARTY CERTIFICATION. PIPES LESS THAN OR EQUAL TO 500mm DIA. SHALL HAVE A SHORT-TERM RING STIFFNESS OF NOT LESS THAN 8kN/m² (SN8).
- ALL JOINTING IN ACCORDANCE WITH MANUFACTURERS TECHNICAL ADVICE & SPECIFICATION.
- ALL NON ADOPTABLE DRAINAGE TO BE THE STANDARD UPVC 110mm, 160mm DRAINAGE AND MANUFACTURED TO BS-EN 1401 AND BS 4660 UNLESS NOTED OTHERWISE.
- SOIL & VENT PIPE LOCATION AND NUMBER TO BE CONFIRMED WITH ARCHITECT.
- THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS DRAWINGS, TOGETHER WITH THEIR LATEST SPECIFICATIONS. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER AS SOON AS POSSIBLE.
- FIGURED DIMENSIONS ONLY TO BE USED. ANY QUERIES OR DISCREPANCIES TO BE REFERRED TO THE ENGINEER.
- PRIOR TO ORDERING ANY MATERIALS THE CONTRACTOR IS TO CONFIRM MANUFACTURER/PIPE MATERIAL AND GRADE PROPOSED WITH WATER AUTHORITY.
- DESIGN RISK ASSESSMENTS AND METHOD STATEMENTS ARE TO BE PROVIDED TO THE PRINCIPLE CONTRACTOR PRIOR TO THE COMMENCEMENT OF ANY WORKS.

01	FP	MJ	MJ	11.01.21	Issue for SAB approval

rev.	drawn	chd.	approved	date	description
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Client
LEE PICKETT

Project
**6 CRICCIETH GROVE,
MERTHYR TYDFIL,
CF48 1JY**

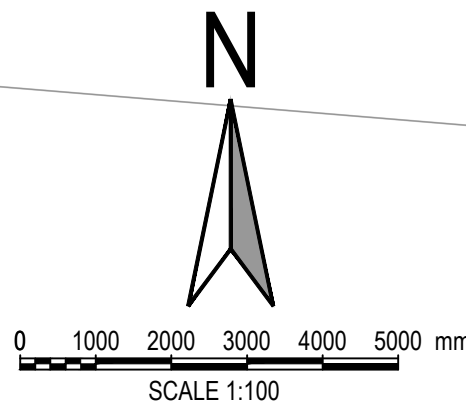
Title
DRAINAGE PLAN

**Vale Consultancy**
CONSULTING CIVIL & STRUCTURAL ENGINEERS
29 Bocam Park, Old Field Road, Pencoed, Bridgend CF35 5LJ.
Phone: 01656 863794 Email: enquiries@vale-consultancy.co.uk

date	drawn	checked	approved
11.01.21	FP	MJ	MJ

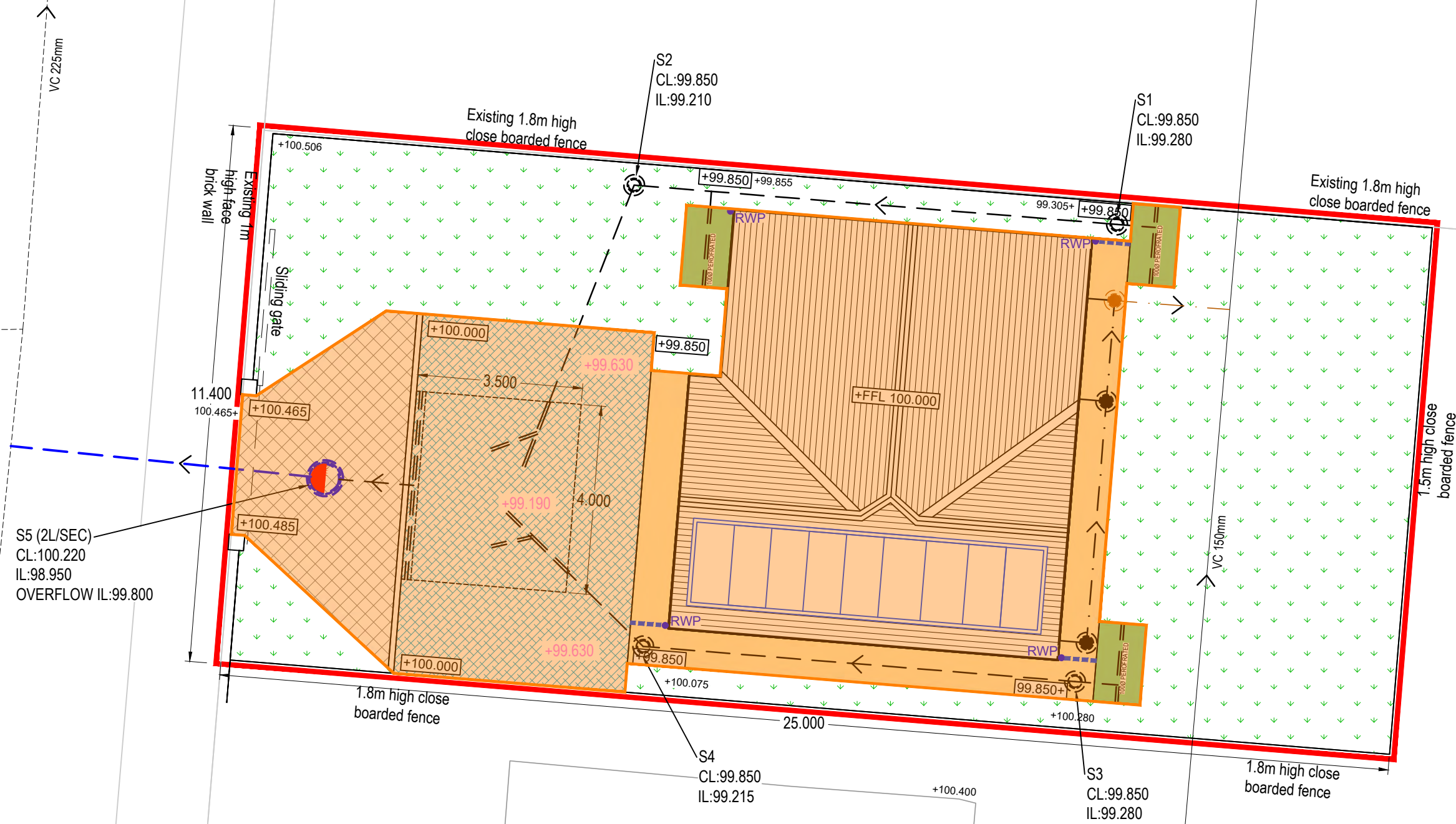
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status	drg. no.	rev.
A	11817_500	01



Criccieth Grove

No. 42 Kidwelly Grove



LEGEND

- POROUS ASPHALT
- TRADITIONAL ASPHALT CONSTRUCTION
- PAVING TO ARCHITECTS REQUIREMENTS
- GRASS / SOFT LANDSCAPING
- BIORETENTION RAINGARDEN
- EXISTING LEVEL
- PROPOSED LEVEL
- SITE BOUNDARY

CATCHMENT AREAS

- CATCHMENT AREA FOR CGA SUB-BASE ATTENUATION STORAGE (154m²)

NOTES:

- MH COVERS AND FRAMES TO CONFORM TO BS EN 124:
 - HIGHWAYS AND PUBLIC CAR PARKS (D400)
 - LIGHTLY TRAFFICKED ROADS AND PRIVATE CAR PARKS (C250)
 - DOMESTIC DRIVEWAYS (B125)
- TYPE S BEDDING AND SURROUND TO ALL PIPES EXCEPT IN THE FOLLOWING CIRCUMSTANCES, IN WHICH TYPE Z BEDDING AND SURROUND ARE TO BE USED:
 - DOMESTIC GARDENS AND PATHWAYS WITHOUT ANY POSSIBILITY OF VEHICULAR ACCESS, 0.35m;
 - DOMESTIC DRIVEWAYS, PARKING AREAS AND YARDS WITH HEIGHT RESTRICTIONS TO PREVENT ENTRY BY VEHICLES WITH A GROSS VEHICLE WEIGHT IN EXCESS OF 7.5 TONNES, 0.5m;
 - DOMESTIC DRIVEWAYS, PARKING AREAS AND NARROW STREETS WITHOUT FOOTWAYS (E.G., MEWS DEVELOPMENTS) WITH LIMITED ACCESS FOR VEHICLES WITH A GROSS VEHICLE WEIGHT IN EXCESS OF 7.5 TONNES, 0.9m;
 - AGRICULTURAL LAND AND PUBLIC OPEN SPACE, 0.9m;
 - OTHER HIGHWAYS AND PARKING AREAS WITH UNRESTRICTED ACCESS TO VEHICLES WITH A GROSS VEHICLE WEIGHT IN EXCESS OF 7.5 TONNES, 1.2m.
- ALL EXISTING MANHOLE INVERTS TO BE CHECKED AND REPORTED TO THE ENGINEER PRIOR TO THE COMMENCEMENT OF DRAINAGE WORKS. EXISTING PIPE CONNECTIONS ARE TO BE CCTV SURVEYED AND INSPECTED. IF THE PIPE CONNECTION IS FOUND TO BE DAMAGED OR IN DISTRESS, THE CONTRACTOR IS TO CARRY OUT REMEDIAL WORKS OR PROVIDE A NEW CONNECTION TO THE EXISTING SEWER (PIPE SIZE AND GRADIENT TO BE DETERMINED BY THE ENGINEER).
- THE CONTRACTOR SHALL INSTALL DRAINS TO THE INVERT LEVELS SHOWN FOR EACH MANHOLE OR OTHER INDICATED POSITION.
- ALL FOUL DRAINAGE TO BE MINIMUM 100mm DIAMETER AND LAID TO THE INVERT LEVELS SHOWN OR A MINIMUM 1 IN 100 FALL, UNLESS OTHERWISE NOTED.
- ALL STORM WATER DRAINAGE TO BE A MINIMUM OF 150mm DIAMETER AND LAID TO THE INVERT LEVELS SHOWN OR A MINIMUM 1 IN 150 FALL, UNLESS OTHERWISE NOTED.
- ALL ADOPTABLE THERMOPLASTIC STRUCTURED WALL SEWER PIPE SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 13476-1 AND WIS 4-35-01 AND BS EN 13476-2 OR BS EN 13476-3. PIPES SHALL BE BSI KITEMARKED OR HAVE EQUIVALENT THIRD PARTY CERTIFICATION. PIPES LESS THAN OR EQUAL TO 500mm DIA. SHALL HAVE A SHORT-TERM RING STIFFNESS OF NOT LESS THAN 8kN/m² (SN8).
- ALL JOINTING IN ACCORDANCE WITH MANUFACTURERS TECHNICAL ADVICE & SPECIFICATION.
- ALL NON ADOPTABLE DRAINAGE TO BE THE STANDARD UPVC 110mm, 160mm DRAINAGE AND MANUFACTURED TO BS-EN 1401 AND BS 4660 UNLESS NOTED OTHERWISE.
- SOIL & VENT PIPE LOCATION AND NUMBER TO BE CONFIRMED WITH ARCHITECT.
- THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS DRAWINGS, TOGETHER WITH THEIR LATEST SPECIFICATIONS. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER AS SOON AS POSSIBLE.
- FIGURED DIMENSIONS ONLY TO BE USED. ANY QUERIES OR DISCREPANCIES TO BE REFERRED TO THE ENGINEER.
- PRIOR TO ORDERING ANY MATERIALS THE CONTRACTOR IS TO CONFIRM MANUFACTURER/PIPE MATERIAL AND GRADE PROPOSED WITH WATER AUTHORITY.
- DESIGN RISK ASSESSMENTS AND METHOD STATEMENTS ARE TO BE PROVIDED TO THE PRINCIPLE CONTRACTOR PRIOR TO THE COMMENCEMENT OF ANY WORKS.

01	FP	MJ	MJ	11.01.21	Issue for SAB approval

rev.	drawn	chkd.	approved	date	description
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Client
LEE PICKETT

Project
**6 CRICCIETH GROVE,
MERTHYR TYDFIL,
CF48 1JY**

Title
CATCHMENT AREA PLAN



date	drawn	checked	approved
11.01.21	FP	MJ	MJ

scale @ A1	project no.
1:100	11817

status	drg. no.	rev.
A	11817_502	01

APPENDIX C: Site Investigation Report

Report No. BC/MB/11.19.04.

**Site Investigation Report:
Land at 6 Criccieth Grove, Castle Park Estate,
Merthyr Tydfil.**

Prepared on behalf of:

Eco Valley Homes

By:



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Liability.

Blandford Consulting does not accept any liability other than arising out of the information that forms the basis of this report.

Site Investigation Report: Land at 6 Criccieth Grove, Castle Park Estate, Merthyr Tydfil.

Contents.

	Page:
1. Introduction	1
2. Brief Description of the Site	2
3. Geology of the Site	3
4. Mining History	4
5. Mine Gases	4
6. Site Investigation	4
7. Recommendations: Foundation Options	5
8.	

List of Plans

Drawing No:		Scale:
<i>BC/MB/11.19.04.01.</i>	<i>General Location Plan.</i>	<i>1:50,000.</i>
<i>BC/MB/11.19.04.02.</i>	<i>Geology Plan.</i>	<i>1:10,560.</i>
<i>BC/MB/11.19.04.03.</i>	<i>Detailed Location Plan.</i>	<i>1:1,250.</i>
<i>BC/MB/11.19.04.05.</i>	<i>Borehole Location Plan.</i>	<i>1:200.</i>

Appendix

Graphic Logs of Boreholes 1-3.

Site Investigation Report: Land at 6 Criccieth Grove, Castle Park Estate, Merthyr Tydfil.

1 Introduction

This report has been prepared on behalf of our client:

*Eco Valley Homes,
17 Pembroke Close,
Castle Park,
Merthyr Tydfil,
CF48 1JF*

and relates to land at 6 Criccieth Grove on Castle Park Estate, where it is proposed to erect a detached dwelling. This report discusses the geology and mining history of the Site and the immediately surrounding area as they may affect the construction of the proposed dwelling and thereby assesses the mining risk to the proposed development. Recommendations are made on the appropriate foundation option.

The following sources of data were used in the compilation of this report:

- i) The findings of the report, 'Mining Risk Assessment: Land at 6 Criccieth Grove, Castle Park Estate, Merthyr Tydfil' reference no. BC/MB/06.19.04, published by Blandford Consulting;*
- ii) The findings of the site investigation programme carried out on the Site; and*
- iii) the archive records of Blandford Consulting.*

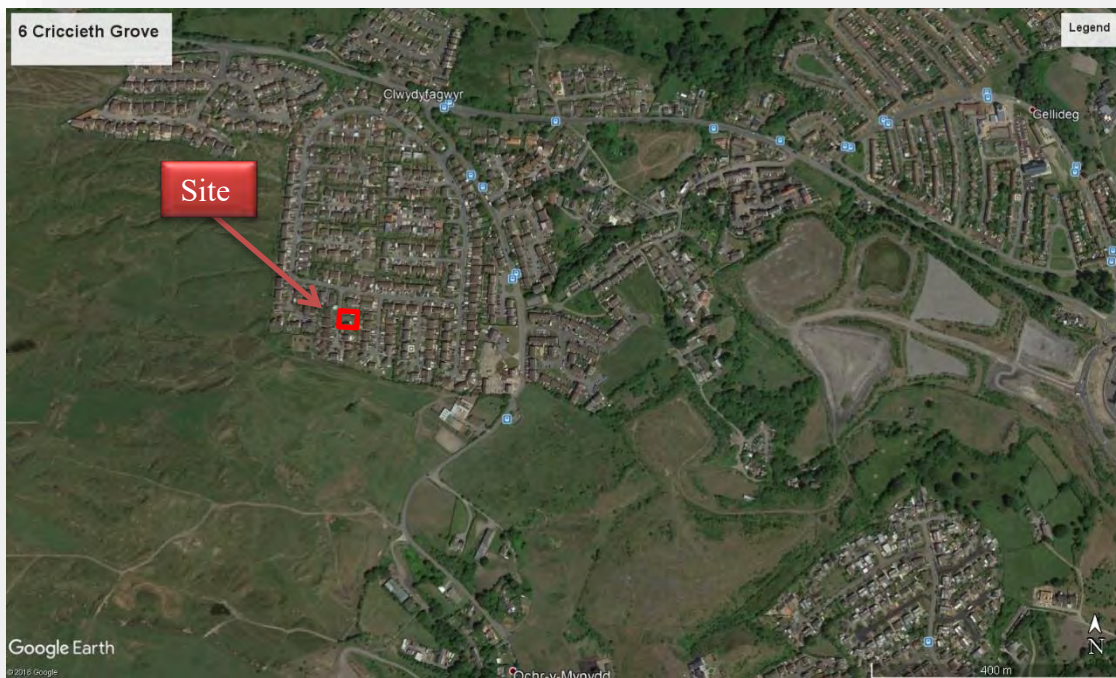
The findings of this report are necessarily based upon the data used in its compilation and may be amended in the future in the light of additional material information. The report must only be used in its entirety for its stated purpose.

/Cont....

2 Brief Description of the Site

The parcel of land that is the subject of this report ('the Site') is located at the north-western margins of Merthyr Tydfil and is approximately 5.5 km north-west of the centre of the town (see Figure 1 and *General Location Plan, drawing no. BC/MB/11.19.04.01*). The Site is located on north-easterly facing slopes and is at an approximate elevation of 321m aod: it is rectangular in outline with approximate maximum dimensions of 25m and 12m (see *Detailed Location Plan, drawing no. BC/MB/11.19.04.03*). The Site lies within a mixed residential area where houses and bungalows are a mixture of terraced, semi-detached and detached. There are sports fields to the west and north-west of the Site.

Figure 1
Aerial View of Site



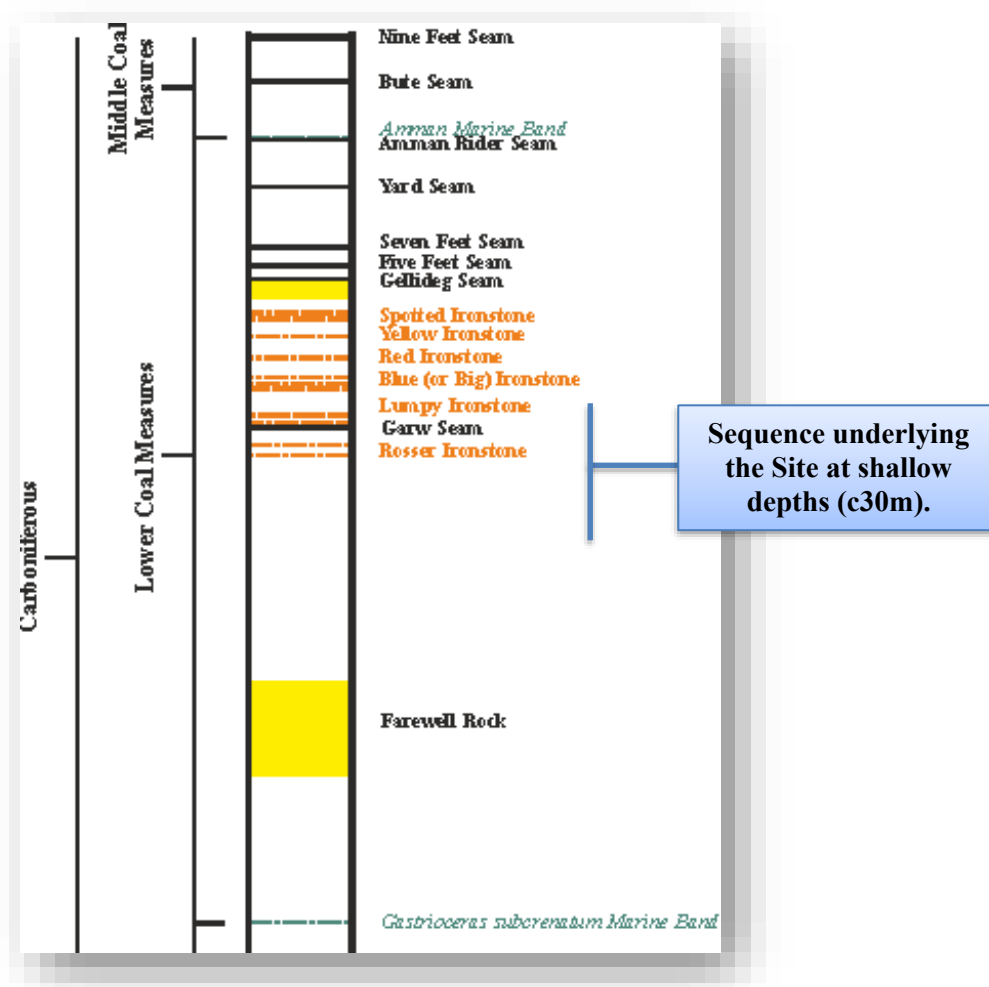
3 Geology of the Site

The earlier coal mining risk assessment report found that the Site is situated at the northern margin of the South Wales Coalfield and is underlain at shallow depths with strata assigned to the Lower Coal Measures. The outcrop of the Garw Seam lies approximately 50m

/Cont....

north of the Site (see *Geology Plan, drawing no. BC/MB/11.19.04.02*); there are a series of ironstone veins above the Seam in the geological sequence and it is underlain by the Rosser Ironstone Veins (see Figure 2, Part of the Stratigraphic Column). There are no coal seams below the Garw Seam that are thick enough to have supported underground mining operations. The regional dip of the coal measures in this area is 1 in 12 towards the south-west such that the sequence containing the ironstone veins and the Garw Seam underlie the Site at shallow depths.

Figure 1
Part of the Stratigraphic Column.



The Site is not affected by large faults and is not affected by landslip conditions. The published geological sheet also shows the Site to be covered with glacial deposits of Boulder Clay.

/Cont....

4 Mining History

The earlier coal mining risk assessment identified a risk of shallow mine workings underlying the Site in the Garw Seam or in a number of the ironstone veins. The report recommended exploratory boreholes to examine the risk from shallow mine workings in greater detail. The report found no record of a disused shaft or adit within the confines of the Site or within 20m of its boundary. The Site has not been part of an opencast coal site, and there have been no opencast mining operations close enough to the Site to affect the structural integrity of the proposed development. There are no operating collieries within influencing distance of the Site.

5 Mine Gases

The earlier report identified a low risk from mine gases, but recommended monitoring the exploration boreholes for the presence of mine gases.

6 Site Investigation

6.1 Site Investigation Programme

A programme of three rotary percussive boreholes was planned for the Site; the boreholes were drilled to a maximum depth of 30m. The locations of the boreholes are shown on the *Site Investigation Plan, drawing no. BC/MB/11.19.04.05* and the borehole logs are included in the Appendix. The boreholes were supervised by a Chartered Geologist and drilled by Apex Drilling Services using a Beretta T44 rig. The boreholes were monitored for the presence of mine gases.

6.2 Findings of the Site Investigation: Rotary Boreholes

All three boreholes encountered glacial till, Boulder Clay, the thickness of which was found to vary between 6.0m and 7.1m. Beneath the Boulder Clay coal measures were

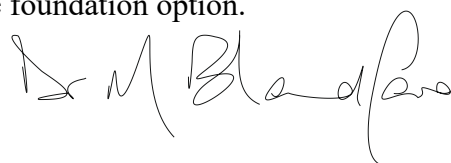
/Cont....

proved to a maximum depth of 30m; the coal measures were found to be comprised variously of mudstone, sandstone, sandstone with mudstone bands, and ironstone. Old workings were encountered only in Borehole 3, where 0.8m of soft drilling, suspected to be old workings, was encountered at a depth of 21.0m. The thickness of coal measures above the suspected old workings was found to be 15.0m, resulting in a strata: void ratio of 18.8:1. A strata: void ratio of 10:1 is generally accepted as the limiting ratio where old workings might collapse as far as rockhead or the surface. The 18.8:1 ratio is much higher than the 10:1 ratio, resulting in a negligible risk of the old workings collapsing to the base of the superficial deposits.

The boreholes were monitored for mine gases throughout the drilling operations; the operations were monitored for the presence of methane, carbon monoxide, hydrogen sulphide and levels of oxygen outside the 20% - 21% range. None of the above mine gases were encountered and the readings of oxygen levels all fell within the above range.

7 Recommendations: Foundation Options

The risk of shallow mine workings collapsing to the surface at the Site can be considered to be negligible. In so far as the risk from past mining operations is concerned, shallow spread foundations, either conventional strip/trench or raft, will be appropriate. The soil conditions at the Site should be assessed before deciding on the appropriate foundation option.



**Dr Malcolm Blandford,
Chartered Geologist.**

Report Date: 13th February 2020.

**Blandford Consulting,
Consultant Geologists and Geotechnical Engineers,
The Enterprise Centre, Merthyr Industrial Park, Pentrebach, Merthyr Tydfil, CF48 4DR.
Tel. No. (01443) 693353. Fax. No. (01443) 693351.**

PLANS



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Geologists Working With The Environment....

Study on Land at 6 Criccieth Grove, Castle Park,
Merthyr Tydfil.

General Location Plan.

Plan Scale: 1:50,000.

Key to Symbols:



Approximate Position of Site.

Note:
North is at top of plan.

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Drawing No: BC/MB/11.19.04.01.



Geologists Working With The Environment...

Study on Land at 6 Criccieth Grove, Castle Park,
Merthyr Tydfil.

Geology Plan.

Plan Scale: 1:10,560.

Key to Symbols:



Approximate Position of Site.

Note:
North is at top of plan.

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Drawing No: BC/MB/11.19.04.02.



Study on Land at 6 Criccieth Grove, Castle Park,
Merthyr Tydfil.

Detailed Location Plan.

Plan Scale: 1:1,250.

Key to Symbols:

 Approximate Site Boundary.

Notes:

North is at top of plan.

Drawing prepared from plan supplied by client.

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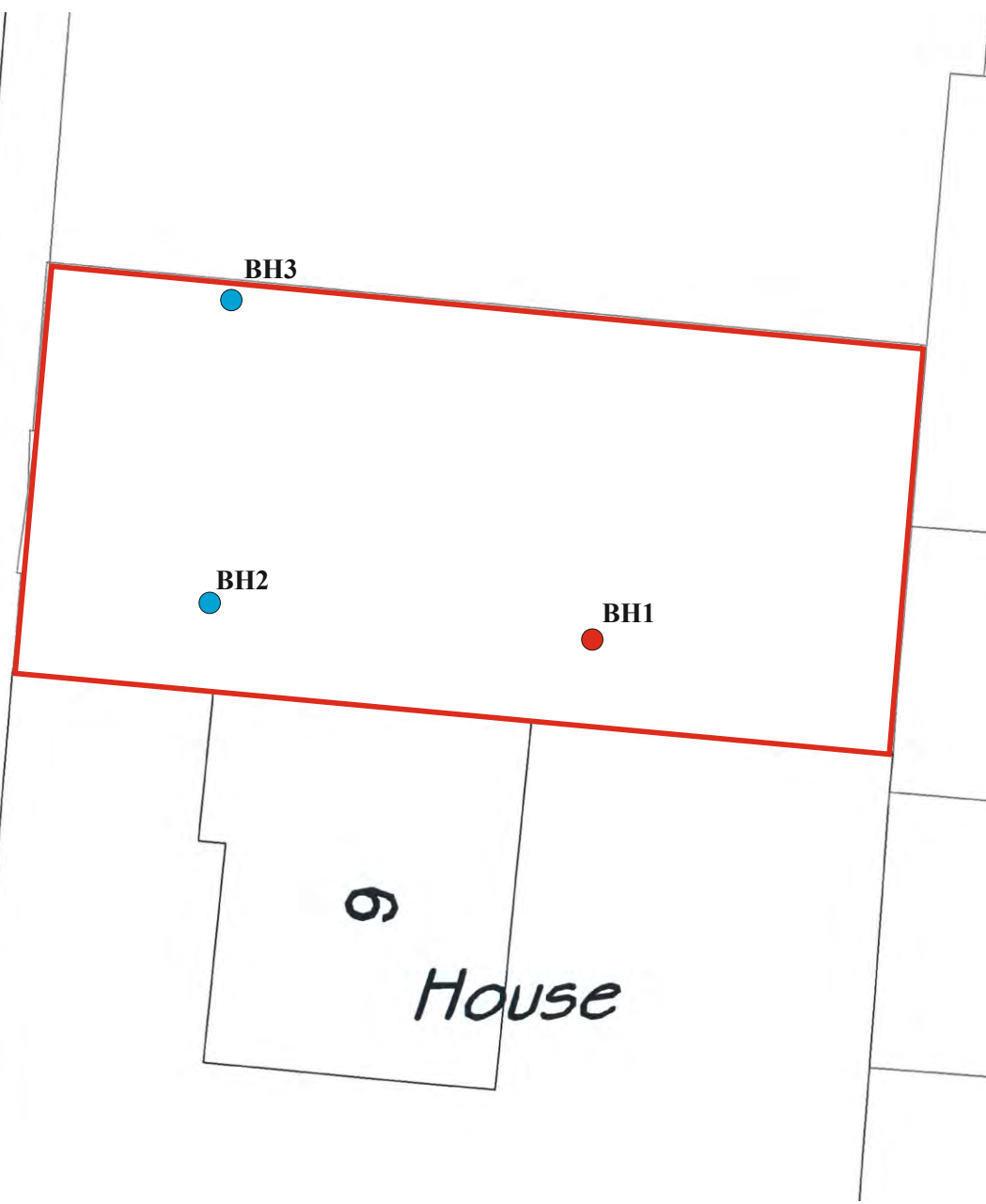
Drawing No: BC/MB/11.19.04.03.

Geologists Working With The Environment...





CRICKIETH GROVE



Study on Land at 6 Crickieth Grove, Castle Park,
Merthyr Tydfil.

Borehole Location Plan.

Plan Scale: 1:200.

Key to Symbols:

- **Approximate Site Boundary.**
- **Borehole that Encountered No Old Workings.**
- **Borehole that Encountered Old Workings.**

Notes:

North is at top of plan.

Drawing prepared from plan supplied by client.

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Geologists Working With The Environment...

Drawing No: BC/MB/11.19.04.05.

APPENDIX

GRAPHIC LOGS OF BOREHOLES 1-3



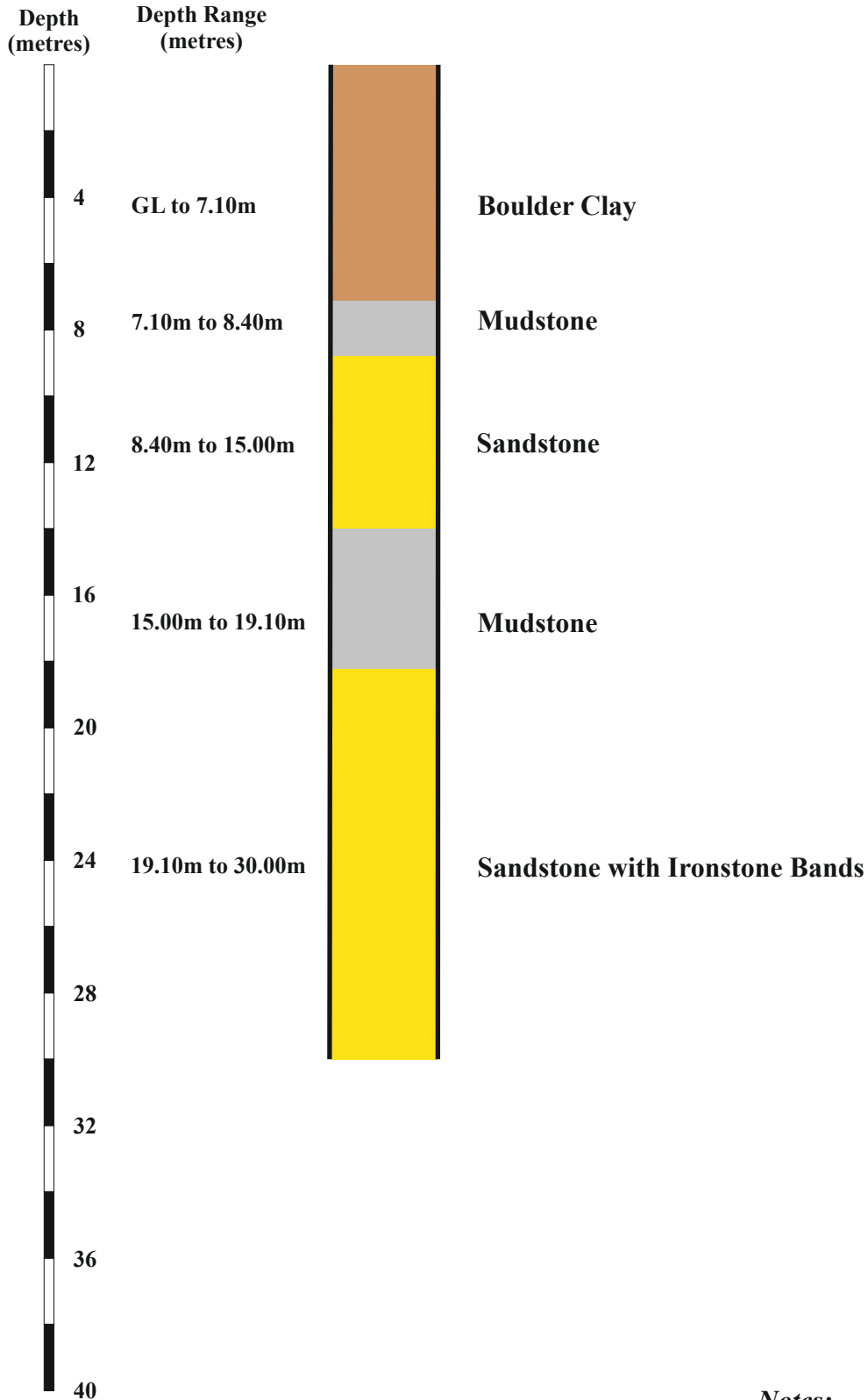
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Geologists Working With The Environment....

Study on Land at 6 Criccieth Grove

Borehole No. 1

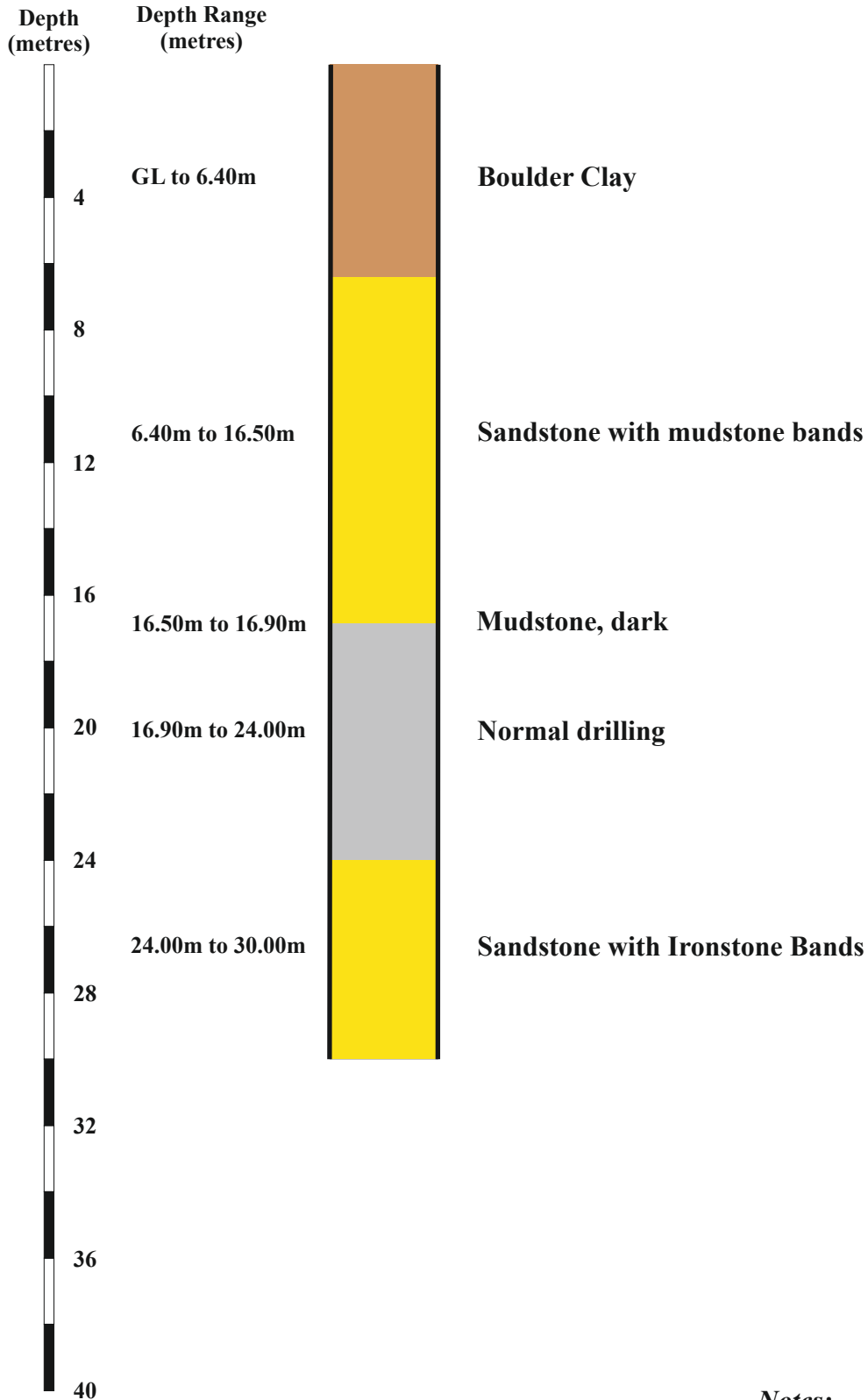


Notes:

1. *Driller's Descriptions*
2. *Borehole dry.*
3. *Total depth of borehole, 30.00m.*

Study on Land at 6 Criccieth Grove

Borehole No. 2

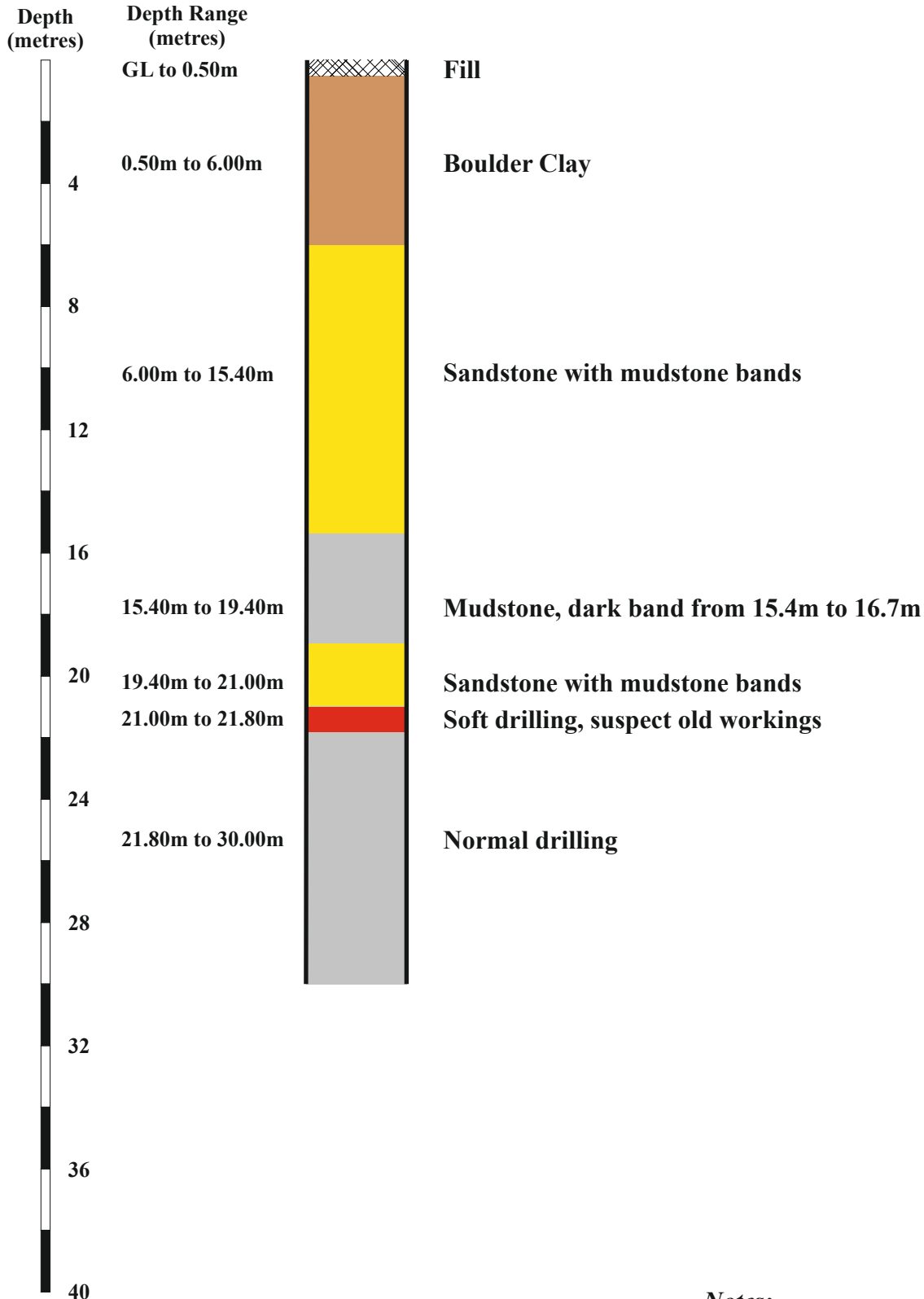


Notes:

1. Driller's Descriptions
2. Borehole dry.
3. Total depth of borehole, 30.00m.

Study on Land at 6 Criccieth Grove

Borehole No. 3



Notes:

1. *Driller's Descriptions*
2. *Borehole dry.*
3. *Total depth of borehole, 30.00m.*

APPENDIX D: Design Calculations

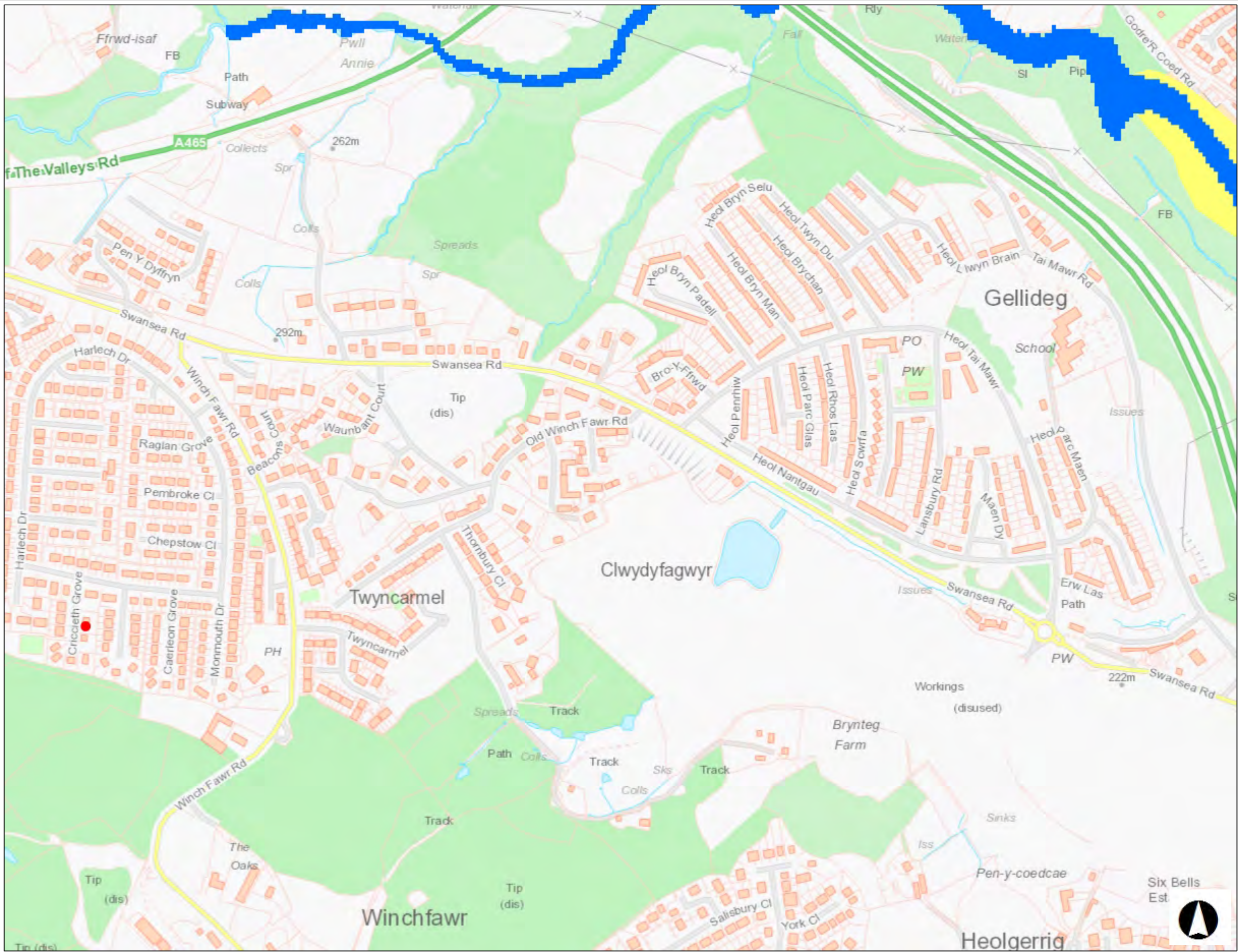
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<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time : 11 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max E Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>99.564</td><td>0.374</td><td>0.0</td><td>2.0</td><td>2.0</td><td>1.6</td><td>Flood Risk</td></tr><tr><td>30 min Summer</td><td>99.658</td><td>0.468</td><td>0.0</td><td>2.0</td><td>2.0</td><td>2.0</td><td>Flood Risk</td></tr><tr><td>60 min Summer</td><td>99.704</td><td>0.514</td><td>0.0</td><td>2.0</td><td>2.0</td><td>2.2</td><td>Flood Risk</td></tr><tr><td>120 min Summer</td><td>99.649</td><td>0.459</td><td>0.0</td><td>2.0</td><td>2.0</td><td>1.9</td><td>Flood Risk</td></tr><tr><td>180 min Summer</td><td>99.535</td><td>0.345</td><td>0.0</td><td>2.0</td><td>2.0</td><td>1.4</td><td>O K</td></tr><tr><td>240 min Summer</td><td>99.392</td><td>0.202</td><td>0.0</td><td>2.0</td><td>2.0</td><td>0.8</td><td>O K</td></tr><tr><td>360 min Summer</td><td>99.235</td><td>0.045</td><td>0.0</td><td>2.0</td><td>2.0</td><td>0.2</td><td>O K</td></tr><tr><td>480 min Summer</td><td>99.190</td><td>0.000</td><td>0.0</td><td>1.9</td><td>1.9</td><td>0.0</td><td>O K</td></tr><tr><td>600 min Summer</td><td>99.190</td><td>0.000</td><td>0.0</td><td>1.7</td><td>1.7</td><td>0.0</td><td>O K</td></tr><tr><td>720 min Summer</td><td>99.190</td><td>0.000</td><td>0.0</td><td>1.5</td><td>1.5</td><td>0.0</td><td>O K</td></tr><tr><td>960 min Summer</td><td>99.190</td><td>0.000</td><td>0.0</td><td>1.2</td><td>1.2</td><td>0.0</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>99.190</td><td>0.000</td><td>0.0</td><td>0.9</td><td>0.9</td><td>0.0</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>99.190</td><td>0.000</td><td>0.0</td><td>0.7</td><td>0.7</td><td>0.0</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>99.190</td><td>0.000</td><td>0.0</td><td>0.6</td><td>0.6</td><td>0.0</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>99.190</td><td>0.000</td><td>0.0</td><td>0.4</td><td>0.4</td><td>0.0</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>99.190</td><td>0.000</td><td>0.0</td><td>0.4</td><td>0.4</td><td>0.0</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>99.190</td><td>0.000</td><td>0.0</td><td>0.3</td><td>0.3</td><td>0.0</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>99.190</td><td>0.000</td><td>0.0</td><td>0.3</td><td>0.3</td><td>0.0</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>99.190</td><td>0.000</td><td>0.0</td><td>0.3</td><td>0.3</td><td>0.0</td><td>O K</td></tr><tr><td>15 min Winter</td><td>99.632</td><td>0.442</td><td>0.0</td><td>2.0</td><td>2.0</td><td>1.9</td><td>Flood Risk</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>108.388</td><td>0.0</td><td>3.0</td><td>14</td></tr><tr><td>30 min Summer</td><td>80.084</td><td>0.0</td><td>4.4</td><td>23</td></tr><tr><td>60 min Summer</td><td>56.713</td><td>0.0</td><td>6.3</td><td>40</td></tr><tr><td>120 min Summer</td><td>38.228</td><td>0.0</td><td>8.6</td><td>74</td></tr><tr><td>180 min Summer</td><td>29.624</td><td>0.0</td><td>10.0</td><td>108</td></tr><tr><td>240 min Summer</td><td>24.692</td><td>0.0</td><td>11.1</td><td>136</td></tr><tr><td>360 min Summer</td><td>19.016</td><td>0.0</td><td>12.7</td><td>190</td></tr><tr><td>480 min Summer</td><td>15.750</td><td>0.0</td><td>14.1</td><td>0</td></tr><tr><td>600 min Summer</td><td>13.583</td><td>0.0</td><td>15.2</td><td>0</td></tr><tr><td>720 min Summer</td><td>12.022</td><td>0.0</td><td>16.1</td><td>0</td></tr><tr><td>960 min Summer</td><td>9.894</td><td>0.0</td><td>17.7</td><td>0</td></tr><tr><td>1440 min Summer</td><td>7.501</td><td>0.0</td><td>20.1</td><td>0</td></tr><tr><td>2160 min Summer</td><td>5.701</td><td>0.0</td><td>23.0</td><td>0</td></tr><tr><td>2880 min Summer</td><td>4.701</td><td>0.0</td><td>25.2</td><td>0</td></tr><tr><td>4320 min Summer</td><td>3.603</td><td>0.0</td><td>29.0</td><td>0</td></tr><tr><td>5760 min Summer</td><td>3.007</td><td>0.0</td><td>32.2</td><td>0</td></tr><tr><td>7200 min Summer</td><td>2.625</td><td>0.0</td><td>35.2</td><td>0</td></tr><tr><td>8640 min Summer</td><td>2.348</td><td>0.0</td><td>37.7</td><td>0</td></tr><tr><td>10080 min Summer</td><td>2.136</td><td>0.0</td><td>40.0</td><td>0</td></tr><tr><td>15 min Winter</td><td>108.388</td><td>0.0</td><td>3.3</td><td>15</td></tr></table>								Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status	15 min Summer	99.564	0.374	0.0	2.0	2.0	1.6	Flood Risk	30 min Summer	99.658	0.468	0.0	2.0	2.0	2.0	Flood Risk	60 min Summer	99.704	0.514	0.0	2.0	2.0	2.2	Flood Risk	120 min Summer	99.649	0.459	0.0	2.0	2.0	1.9	Flood Risk	180 min Summer	99.535	0.345	0.0	2.0	2.0	1.4	O K	240 min Summer	99.392	0.202	0.0	2.0	2.0	0.8	O K	360 min Summer	99.235	0.045	0.0	2.0	2.0	0.2	O K	480 min Summer	99.190	0.000	0.0	1.9	1.9	0.0	O K	600 min Summer	99.190	0.000	0.0	1.7	1.7	0.0	O K	720 min Summer	99.190	0.000	0.0	1.5	1.5	0.0	O K	960 min Summer	99.190	0.000	0.0	1.2	1.2	0.0	O K	1440 min Summer	99.190	0.000	0.0	0.9	0.9	0.0	O K	2160 min Summer	99.190	0.000	0.0	0.7	0.7	0.0	O K	2880 min Summer	99.190	0.000	0.0	0.6	0.6	0.0	O K	4320 min Summer	99.190	0.000	0.0	0.4	0.4	0.0	O K	5760 min Summer	99.190	0.000	0.0	0.4	0.4	0.0	O K	7200 min Summer	99.190	0.000	0.0	0.3	0.3	0.0	O K	8640 min Summer	99.190	0.000	0.0	0.3	0.3	0.0	O K	10080 min Summer	99.190	0.000	0.0	0.3	0.3	0.0	O K	15 min Winter	99.632	0.442	0.0	2.0	2.0	1.9	Flood Risk	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	108.388	0.0	3.0	14	30 min Summer	80.084	0.0	4.4	23	60 min Summer	56.713	0.0	6.3	40	120 min Summer	38.228	0.0	8.6	74	180 min Summer	29.624	0.0	10.0	108	240 min Summer	24.692	0.0	11.1	136	360 min Summer	19.016	0.0	12.7	190	480 min Summer	15.750	0.0	14.1	0	600 min Summer	13.583	0.0	15.2	0	720 min Summer	12.022	0.0	16.1	0	960 min Summer	9.894	0.0	17.7	0	1440 min Summer	7.501	0.0	20.1	0	2160 min Summer	5.701	0.0	23.0	0	2880 min Summer	4.701	0.0	25.2	0	4320 min Summer	3.603	0.0	29.0	0	5760 min Summer	3.007	0.0	32.2	0	7200 min Summer	2.625	0.0	35.2	0	8640 min Summer	2.348	0.0	37.7	0	10080 min Summer	2.136	0.0	40.0	0	15 min Winter	108.388	0.0	3.3	15
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																																																																																	
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Date 12/01/2021 08:48 File 11817_porous asphalt.SRCX	Designed by freddy.payne Checked by						
Innovyze Source Control 2020.1							
<u>Summary of Results for 100 year Return Period (+40%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	99.731	0.541	0.0	2.0	2.0	2.3	Flood Risk
60 min Winter	99.759	0.569	0.0	2.0	2.0	2.4	Flood Risk
120 min Winter	99.624	0.434	0.0	2.0	2.0	1.8	Flood Risk
180 min Winter	99.380	0.190	0.0	2.0	2.0	0.8	O K
240 min Winter	99.226	0.036	0.0	2.0	2.0	0.2	O K
360 min Winter	99.190	0.000	0.0	1.7	1.7	0.0	O K
480 min Winter	99.190	0.000	0.0	1.4	1.4	0.0	O K
600 min Winter	99.190	0.000	0.0	1.2	1.2	0.0	O K
720 min Winter	99.190	0.000	0.0	1.1	1.1	0.0	O K
960 min Winter	99.190	0.000	0.0	0.9	0.9	0.0	O K
1440 min Winter	99.190	0.000	0.0	0.7	0.7	0.0	O K
2160 min Winter	99.190	0.000	0.0	0.5	0.5	0.0	O K
2880 min Winter	99.190	0.000	0.0	0.4	0.4	0.0	O K
4320 min Winter	99.190	0.000	0.0	0.3	0.3	0.0	O K
5760 min Winter	99.190	0.000	0.0	0.3	0.3	0.0	O K
7200 min Winter	99.190	0.000	0.0	0.2	0.2	0.0	O K
8640 min Winter	99.190	0.000	0.0	0.2	0.2	0.0	O K
10080 min Winter	99.190	0.000	0.0	0.2	0.2	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	80.084	0.0	4.9	24			
60 min Winter	56.713	0.0	7.1	44			
120 min Winter	38.228	0.0	9.6	80			
180 min Winter	29.624	0.0	11.1	110			
240 min Winter	24.692	0.0	12.3	134			
360 min Winter	19.016	0.0	14.3	0			
480 min Winter	15.750	0.0	15.8	0			
600 min Winter	13.583	0.0	17.0	0			
720 min Winter	12.022	0.0	18.1	0			
960 min Winter	9.894	0.0	19.8	0			
1440 min Winter	7.501	0.0	22.6	0			
2160 min Winter	5.701	0.0	25.7	0			
2880 min Winter	4.701	0.0	28.3	0			
4320 min Winter	3.603	0.0	32.5	0			
5760 min Winter	3.007	0.0	36.1	0			
7200 min Winter	2.625	0.0	39.4	0			
8640 min Winter	2.348	0.0	42.3	0			
10080 min Winter	2.136	0.0	44.9	0			
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<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>20.000</td> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Ratio R</td> <td>0.200</td> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> <td>Climate Change %</td> <td>+40</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 0.015 <table> <tr> <td>Time (mins)</td> <td>Area</td> </tr> <tr> <td>From: To:</td> <td>(ha)</td> </tr> <tr> <td>0</td> <td>4 0.015</td> </tr> </table>			Rainfall Model	FSR	Winter Storms	Yes	Return Period (years)	100	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	20.000	Shortest Storm (mins)	15	Ratio R	0.200	Longest Storm (mins)	10080	Summer Storms	Yes	Climate Change %	+40	Time (mins)	Area	From: To:	(ha)	0	4 0.015
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APPENDIX E: Natural Resource Wales Development Advice Map & Detailed View Map



Map Perygl Llifogydd / Flood Risk Map -

Allwedd / Map Key

- Zone C1
- Zone C2
- Zone B
- Zone A

Graddfa / Scale at A3 1:5,001

Dyddiad / Date
04/01/2021



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Risk Level Under Review

 High
 Medium
 Low

Need Rating

- High
- Medium
- Low

 High
 Medium
 Low

Graddfa / Scale at A3 1: 5,001

Dyddiad / Date
04/01/2021



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APPENDIX F: Planting Schedule

Planting Schedule:

6 Criccieth Grove,
Merthyr Tydfil,
CF48 1JY

Prepared for:

Lee Pickett

REF: 11817-PS01

DATE: January 2021

Document Control

Project	6 Criccieth Grove, Merthyr Tydfil, CF48 1JY
Client	Lee Pickett
Vale Consultancy Ref:	11817-PS01

Document Checking:

Prepared By: F Payne

Signed:



Checked By: L Roberts

Signed:



Verified By: M Jones

Signed:



Issue	Date	Status
01	January 2021	First issue
02		
03		

1 Contents

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2	Bioretention raingardens	3

1 Introduction

This document has been prepared by Vale Consultancy, on behalf of the Client. The following list of plants have been selected as appropriate for use within the proposed SuDS areas.

2 Bioretention raingardens

The use of bioretention raingardens can help to provide a new quality habitat for wildlife, having a positive contribution to biodiversity in the area. The use of planting native species can support local biodiversity by providing habitat and food for invertebrates and birds. The Wildlife Trust of South and West Wales have recommended some native plants that are suitable to use in raingardens in the area, which are as follows:

Yellow Flag Iris (*Iris pseudocorus*)

Pendulous Sedge (*Carex pendula*)

Purple Loosestrife (*Lythrum salicaria*)

Water Mint (*Mentha aquatica*)

Hemp agrimony (*Eupatorium cannabinum*)

Ragged Robin (*Lychnis flos-cuculi*)

Marsh Woundwort (*Stachys palustris*)

Soft Rush (*Juncus effusus*)

Royal Fern (*Osmunda regalis*)

Bugle (*Ajuga reptans*)

Chives (*Allium schoenoprasum*)

APPENDIX G: Management & Maintenance Plan

Management and Maintenance Plan for Sustainable Drainage (SuDS) at:

6 Criccieth Grove,
Merthyr Tydfil,
CF48 1JY

Prepared for:

Lee Pickett

REF: 11817-MP01

DATE: January 2021

Document Control

Project	6 Criccieth Grove, Merthyr Tydfil, CF48 1JY
Client	Lee Pickett
Vale Consultancy Ref:	11817-MP01

Document Checking:

Prepared By:

F Payne

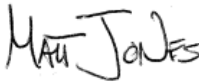
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Checked By:

M Jones

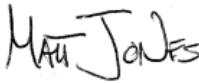
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Verified By:

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Issue	Date	Status
1	January 2021	First issue

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1. INTRODUCTION AND MANAGEMENT RESPONSIBILITIES

- 1.1. This Landscape Management Plan has been prepared by Vale Consultancy in support of a SuDS scheme for the proposed development at 6 Criccieth Grove, Merthyr Tydfil, CF48 1JY.
- 1.2. The proposed scheme is to develop a four-bedroom detached house with associated driveway and garden.
- 1.3. The scheme incorporates a sustainable drainage system for surface water runoff, which consists of porous asphalt in the driveway and small bioretention raingardens. The method for disposal of surface water runoff is discharge to sewer.
- 1.4. The purpose of this document is to set out the overall management and maintenance responsibilities, objectives and requirements for the developments proposed SuDS components. The document will also provide an estimate for the costs associated with the management and maintenance of the proposed SuDS components over the lifetime of the development.
- 1.5. All references to SuDS components are based on the SAB submission drawings:
 - ***11817-500: Drainage Layout***
 - ***11817-501: Drainage Details***

2. MANAGEMENT RESPONSIBILITIES

- 2.1. The current site owner shall be responsible for the implementation of the SuDS Management and Maintenance Plan. If deemed necessary, all landscape operations shall be undertaken by suitable and qualified landscape contractor appointed by the site owner.
- 2.2. All inspections and maintenance work must be recorded. This allows for future assessment of the maintenance activities and their response to the system. It can also provide protection against legal claims should the system be exceeded in a storm event leading to flooding elsewhere.

3. MANAGEMENT OBJECTIVES

- 3.1. The site shall be managed and maintained as an attractive, tidy, and safe finish to all landscape elements. The proposed structure planting will give a cohesive site character, provide a visual buffer, and provide green framework to the newly built development.
- 3.2. The proposed planting shall enhance the biodiversity and nature conservation interests.
- 3.3. The Site Owner shall ensure establishment and long-term health of all landscape elements for the benefit of the tenants and visual amenity of the area.

- 3.4. Best Health & Safety practices shall always be used.
- 3.5. To monitor standards and make amendments where required, it is expected that the Site Owner will review the management work (with reference to this document) at least quarterly for the first year and annually thereafter.

4 MAINTENANCE VISITS OR INSPECTIONS

- 4.1. The Site Owner shall carry out a minimum of 12 maintenance visits or inspections per year to ensure plant establishment and health. Visits shall be monthly throughout the year. Additional visits may be needed to deal with extreme weather conditions or specific horticultural requirements.

5 GENERAL

- 5.1. All materials and workmanship are to be to the highest possible standards and shall be in accordance with relevant British Standards, good horticultural and arboricultural practices, and the landscape specification.
- 5.2. The Site Owner shall employ suitably qualified staff for all work and when using sprays and mechanical equipment. All equipment shall be kept in a sound condition, fit for use and purpose.
- 5.3. The Site Owner and their appointed contractors shall comply with all relevant Health and Safety regulations and good working practices.
- 5.4. The Site Owner shall take care when work is beside any structure or paved area and will, at their own cost, be responsible for making good any damage caused.
- 5.5. All work shall be carried out while soil and weather conditions are suitable.
- 5.6. Weeds, pruning's, leaves, rubbish and other arisings shall be removed from site for composting, where possible. No material shall be left on site, and the area shall be left in a neat and tidy condition after each visit.
- 5.7. Entomological or disease infestation shall be dealt with as required and shall be checked at each visit. Control shall be either by spraying with approved chemicals, pruning all dead wood by cutting back to an outward pointing bud or by removal of the affected plants.
- 5.8. Watering during the first two years after planting may be necessary during times of drought in summer months and, when watering is required, it shall be carried out on a regular basis to suit climatic conditions. If conditions are severe or soils are particularly free-draining, careful monitoring and more frequent watering may be necessary to maintain good plant health and avoid plant failure.
- 5.9. All shrubs/hedges shall be pruned to remove deadwood, overhanging/ tangled and

damaged branches. Winter flowering shrubs shall be pruned in spring. Shrubs flowering in March-July shall be pruned immediately after the flowering period and shrubs flowering in July-October shall be cut back to old wood in winter. Shrubs that require spring pruning to provide seasonal colour shall be pruned in March and shrubs that require seasonal pruning to promote continual flowering will be pruned appropriately.

- 5.10. Plants shall be re-firmed when necessary to ensure that plants are securely planted and upright.
- 5.11. Bark mulch levels shall be maintained, being topped up when necessary to a minimum depth of 50mm. Any spillages shall be swept back on to the bed from surrounding areas, ensuring no plants are smothered.
- 5.12. Edge valleys in beds shall be maintained to reduce mulch spillage and grass edges shall be cut at each maintenance visit.

6 PROPOSED TREES

Specific objectives:

- To ensure early establishment and healthy growth
- To create a well-shaped framework for future balanced growth
- To enhance appearance and visual interest

Maintenance Operations:

- 6.1. In the first two years following planting, new trees are to be closely monitored at each maintenance visit to ensure that they are upright, firm, stable and in good health.
- 6.2. Checks shall be made to ensure all stakes and ties of planted trees are properly adjusted at each maintenance visit. Between years 5-7 tree stakes shall be removed once trees have established and are root firm.
- 6.3. Trees shall be maintained and watered to field capacity throughout the first and second years of planting, considering prevailing weather conditions and hot dry periods. They should be watered with the use of a hose being left to run slowly down the irrigation tube until the pit reaches full capacity. Careful monitoring during watering shall be necessary to minimise the risk of failures, leaks, or damage to property.
- 6.4. Any damaged or dying branches shall be removed using the standard methods appropriate for the work. Any dead, dying or defective trees shall be replaced in the following dormant winter period. ***Refer to Section 8 Plant Replacement.***
- 6.5. Trees planted in grass areas shall have a 1000mm diameter circle around the trunk which should be maintained free of weeds and be mulched until the tree is no longer vulnerable to damage from mowing equipment.

- 6.6. All trees on site, in publicly accessible areas should be inspected by an arboriculture consultant every 2 years and findings attuned promptly to ensure the site poses no risks.

7 ORNAMENTAL PLANTING

Specific objectives:

- To ensure early establishment and healthy growth
- To maintain a dense canopy cover
- To maintain year-round appearance and visual interest

Maintenance Operations:

- 7.1. All shrub beds in the detention basin areas shall be maintained substantially free of weeds. Work shall be done either manually or with appropriate selective weed killer in accordance with manufacturer's recommendations. If weed killer is used the dead weeds shall be removed at the next maintenance visit. Care must be taken to avoid damage to adjacent planting and grass and replaced immediately if affected by weed killer.
- 7.2. Once established, shrubs shall be selectively thinned or reduced in height as appropriate by removal or pruning to allow room for growth and avoid overcrowding/overshadowing and create a natural form rather than cube or cloud shapes. Care shall be taken to avoid over pruning and so creating obvious gaps in the shrub beds.
- 7.3. Ground cover plants shall be clipped or pruned if necessary, to give a neat and tidy finish and contained within the planting bed. Work to remove dead vegetation shall be carried out during the winter months.
- 7.4. Pruning of herbaceous planting:
- In spring cut stems close to the 'crown' or 'dormant' top of the plant, avoiding the removal of new shoots.
- Tidy up the base of the plant, removing dead foliage and debris.
 - Remove all material from site.
 - Apply a 50mm layer of fine horticultural mulch. This will help moisture retention in the soil, contribute to weed suppression and allow delicate stems to grow.
 - Leave dried flower head over winter for relevant species e.g. ornamental grasses.
- 7.5. Fertilising:
- One application, just before or at the time of spring growth.

- A balanced fertiliser is required, one high in Phosphorus (which encourages blooming as well as strong roots and disease resistance). Fertilisers high in nitrogen should not be used as nitrogen promotes excess foliage at the expense of flowers and roots which can result in weak stems

8 GRASSED AREAS

Specific objectives

- To create an attractive grass sward with height and colour
- To provide habitats for reptiles, insects, bees & butterflies

Maintenance Operations

- 8.1. Refer to the planting schedule for guidance on the proposed extent of grass/plants to be used in the detention basin areas.
- 8.2. Cutting to be carried out using appropriate large wheeled, rotary mower to avoid injury to reptiles unless specified otherwise.
- 8.3. Remove any litter, debris, stones, and earth clods larger than 25mm in any dimension prior to mowing.
- 8.4. Sward heights to be kept to minimum 5cm with two cuts per year in May and September after the first year. Footpaths through meadow areas to be mown at time of general amenity grass cutting to a height of 30-60mm.
- 8.5. No fertiliser or nutrients to be added.
- 8.6. Top dress if required with additional appropriate native origin seed if slow to establish.
- 8.7. When necessary grass areas shall be sprayed with a suitable approved selective herbicide in accordance with the manufacturer's recommendations to control injurious or invasive weeds. Alternatively, spot treatment weeding of isolated weed growth may be carried out by hand or herbicide application. All arisings shall be removed from site.
- 8.8. Reinstatement by re-seeding of damaged, defective, or bare areas shall be carried out as appropriate. Any dips or holes within the grass shall be filled as above to restore even falls and reseeded, as necessary.
- 8.9. Where necessary compacted areas shall be aerated with appropriate equipment in autumn.
- 8.10. At no time shall machinery get closer than 500mm to any tree trunk. Damage must be avoided to trunks when using a strimmer.
- 8.11. Depressions to be filled in over time by adding a top dressing and over-seeding, using a sandy soil.

8.12. Year One

- First cut to 5cm March/April (Spring Seeding 1st cut in May)
- Cut every 2 months or when sward reaches 15cm
- Final cut September/October
- Allow cut grass to dry and disperse seed before removing arisings
- The requirements in the first year are to control weeds and reduce competition from grasses. Cut the sward to a height of 5 cm every two months or when the sward reaches 15 cm. Remove all cut material to avoid smothering the sward. Where persistent weeds are a problem, spot treat with Glyphosate or dig-out

8.13. Future years

- One cut in May and September to 5cm
- Remove all cuttings
- Allow cut grass to dry and disperse seed before removing arisings
- The requirements in future years is to maintain a species diverse sward of value to wildlife

8.14. The site may require further cuts in the autumn period to remove untidy growth in an extended growing season.

9 PLANT REPLACEMENT

- 9.1. An annual inspection of trees and shrubs shall be undertaken in September of each subsequent year after planting to assess the condition of stock and prepare a list of necessary remedial work and replacement planting. Replacement planting shall be implemented in accordance with the planning requirements.
- 9.2. All work shall be carried out by appropriately qualified horticultural operatives with adequate insurance. All work shall be carried out in accordance with good horticultural practice and B.S. standards. All debris arising from the works shall be removed from site.
- 9.3. Any new replacement planting shall be tagged so the local SAB, the Site Owner are aware that these plants will have a further one year's defect liability period.
- 9.4. Replacement tree and shrub planting shall take place in the following November-February, dormant winter period during suitable weather conditions. All stock shall be of the same size and species as originally specified.
- 9.5. Approval of all remedial and replacement work shall be obtained before commencing any remedial work.

10 LITTER COLLECTION

- 10.1. All hard surfacing shall be swept as necessary, and all rubbish removed from site.
- 10.2. Litter picking/clearance shall take place during each maintenance visit and all waste shall be removed from site.
- 10.3. During autumn maintenance visits all fallen leaves shall be collected and removed from site.

11 FENCING/WALLS/RAILING

- 11.1. All fencing, walls and railings shall be checked for damage/wear and when necessary shall be replaced/repaired/ re-stained or painted as appropriate.
- 11.2. Ensure retaining /boundary walls are maintained in accordance with engineers/manufacturers requirements.

12 HARD SURFACES

- 12.1. A common-sense approach to the maintenance of the permeable paving will be adopted, the maintenance program is outlined as follows and is designed to ensure the structural and hydraulic performance of the permeable paving system.
- 12.2. The site owner or management company is to inspect each of the respective assigned areas of the hard landscape for which they have responsibility on a six-monthly basis to identify and repair any damaged areas.
- 12.3. Seasonal maintenance (leaf and snow clearance, de-icing). To be proactively managed with the checking weather reports.
- 12.4. Surfaces to be always kept weed and litter free. Spray paved areas every 5 years or as required with herbicide to keep weed free.
- 12.5. Drainage systems associated with hard surfaces to be inspected annually and maintenance work undertaken, as necessary.
- 12.6. The permeable paving should be brushed once a year after autumn leaf fall or less frequently as required, based on site-specific observations. Water jetting may also be required to rehabilitate the surface when clogging becomes apparent.
- 12.7. Visually inspect the surface on a regular basis typically 2 per year (Spring and Autumn). Ensure no displacement of any organic matter has occurred on the surface, particularly after heavy precipitation. The paving should be agitated (e.g. brushed, vacuumed, etc.) at least once a year, ideally in the spring to ensure no vegetation of any sort can grow and develop in the voids.

Note: If the infiltration rate of the paving becomes prolonged, allowing ponding to develop, and rehabilitation through remedial sweeping is not effective, the laying course material may require taking up and cleaning/replacing. This should happen about every 30 years.

- 12.8. Repair any subsidence or breakages promptly in accordance with best practice, manufacturer's guidance and using matching materials.
- 12.9. Inspect and repair all edging on a regular basis making good any damage or wear promptly to maintain the good upkeep of the development.

13 TRADITIONAL DRAINAGE AND FLOW CONTROL CHAMBERS

- 13.1. A monthly site inspection should be carried out, checking for any areas that are not operating correctly and collecting/removing litter and debris.
- 13.2. All rainwater pipes, linear drains, gullies and inspection chambers should be inspected biannually, typically spring and autumn.
- 13.3. Any excessive sediment build-up in rainwater pipes, linear drains, gullies or inspection chambers causing blockage or poor performance shall be cleared and cleaned as required.
- 13.4. Flow control devices provide customised water quantity management for surface water across a wide range of flows and for a variety of applications. The flow control has no moving parts and no power requirements and provides reliable, low-maintenance, engineered flood management. The two most common flow control devices are vortex and orifice plate flow controls. Maintenance for the two types varies slightly and is to be undertaken according to manufacturer's specifications. However, as a general guide should include the following:

Vortex Flow Control

Maintenance Schedule	Required Action	Typical Frequency
	Inspection	Routine maintenance should be undertaken on completion of drainage works. Year 1, Year 3 and then every 5 years
Routine Maintenance	Litter / debris removal	
	Check emergency drain down is in good working order	
	Check component fixings are secure	
Occasional Maintenance	De-silting / sediment removal	As required upon inspection
Remedial Maintenance	Damage repair	As required upon inspection

Orifice Flow Control

Maintenance Schedule	Required Action	Typical Frequency
	Inspection	Routine maintenance should be undertaken on completion of drainage works and then annually thereafter
	Litter / debris removal	
Routine Maintenance	Check emergency drain down (if fitted) is in good working order	
	Check and clean orifice screening device and replace if damaged	
	Check component fixings are secure	
Occasional Maintenance	De-silting / sediment removal	As required upon inspection
Remedial Maintenance	Damage repair	As required upon inspection

14 SUMMARY OF INSPECTION AND MAINTENANCE

14.1. The following briefly summarises the frequency and type of inspections and maintenance required for the SuDS components and drainage system used in this scheme:

14.2. General

- General inspections of SuDS areas (Raingardens, porous asphalt paving, inlets and outlets) – monthly and shall include litter collection.
- Biannual check of traditional drainage including rainwater pipes, linear drains, gullies and inspection chambers.
- Annual check of flow control chamber

14.3. Porous Asphalt

- Initial inspection – within 3 months of completion
- Visual inspection - 2 times a year
- General brushing of surface - once a year
- Weed removal – as required
- Remediate areas of Rutting and depressions – as required
- Rehabilitate surface with brushing and water jetting when clogging becomes apparent – as required, typically every 10 - 15 years
- Take up and clean/replace surface course if rehabilitation fails due to significant clogging – expect every 30 years
- Inspection for performance and clogging and ancillary drainage components – once a year

14.4. Bioretention raingardens

- Inspect surfaces for silting and ponding, record de-watering time to determine if any remedial work is required – annually
- Pruning, weed removal and plant replacement, assess plants for disease infection, poor growth and invasive species – annually
- Inspect inlets for damage or blockage at general inspections
- Clear inlet/outlets of sediment build-up – as required

15 LIFETIME MANAGEMENT AND MAINTENANCE COSTS

15.1. The costs associated with the management and maintenance of the SuDS system over the 60-year design life of the scheme has been estimated based on the inspection and maintenance activities in section 14 are as follows:

15.2. General

- General monthly inspection (incl. litter removal) – included in general household maintenance undertaken by Homeowner
- Biannual check of traditional drainage including rainwater pipes, linear drains, gullies and inspection chambers – can be included in general household maintenance undertaken by Homeowner
- Annual check of flow control chamber @ £20 each - £1,200

15.3. Porous Asphalt

- Annual brush/sweep – 60 sweeps at £0.12 / m² x 38m² - £274
- Weed kill every 5 years @ £0.90 / m² x 38m² - £411
- Brush/water jetting rehabilitation at 15 and 45 years @ £2.50 / m² x 38m² - £190
- Take up and clean/replace surface course once in year 30 @ £29.30 /m² x 38m² - £1,114

15.4. Bioretention raingarden

- Annual pruning/fertilising and inspection for plant replacement over 60 years @ £70 / year - £4,200

15.5. The total sum of management and maintenance costs for the proposed SuDS over a 60-year design life - **£7,389 or circa £124 a year**