

**Bryniau Road, Pant,
Merthyr Tydfil.
Holbrook Homes**



Flood Consequences Assessment and Drainage Strategy Report

November 2019



**62 Albany Road
CARDIFF, CF24 3RR
t: 029 2030 2521**

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1. INTRODUCTION

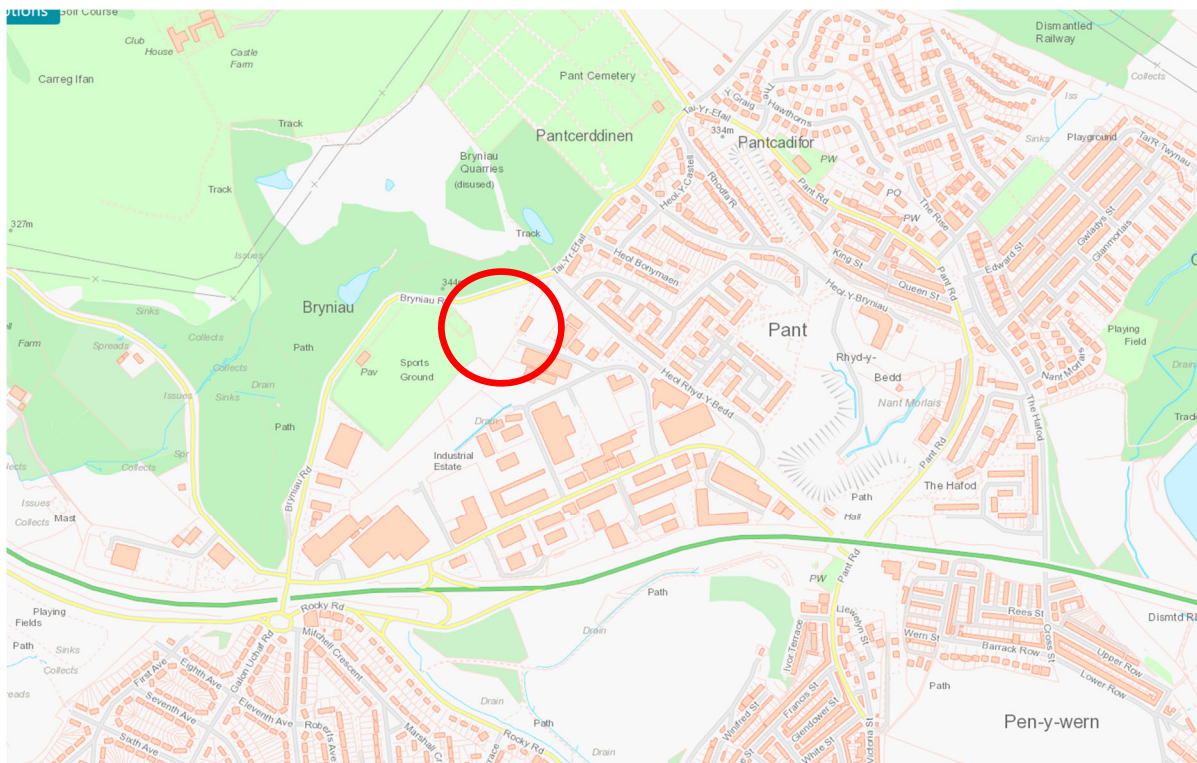
1.1 Background

- 1.1.1 PHG Consulting has been commissioned by Holbrook Homes to undertake a flood consequences assessment and drainage strategy report for proposed development off Bryniau Road, Pant, Merthyr Tydfil.
- 1.1.2 The purpose of the report is to identify existing sources of flood risk to the site and ensure that surface and foul water drainage can be discharged from the site without affecting the downstream catchments detrimentally.
- 1.1.3 The report demonstrates how the drainage for the development will be discharged and how flows will be managed to prevent increased flood risk.

1.2 Existing Site

- 1.2.1 The site covers an area of approximately 0.9 ha and open ground located at National Grid Reference SO058088. It is bounded by Bryniau Road to the north, Merthyr Saints FC to the west and Pant Industrial Estate to the south-east. The approximate site location is shown on figure 1 below.

Figure 1



- 1.2.2 The site topography slopes relatively steeply from the north-west to south-east. The average gradient is approximately 1 in 10. Ground levels vary from 344m AOD in the north-west sloping 1:5 then 1:20 to a site low point of 333m in the south-east.

1.3 Surface Water Features

- 1.3.1 The site is generally open rough ground and greenfield.
- 1.3.2 There are no visible watercourses or other features within the site.
- 1.3.3 The nearest main river or water body to the development is the Nant Morlais basin which is located approximately 500m to the south east of the site.

1.4 Existing drainage

- 1.4.1 Welsh Water (DCWW) adopted sewer records shows limited records of sewers in the nearby Pant Industrial Estate including surface, foul, and combined. Due to the nature and age of the Industrial Estate it is likely these records are incorrect and may require further investigation. The DCWW sewer map is included in Appendix E.

1.5 Geology and Hydrogeology

- 1.5.1 An intrusive site investigation (SI) was undertaken by Terra Firma November 2019 (Ref:15724).
- 1.5.2 Shallow soil infiltration testing was initially considered but following percolation testing in line with BRE 365 this was discounted due to poor results. An extract is shown in Appendix C.

1.6 Development Proposals

- 1.6.1 The proposal comprises the construction of 31 residential dwellings and associated infrastructure. The dwellings will include 2 and 3 bed units. The proposed Site Layout / Engineering Layout is included in Appendix A.

2. FLOOD CONSEQUENCES ASSESSMENT

2.1 Legislation

2.1.1 TAN 15 is the planning guidance used in Wales to assess flood risk. A requirement of TAN 15 is that developers making planning applications on sites that are potentially at risk from flooding should consult with Natural Resources Wales and produce a Flood Consequence Assessment (FCA) to support their proposals. This assessment has been conducted in accordance with TAN 15: Development and Flood Risk

2.2 Definition of Flood Risk

2.2.1 Flood risk is the product of the likelihood or chance of a flood occurring (flood frequency) and the consequence or impact of the flooding (flood consequence).

2.3 Flood Frequency

2.3.1 Flood frequency is identified in terms of the return period and annual probability. For example, a 1 in 100-year flood event has a 1% annual probability of occurring. Table 1 below provides a conversion between return periods and annual flood probabilities.

Table 1: Flood Probability Conversion Table

Return Period (years)	2	5	10	20	50	100	200	1000
Annual Flood Probability (%)	50	20	10	5	2	1	0.5	0.1

2.4 Flood Zone

- 2.4.1 The proposed development is located entirely within Zone A on Natural Resources Wales (NRW) flood maps so is at low risk of fluvial or tidal flooding.

2.5 Flood Risk Vulnerability Classification

- 2.5.1 The proposed development is residential so is classed as highly vulnerable in TAN 15.

2.6 Flood Risk Vulnerability Classification and Flood Zone Compatibility

- 2.6.1 As the development is located entirely within Zone A the proposed land use is appropriate.

2.7 Other Sources of Flooding

- 2.7.1 The site is generally well protected from overland flow by existing topography and surrounding built environment.
- 2.7.2 The NRW surface water flood map shows no routes through the development and only some minor ponding to one low point. Any exceedance flows would tend to run down the site towards the Pant Industrial Estate to the south-east of the site.

2.8 Summary of Existing Flood Risk

- 2.8.1 The proposed development site is considered to be at low risk of flooding from rivers, groundwater and overland flows. NRW Flood Map is included in Appendix B.

3. DRAINAGE STRATEGY

3.1 Surface Water Management Approach

3.1.1 Surface water management proposals for the new development have been prepared to meet the following principles:

- Surface water runoff from the site will be restricted to the greenfield QBar rate for all rainfall events up to and including the 100-year event with 30% increase in rainfall intensity to allow for climate change.
- No increase in flooding to people and property elsewhere as a result of the development;
- No surface water flooding within the proposed development in all rainfall events up to and including a 1 in 30-year return period storm;
- Overland flows within the site from rainfall events in exceedance of a 1 in 30-year return period storm are to be managed to minimise risk to people and property, up to the 1 in 100-year return period storm;
- The surface water management proposals are to be designed to allow for a 30% increase in rainfall intensity in the 1 in 100-year rainfall event in the next 100 years.

3.1.2 In accordance with the Defra/EA guidance document 'Preliminary rainfall runoff management for developments' (Kellagher, 2012) and the SuDS Wales Design Guidance, the following approaches were considered (in order of preference):

1. Infiltration to ground via an adequate soakaway or soil infiltration.

3.1.3 Site investigation has been undertaken by Terra Firma and poor infiltration was discovered. The conclusion is that infiltration drainage is not feasible.

2. Discharge to a watercourse.

3.1.4 There are no watercourses within or adjacent to the site boundary.

3. Discharge to a mains sewer.

3.1.5 Sewer records in the area are limited but following a CCTV survey of the existing drainage in Pant Industrial Estate there is a combined sewer managing all foul and surface water in the area. Therefore surface and foul water drainage from the proposed development shall discharge to the existing combined sewer.

3.2 Surface Water Management Strategy

- 3.2.1 CCTV survey investigation confirms there is a combined sewer within Pant Industrial Estate.
- 3.2.2 Surface water from private and adoptable areas will discharge to the combined system at a rate equivalent to the existing QBar (mead annual flood) rate of 13.1 l/s. See Appendix F.
- 3.2.3 The surface water run-off for up to the 30-year event will be subject to a Section 104 Agreement with Welsh Water. Attenuation will be achieved via an online pipe system and offline cellular system.
- 3.2.4 The surface water runoff generated during the extreme rainfall events above the 30 year and including the 1 in 100-year event, will be directed from the adopted system to a managed depression within the Public Open Space. The attenuation will be designed for up to and including the 1 in 100-year storm event with 30% increase in rainfall intensity to allow for climate change.
- 3.2.5 As discharge will be limited to 13.1 l/s for all storm events via a Hydrobrake Chamber up to the year event plus climate change; this is considerable betterment for the local area noting an existing Q100 rate of 28.5 l/s.
- 3.2.6 Surface water drainage strategy is included in the Engineering Layout in Appendix A. Calculations for the 30-year system (cellular storage) and 100 year plus 30% climate change (cellular storage and basin / depression) are included in Appendix G.

3.3 Existing Foul Drainage

- 3.3.1 There is no existing foul drainage within the site, but there is a foul and combined system within the adjacent Pant Industrial Estate.

3.4 Proposed Foul Drainage

- 3.4.1 Based on site topography a gravity connection is achievable.
- 3.4.2 Connection shall be made to the combined sewer within Pant Industrial Estate with connection via a Section 106 Notice with Welsh Water.
- 3.4.3 Foul drainage will be to Sewers for Adoption 7th Edition and offered for adoption to Welsh Water via a Section 104 Agreement.

4. CONCLUSIONS

4.1 Summary

- 4.1.1 The proposed development site is assessed to be of low risk of flooding from all sources of flooding, including rivers, groundwater, surface water, reservoirs, sewers and overland flows.
- 4.1.2 The new development is located in the low risk Flood Zone A and is therefore justified.
- 4.1.3 Intrusive testing confirms that discharging surface water to ground by infiltration is not feasible.
- 4.1.4 The surface water runoff generated during the extreme rainfall events for up to and including the 30 year 1 in 100-year event, will be directed away from properties and other vulnerable areas of the development, and conveyed into the proposed attenuation structures. The attenuation storage structure will be designed for the 30 year and up to and including the 1 in 100-year storm event with 30% increase in rainfall intensity to allow for climate change.
- 4.1.5 Foul water will discharge from site via gravity to the local sewer system.

4.2 Conclusion

- 4.2.1 It is evident from the report that the development is not at risk of flooding and a surface and foul water drainage solution is available for the site.

APPENDIX A – ENGINEERING LAYOUT



GENERAL NOTES

1. Do Not Scale
2. The contractor is to check and verify all buildings and site dimensions and levels, including sewer invert levels, before works start on site. The contractor is to comply in all aspects with the current building legislation, British Standards, building regulations etc.
3. Positions of existing services/statutory undertakers apparatus adjacent to or crossing proposed excavations are to be checked by the contractor prior to starting work
4. This drawing is to be read in conjunction with and checked against all other drawings, Engineering Details, Specification and any structural, geotechnical or other specialist document provided.
5. Any anomaly or contradiction between any of the above is to be reported to Holbrook Homes.
6. This drawing is schematic for clarity only, positions of pipe runs and manholes may vary on site due to site conditions.

ROAD AND SEWER ADOPTION NOTES

1. All works for adoption under a Section 38 agreement shall be carried out to the approval of the Merthyr Tydfil County Borough Council.
2. All works for adoption under a Section 104 agreement shall be carried out to the National Water Council guide 'Sewers for Adoption' 7th edition and Dwr Cymru Welsh Water's requirements.
3. Streetlighting positions to be pegged on site and agreed by the Local Authority PRIOR to erection commencing.

LEGEND

- Existing Foul Sewer
- Combined Sewer & Manhole (S104)
- Foul Sewer & Manhole (S104)
- Surface Water Sewer & Manhole (S104)
- Road Gully
- FFL Level
- Proposed Spot Level
- Underbuild
- Tanking
- Retaining Wall
- Street lighting

REV	DATE	DETAILS	AMENDMENTS	BY	CHK

CLIENT:

Holbrook Homes

phg Consulting Engineers

PROJECT:

**Holbrook Homes
Bryniau Road,
Pant, Merthyr Tydfil**

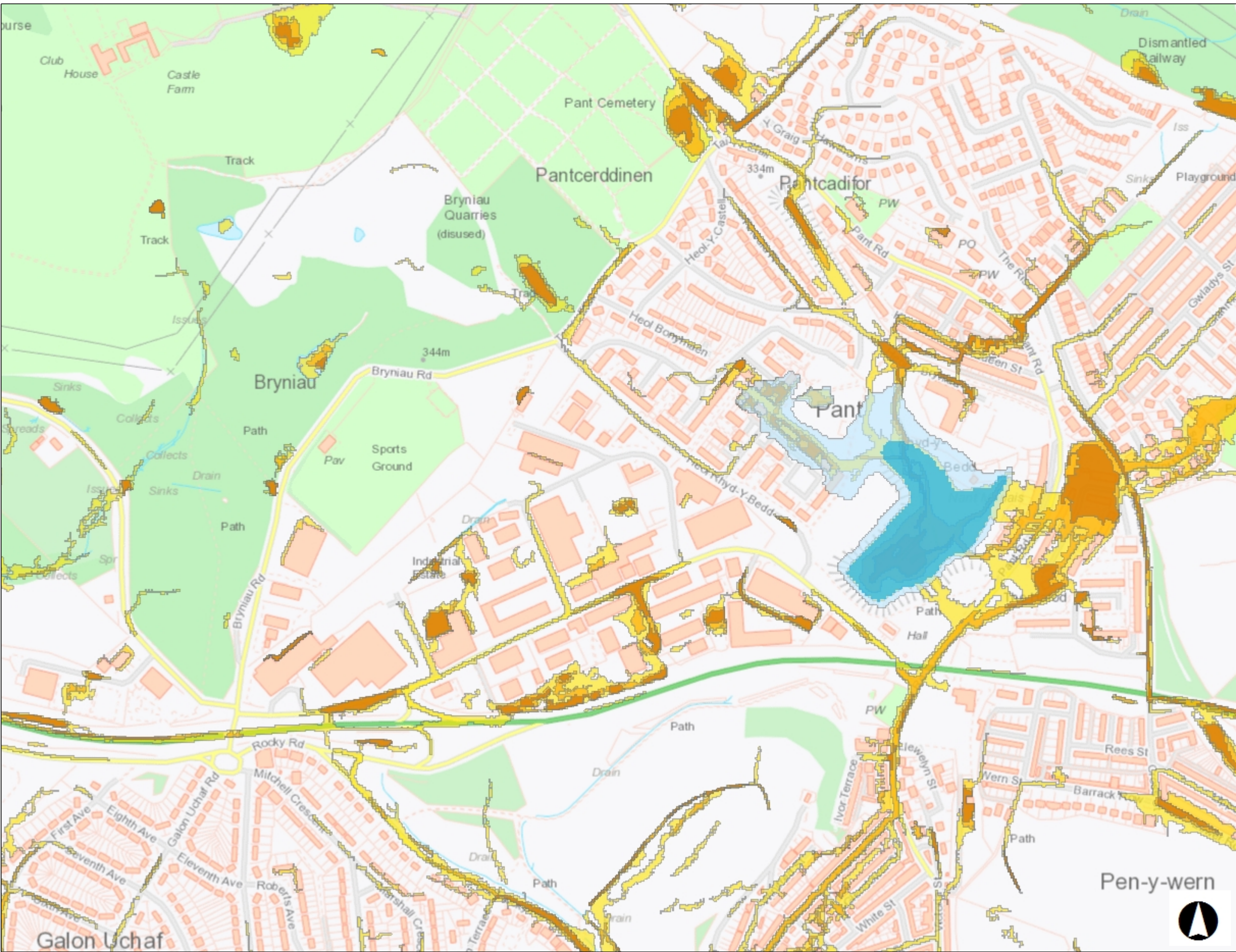
DRAWING TITLE:

Engineering Layout

DRAWN	CHK	STATUS	SCALE
SJD	PHG	Planning	1:250 @ A1

DATE	JOB NO.	DWG NO.	REV.
Nov'2019	1982	100	

APPENDIX B –NRW FLOOD MAP



Map Title

Map Perygl Llifogydd / Flood Risk Map

Allwedd / Map Key

Main Rivers

Flood Defences

Areas Benefiting from Flood Defences

Flood Storage Areas

Floodmap Flood Zone 3

Floodmap Flood Zone 2

High Surface Water Flood Risk - Extent

Medium Surface Water Flood Risk - Extent

Low Surface Water Flood Risk - Extent

Graddfa / Scale 1: 5,001

Dyddiad / Date

29/11/2019



APPENDIX C – SITE INVESTIGATION EXTRACT

Executive Summary

Site Location and Proposed Development	<i>Holbrook Homes Ltd is proposing the residential development of land off Bryniau Road, Pant, Merthyr Tydfil. It occupies a plan area of approximately 0.99 Hectares.</i>
Site History	<i>There is no significant change on site since 1972 and the site remains undeveloped. A road lies on the northern site boundary and a track crosses the site. The site's only recorded use is for keeping horses.</i> <i>A quarry once operated to the north of the site and a former ICE works operated to the south.</i>
Ground Conditions	<i>The geological map of the area shows the site to be underlain by sandstones of the Twrch Sandstone Formation.</i> <i>Superficial Till deposits are shown to overlie the solid geology.</i> <i>Made ground is anticipated beneath the road, however limited or little made ground is anticipated to be present across the remainder of the site since the site has not been previously developed. Some fill materials may have been deposited on site locally in connection with adjacent development.</i>
Radon	<i>No radon protection is required for new development.</i>
Ground Gas and Landfill Gas	<i>Only one area of potentially infilled land is recorded, lying some 120m northwest of the site. This relates to land previously quarried.</i> <i>There are no active or historical landfills or waste management facilities recorded within 250m of the site.</i> <i>There are not deemed to be any significant risks from landfill or ground gas.</i>
Laboratory Chemical Testing and Proposed Remediation	<i>Laboratory testing of site soils and quantitative risk assessment has confirmed that site soils are uncontaminated and do not present a risk to the human health of construction workers and future site residents.</i> <i>There are no risks to the aquatic environment.</i> <i>No remedial measures are required.</i>
Foundation Solution	<i>Due to the very soft nature of the encountered ground conditions the use of traditional mass concrete or trench fill foundation will not be possible. Such foundations are likely to lead to high total and differential settlements and are not recommended.</i> <i>It is therefore likely that driven precast concrete piles will be suitable. Pile lengths should be confirmed by a supplementary cable percussion drilling investigation.</i>

7.6 Roads and Car Parking

For access roads and car parking areas, formations within the shallow in-situ soils / made ground a CBR value of 1% may be used for design purposes.

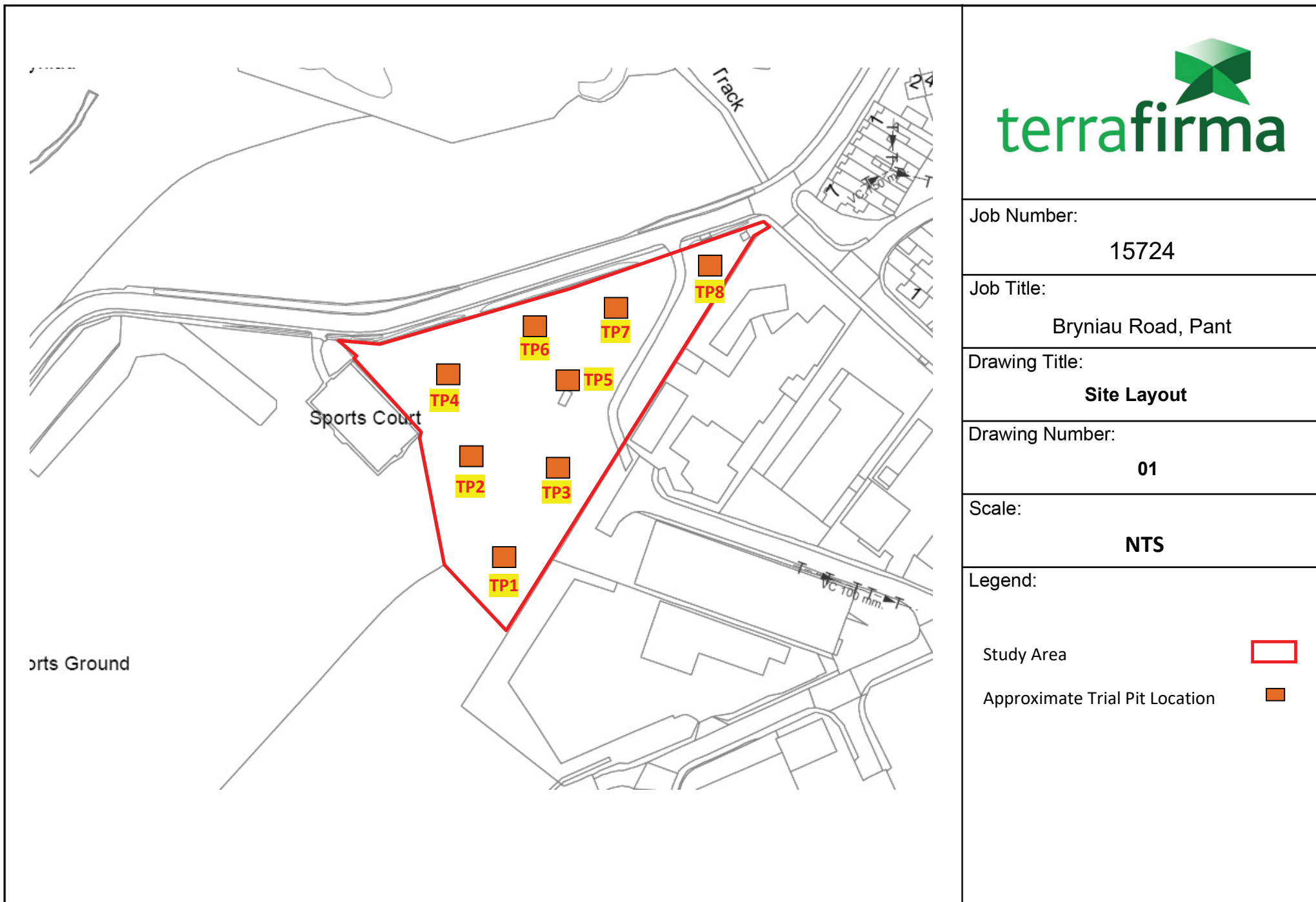
Allowances should be made for the removal of any 'soft spots/areas' and their replacement with well-compacted granular materials as previously described.

7.7 Storm Drainage

Three in-situ soakaway tests were performed in trial pits TP1, TP4, TP6 in general accordance with BRE365.

Negligible infiltration was recorded in all soakaways. The tests were terminated after a minimum of 4 hours.

Soakaway tests indicate that the shallow clay deposits have a very low infiltration rate. it is considered that soakaway storm water drainage is unsuitable within this strata.



APPENDIX D – CCTV DRAINAGE SURVEY



Project-information

Project name:

Contract number:

Contact:

 Date:
 28/10/2019

Client **Holbrook Homes Ltd**
 Contact: **Steve Jeffries**
 Position: **Procurement Manager**
 Road **Crownford House, Swan Street**
 Town **Merthyr Tydfil**
 County **CF47 8EU**
 Telephone: **01685 267590**
 Fax:
 Mobile: **07508 995832**
 E-Mail: **Steve.jeffries@hotbrookhomes.co.uk**

Site
 Contact:
 Position:
 Road **Bryniau Road**
 Town **Merthyr Tydfil**
 County **CF48 2SR**
 Telephone:
 Fax:
 Mobile:
 E-Mail:

Contractor **Redwood Environmental Services Ltd**
 Contact: **Jay Forester**
 Position: **CCTV Survey Processor**
 Road **Unit 43, Village Farm Road, Village Farm Ind. Est.**
 Town **Pyle, Bridgend**
 County **Mid Glamorgan, CF33 6BN**
 Telephone: **01656 745464**
 Fax:
 Mobile:
 E-Mail: **Jay@redwood.co.uk**

Report Interpretation.

Overview:

Each section of drainage system is allocated a score indicating areas that require attention. These areas are detailed in the Overview section of the report. We use colour coding as an indicator of severity. Additional information concerning rehabilitation options / recommendations is also included in the Summary report, which can also be used as an 'at a glance' indication of the system condition. More in depth information for each section, including images can be found later in the report. Grade indicators are as follows:

Grade A: Drain is serviceable no recommendations required

Grade B: There is an issue that might require remedial works

Grade C: There is a defect that requires remedial works, the drain is not serviceable

Observations:

Each section of drainage reported on, contains detailed information about that drain and any observations made. The observations are colour coded and given a score, with more significant defects being given a higher score, using a scale from 1 to 5 as detailed below:

Grades 1: These defects may require monitoring

Grades 2: These defects should be monitored

Grades 3: These defects probably require some form of remedial works.

Grades 4: Defects that will require remedial repair or replacement

Grades 5: Defects that require immediate repair or replacement

General:

The information provided is relevant at the time of survey. The coding system in this report is based on the Manual of Sewer Condition Classification, 5th edition (MSCC5) domestic codes (BS EN 13508-1:2003) This being the official standard for the UK water industry.

The grading system is based on the drain Repair Book 4th edition recommendations provided by the WRC and the 1-5 grades represent the severity of individual defects: 5 representing a serious defect.

Please feel free to contact us for further explanations and information.



Summary Report

Client: Holbrook Homes Ltd.

RE: Bryniau Road, Merthyr Tydfil.

Survey Date: 25.10.19.

CCTV operative: James Steer.

Redwood attended site on Friday 25th October to conduct an internal inspection of Foul and Surface water drainage using drain CCTV unit and have appended below a summary of the CCTV report.

Survey Summary:

Section 1 – MH1 to Con 1 – Grade A.

- No faults noted.

Section 2 – MH1 to MH2 – Grade B.

- Medium open joint at 11.1M.

Sections 3 – 6 – Grade A.

- No faults noted.

Section 7 – MH3 to Con 3 – Grade B.

- Water levels of 50% at 0.7M.
- Camera underwater from 7.2M to 10.7M.
- Debris at 13.9M.
- Survey abandoned at 15.3M.

Section 8 – MH1 to MH1.1 – Grade C.

- Medium open joint at 2.4M.
- Sewer deformed at 2.5M, 7.4M and 13.2M.
- Debris at 16.5M.
- Water levels of 20% at 23.9M.
- Survey abandoned at 24M.



Inspection report

Date: 25/10/2019	Job N°:	Weather:	Operator: JAMES	section number: 1	PLR: CON 1 X
Present:	Vehicle:	Camera: IBOS	Preset:	Cleaned:	Grade:

Road: BRYNIAU ROAD	Division:	start MH: MH1
Place: MERTHYR TYDFIL	District:	end MH: CON 1
Location:	Tape No.:	Total length: 0.2 m
Purpose: Asset condition	Shape/Size: Circular 150	
Use: Combined	Material: Polyvinyl chloride	Pipe length:
Catchment:	Lining:	
	Category:	
Comment:		
Location details:		

1:25	position	observation	counter	photo	grade
	0.00	Start of Survey	00:00:00		0
	0.00	Manhole Remark: MH1	00:00:00		0
	0.00	Water level, 5 % height/diameter	00:00:00		0
	0.20	Finish Survey, Remark: Line capped	00:00:00		0



Inspection report

Date: 25/10/2019	Job N°:	Weather:	Operator: JAMES	section number: 2	PLR: MH2 X
Present:	Vehicle:	Camera: IBOS	Preset:	Cleaned:	Grade:

Road: BRYNIAU ROAD	Division:	start MH: MH1
Place: MERTHYR TYDFIL	District:	end MH: MH2
Location:	Tape No.:	Total length: 11.4 m
Purpose: Asset condition	Shape/Size: Circular 150	
Use: Combined	Material: Polyvinyl chloride	Pipe length:
Catchment:	Lining:	
	Category:	
Comment:		
Location details:		

1:100	position	observation	counter	photo	grade
	0.00	Start of Survey	00:00:00		0
	0.00	Manhole Remark: MH1	00:00:00		0
	0.00	Water level, 5 % height/diameter	00:00:00		0
	0.50	Line of Sewer deviates right	00:00:00		0
	11.10	Open joint medium	00:00:00	18_5a	1
	11.40	Manhole Remark: MH2	00:00:00		0
	11.40	Finish Survey	00:00:00		0

Inspection photos

Place:
MERTHYR TYDFILRoad:
BRYNIAU ROADDate:
25/10/2019section number:
2PLR:
MH2 XPhoto: 18_5a, 00:00:00
11.1m, Open joint medium



Inspection report

Date: 25/10/2019	Job N°:	Weather:	Operator: JAMES	section number: 3	PLR: CON 1 X
Present:	Vehicle:	Camera: IBOS	Preset:	Cleaned:	Grade:

Road: BRYNIAU ROAD	Division:	start MH: MH2
Place: MERTHYR TYDFIL	District:	end MH: CON 1
Location:	Tape No.:	Total length: 7.8 m
Purpose: Asset condition	Shape/Size: Circular 150	
Use: Combined	Material: Polyvinyl chloride	Pipe length:
Catchment:	Lining:	
	Category:	
Comment:		
Location details:		

1:75	position	observation	counter	photo	grade
	0.00	Start of Survey	00:00:00		0
	0.00	Manhole Remark: MH2	00:00:00		0
	0.00	Water level, 5 % height/diameter	00:00:00		0
	7.30	Line of Sewer deviates right	00:00:00		0
	7.80	Manhole Remark: MH2.1	00:00:00		0
	7.80	Finish Survey	00:00:00		0



Inspection report

Date: 25/10/2019	Job N°:	Weather:	Operator: JAMES	section number: 4	PLR: MH3 X
Present:	Vehicle:	Camera: IBOS	Preset:	Cleaned:	Grade:

Road: BRYNIAU ROAD	Division:	start MH: MH2
Place: MERTHYR TYDFIL	District:	end MH: MH3
Location:	Tape No.:	Total length: 12.4 m
Purpose: Asset condition	Shape/Size: Circular 100	
Use: Combined	Material: Polyvinyl chloride	Pipe length:
Catchment:	Lining:	
	Category:	
Comment:		
Location details:		

1:100	position	observation	counter	photo	grade
	0.00	Start of Survey	00:00:00		0
	0.00	Manhole Remark: MH2	00:00:00		0
	0.00	Water level, 5 % height/diameter	00:00:00		0
	5.50	Line of Sewer deviates left	00:00:00		0
	12.40	Manhole Remark: MH3	00:00:00		0
	12.40	Finish Survey	00:00:00		0

Date: 25/10/2019	Job N°:	Weather:	Operator: JAMES	section number: 5	PLR: CON 1 X
Present:	Vehicle:	Camera: IBOS	Preset:	Cleaned:	Grade:

Road:	BRYNIAU ROAD	Division:	start MH:	MH3
Place:	MERTHYR TYDFIL	District:	end MH:	CON 1
Location:		Tape No.:	Total length:	9.5 m
Purpose:	Asset condition	Shape/Size:	Circular 100	
Use:	Combined	Material:	Polyvinyl chloride	Pipe length:
Catchment:		Lining:		
		Category:		
Comment:				
Location details:				

1:75	position	observation	counter	photo	grade
	0.00	Start of Survey	00:00:00		0
	0.00	Manhole Remark: MH3	00:00:00		0
	0.00	Water level, 5 % height/diameter	00:00:00		0
	9.50	Manhole Remark: MH3.1	00:00:00		0
	9.50	Finish Survey	00:00:00		0



Inspection report

Date: 25/10/2019	Job N°:	Weather:	Operator: JAMES	section number: 6	PLR: CON 2 X
Present:	Vehicle:	Camera: IBOS	Preset:	Cleaned:	Grade:

Road: BRYNIAU ROAD	Division:	start MH: MH3
Place: MERTHYR TYDFIL	District:	end MH: CON 2
Location:	Tape No.:	Total length: 0.6 m
Purpose: Asset condition	Shape/Size: Circular 100	
Use: Combined	Material: Polyvinyl chloride	Pipe length:
Catchment:	Lining:	
	Category:	
Comment:		
Location details:		

1:25	position	observation	counter	photo	grade
		Start of Survey	00:00:00		0
		Manhole Remark: MH3	00:00:00		0
		Water level, 5 % height/diameter	00:00:00		0
		Finish Survey	00:00:00		0



Inspection report

Date: 25/10/2019	Job N°:	Weather:	Operator: JAMES	section number: 7	PLR: CON 3 X
Present:	Vehicle:	Camera: IBOS	Preset:	Cleaned:	Grade:

Road: BRYNIAU ROAD	Division:	start MH: MH3
Place: MERTHYR TYDFIL	District:	end MH: CON 3
Location:	Tape No.:	Total length: 15.3 m
Purpose: Asset condition	Shape/Size: Circular 100	
Use: Combined	Material: Polyvinyl chloride	Pipe length:
Catchment:	Lining:	
	Category:	
Comment:		
Location details:		

1:125	position	observation	counter	photo	grade
	0.00	Start of Survey	00:00:00		0
	0.00	Manhole Remark: MH3	00:00:00		0
	0.00	Water level, 5 % height/diameter	00:00:00		0
	0.70	Water level, 50 % height/diameter	00:00:00	45_4a	4
	7.20	S1 Camera Underwater, Start	00:00:00	46_5a	4
	10.70	F1 Camera Underwater, Finish	00:00:00		4
	13.10	Junction at 11 o'clock, dia 100 mm	00:00:00		0
	13.90	Debris, 40 % cross-sectional area loss	00:00:00	49_8a	1
	15.30	Survey abandoned, Remark: Unable to CCTV past debris	00:00:00	50_9a	0

Inspection photos

Place: MERTHYR TYDFIL	Road: BRYNIAU ROAD	Date: 25/10/2019	section number: 7	PLR: CON 3 X
---------------------------------	------------------------------	----------------------------	-----------------------------	------------------------



Photo: 45_4a, 00:00:00
0.7m, Water level, 50 % height/diameter



Photo: 46_5a, 00:00:00
7.2m, Camera Underwater, Start



Photo: 49_8a, 00:00:00
13.9m, Debris, 40 % cross-sectional area loss



Photo: 50_9a, 00:00:00
15.3m, Survey abandoned, Remark: Unable to CCTV past debris



Inspection report

Date: 25/10/2019	Job N°:	Weather:	Operator: JAMES	section number: 8	PLR: MH1.1 X
Present:	Vehicle:	Camera: IBOS	Preset:	Cleaned:	Grade:

Road: BRYNIAU ROAD	Division:	start MH: MH1
Place: MERTHYR TYDFIL	District:	end MH: MH1.1
Location:	Tape No.:	Total length: 24 m
Purpose: Asset condition	Shape/Size: Circular 150	
Use: Combined	Material: Polyvinyl chloride	Pipe length:
Catchment:	Lining:	
	Category:	
Comment:		
Location details:		

1:200	position	observation	counter	photo	grade
	0.00	Start of Survey	00:00:00		0
	0.00	Manhole Remark: MH1	00:00:00		0
	0.00	Water level, 5 % height/diameter	00:00:00		0
	2.40	Open joint medium	00:00:00	56_4a	1
	2.50	Sewer Deformed, 20 %, Remark: Stone Impact, from 02 to 04 o'clock	00:00:00	10_5a	5
	7.40	Sewer Deformed, 10 %, Remark: Stone Impact, from 06 to 08 o'clock	00:00:00	57_6a	5
	13.20	Sewer Deformed, 10 %, Remark: Stone Impact, from 11 to 01 o'clock	00:00:00	58_7a	5
	16.50	Debris, 20 % cross-sectional area loss	00:00:00	59_8a	1
	23.90	Water level, 20 % height/diameter	00:00:00	60_9a	2
	24.00	Survey abandoned, Remark: Unable to CCTV further	00:00:00		0

Inspection photos

Place: MERTHYR TYDFIL	Road: BRYNIAU ROAD	Date: 25/10/2019	section number: 8	PLR: MH1.1 X
---------------------------------	------------------------------	----------------------------	-----------------------------	------------------------

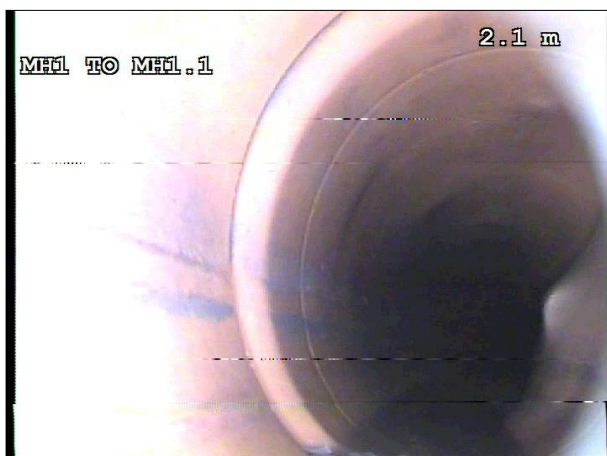


Photo: 56_4a, 00:00:00
2.4m, Open joint medium

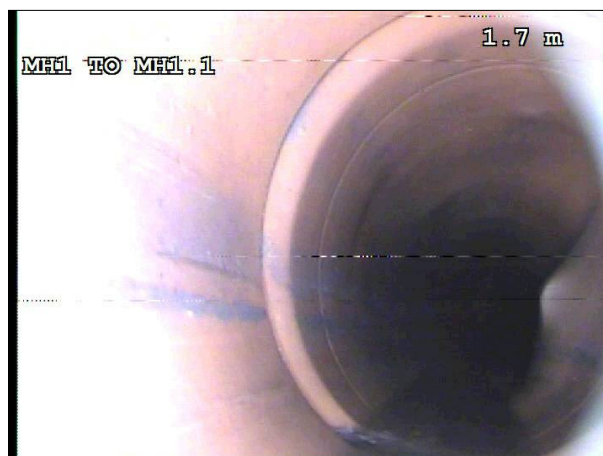


Photo: 10_5a, 00:00:00
2.5m, Sewer Deformed, 20 %, Remark: Stone Impact, from 02 to 04 o'clock

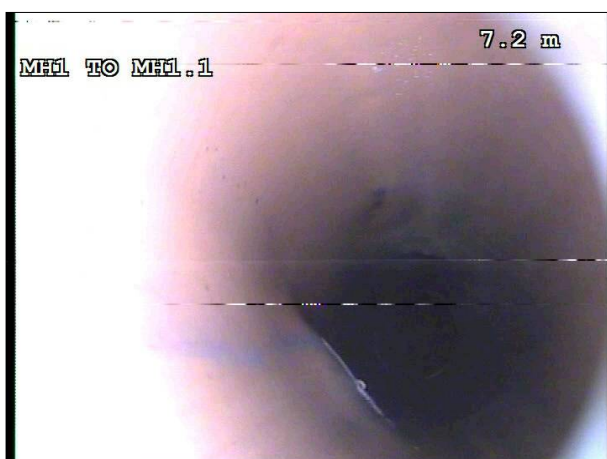


Photo: 57_6a, 00:00:00
7.4m, Sewer Deformed, 10 %, Remark: Stone Impact, from 06 to 08 o'clock



Photo: 58_7a, 00:00:00
13.2m, Sewer Deformed, 10 %, Remark: Stone Impact, from 11 to 01 o'clock

Inspection photos

Place: MERTHYR TYDFIL	Road: BRYNIAU ROAD	Date: 25/10/2019	section number: 8	PLR: MH1.1 X
---------------------------------	------------------------------	----------------------------	-----------------------------	------------------------

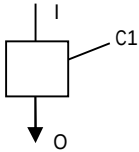
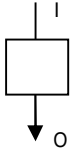
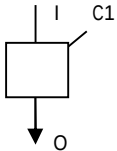
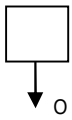
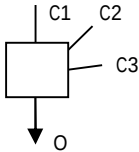


Photo: 59_8a, 00:00:00
16.5m, Debris, 20 % cross-sectional area loss

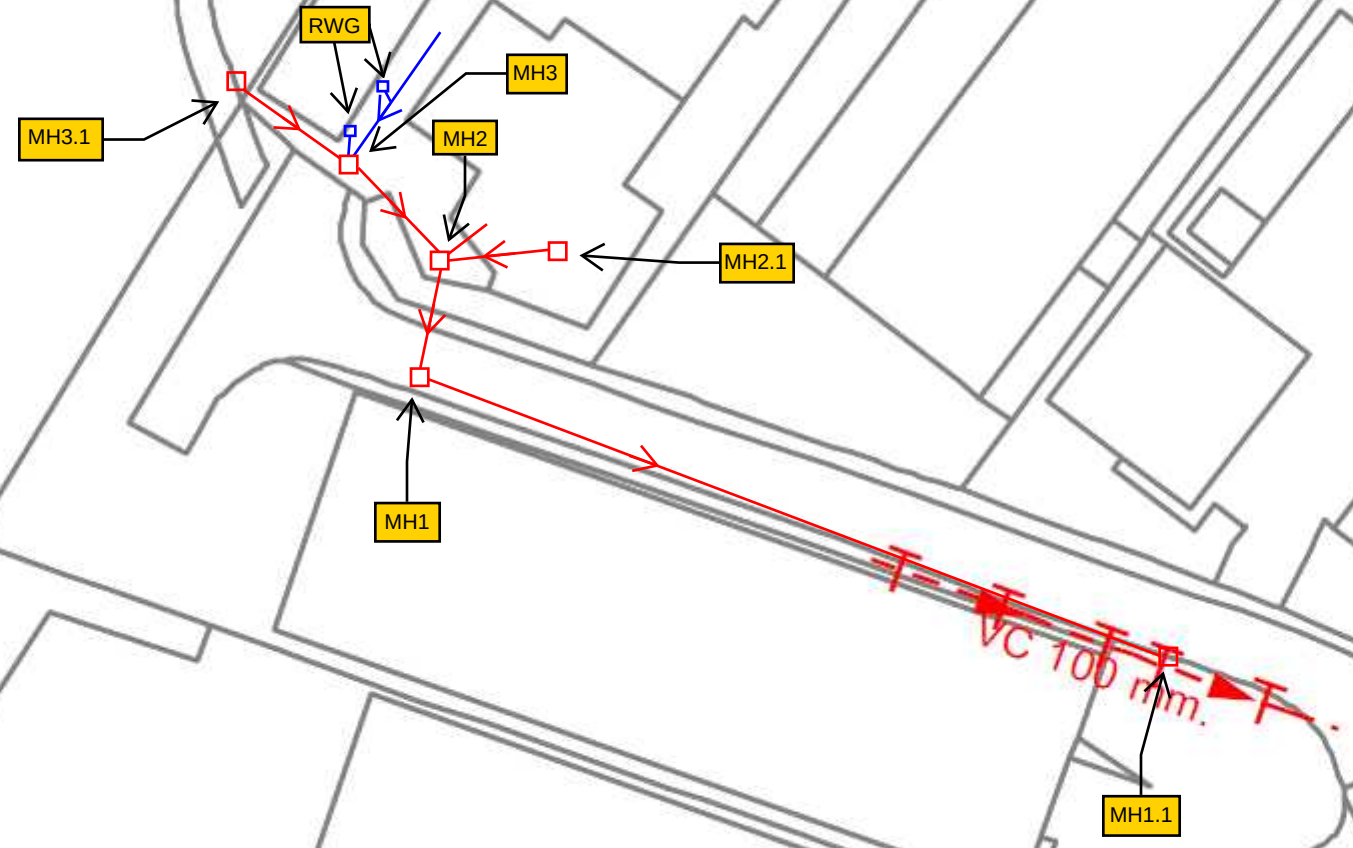


Photo: 60_9a, 00:00:00
23.9m, Water level, 20 % height/diameter

MANHOLE SURVEY INSPECTION DATA SHEET

MANHOLE NO.	CONNECTIONS	INVERTS		PIPE DIA	COMMENTS	IMAGES	
MH1		I O C1	1270 1270 1270	150 150 150			
MH1.1		I O	810 810	150 150	UNABLE TO CCTV DUE TO HEAVY FLOW		
MH2		I O C1	1460 1460 1410	100 150 150			
MH2.1		O	920	150	BLOCKED WITH SILT – REQUIRES CLEANING		
MH3		O C1 C2 C3		100 100 100 100			
MH3.1					LOCATED UNDER DEBRIS		

Sports Court



1

13

7

19

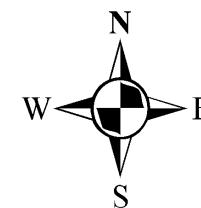
24

150 mm
VC

100 mm
VC

APPENDIX E – WELSH WATER SEWER RECORDS

Bryniau Road



LEGEND(Representative of most common features)

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

NB: Sewer symbol colour indicates the type.
RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - Former S24 sewers (for indicative purposes only)

Notes:

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

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

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

**EXACT LOCATIONS OF ALL APPARATUS
TO BE DETERMINED ON SITE.**

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Map Ref: 305901,208891
Map scale: 1:2500
Printed by: Powell Kelly-Ann
Printed on: 03 May 2019

APPENDIX F – EXISTING GREENFIELD RUN-OFF RATES

PHG Consulting		Page 1
62 Albany Road Cardiff CF24 3RR		
Date 30/11/2019 12:04 File	Designed by Stephen.Davis Checked by	
Innovyze	Source Control 2017.1.2	
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 100 Soil 0.500 Area (ha) 0.900 Urban 0.000 SAAR (mm) 1600 Region Number Region 9 Results l/s QBAR Rural 13.1 QBAR Urban 13.1 Q100 years 28.5 Q1 year 11.5 Q30 years 23.0 Q100 years 28.5		
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APPENDIX G – SURFACE WATER ATTENUATION CALCULATIONS

(30 YEAR CELLULAR STORAGE / 100 YR + 30% CC
COMPLEX CELLULAR & BASIN / DEPRESSION)

PHG Consulting		Page 1	
62 Albany Road Cardiff CF24 3RR		Bryniau Road, Pant, Merthyr Tydfil S104 / 30yr SW Storage	
Date 01/12/2019 09:08 File Bryniau Road 1 in 30yr ...		Designed by SJD Checked by	
Innovyze		Source Control 2017.1.2	

Summary of Results for 30 year Return Period

Half Drain Time : 86 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	330.824	0.524	0.0	11.5	11.5	43.0	O K
30 min Summer	331.045	0.745	0.0	11.5	11.5	61.2	O K
60 min Summer	331.261	0.961	0.0	11.5	11.5	78.9	O K
120 min Summer	331.419	1.119	0.0	11.5	11.5	91.8	O K
180 min Summer	331.463	1.163	0.0	11.5	11.5	95.4	O K
240 min Summer	331.479	1.179	0.0	11.5	11.5	96.7	O K
360 min Summer	331.466	1.166	0.0	11.5	11.5	95.7	O K
480 min Summer	331.415	1.115	0.0	11.5	11.5	91.5	O K
600 min Summer	331.340	1.040	0.0	11.5	11.5	85.4	O K
720 min Summer	331.259	0.959	0.0	11.5	11.5	78.7	O K
960 min Summer	331.098	0.798	0.0	11.5	11.5	65.5	O K
1440 min Summer	330.832	0.532	0.0	11.5	11.5	43.6	O K
2160 min Summer	330.588	0.288	0.0	11.2	11.2	23.6	O K
2880 min Summer	330.461	0.161	0.0	10.4	10.4	13.2	O K
4320 min Summer	330.351	0.051	0.0	8.9	8.9	4.2	O K
5760 min Summer	330.323	0.023	0.0	7.6	7.6	1.9	O K
7200 min Summer	330.307	0.007	0.0	6.6	6.6	0.6	O K
8640 min Summer	330.300	0.000	0.0	5.9	5.9	0.0	O K
10080 min Summer	330.300	0.000	0.0	5.4	5.4	0.0	O K
15 min Winter	330.903	0.603	0.0	11.5	11.5	49.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	60.154	0.0	56.4	22
30 min Summer	43.862	0.0	82.1	35
60 min Summer	30.811	0.0	115.4	62
120 min Summer	20.863	0.0	156.1	106
180 min Summer	16.335	0.0	183.5	140
240 min Summer	13.715	0.0	205.6	176
360 min Summer	10.685	0.0	240.4	246
480 min Summer	8.931	0.0	267.2	316
600 min Summer	7.762	0.0	290.5	380
720 min Summer	6.916	0.0	310.6	444
960 min Summer	5.756	0.0	345.0	568
1440 min Summer	4.437	0.0	398.7	806
2160 min Summer	3.426	0.0	461.8	1152
2880 min Summer	2.854	0.0	513.0	1500
4320 min Summer	2.215	0.0	597.1	2204
5760 min Summer	1.859	0.0	668.1	2936
7200 min Summer	1.627	0.0	731.1	3672
8640 min Summer	1.459	0.0	786.6	0
10080 min Summer	1.330	0.0	836.7	0
15 min Winter	60.154	0.0	63.0	23

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62 Albany Road
Cardiff
CF24 3RR

Date 01/12/2019 09:08
File Bryniau Road 1 in 30yr ...

Innovyze

Bryniau Road,
Pant, Merthyr Tydfil
S104 / 30yr SW Storage

Designed by SJD
Checked by

Source Control 2017.1.2

Page 2



Summary of Results for 30 year Return Period

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	331.163	0.863	0.0	11.5	11.5	70.8	O K
60 min Winter	331.440	1.140	0.0	11.5	11.5	93.6	O K
120 min Winter	331.628	1.328	0.0	11.5	11.5	109.0	O K
180 min Winter	331.662	1.362	0.0	11.5	11.5	111.8	O K
240 min Winter	331.666	1.366	0.0	11.5	11.5	112.1	O K
360 min Winter	331.615	1.315	0.0	11.5	11.5	108.0	O K
480 min Winter	331.520	1.220	0.0	11.5	11.5	100.1	O K
600 min Winter	331.374	1.074	0.0	11.5	11.5	88.2	O K
720 min Winter	331.217	0.917	0.0	11.5	11.5	75.3	O K
960 min Winter	330.954	0.654	0.0	11.5	11.5	53.6	O K
1440 min Winter	330.609	0.309	0.0	11.3	11.3	25.4	O K
2160 min Winter	330.401	0.101	0.0	9.7	9.7	8.3	O K
2880 min Winter	330.338	0.038	0.0	8.4	8.4	3.1	O K
4320 min Winter	330.306	0.006	0.0	6.5	6.5	0.5	O K
5760 min Winter	330.300	0.000	0.0	5.5	5.5	0.0	O K
7200 min Winter	330.300	0.000	0.0	4.8	4.8	0.0	O K
8640 min Winter	330.300	0.000	0.0	4.3	4.3	0.0	O K
10080 min Winter	330.300	0.000	0.0	3.9	3.9	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	43.862	0.0	92.1	35
60 min Winter	30.811	0.0	129.4	64
120 min Winter	20.863	0.0	174.7	116
180 min Winter	16.335	0.0	205.2	148
240 min Winter	13.715	0.0	230.3	186
360 min Winter	10.685	0.0	269.0	266
480 min Winter	8.931	0.0	299.6	344
600 min Winter	7.762	0.0	325.2	414
720 min Winter	6.916	0.0	348.2	476
960 min Winter	5.756	0.0	386.5	594
1440 min Winter	4.437	0.0	446.7	816
2160 min Winter	3.426	0.0	517.3	1148
2880 min Winter	2.854	0.0	574.6	1472
4320 min Winter	2.215	0.0	668.8	2188
5760 min Winter	1.859	0.0	748.4	0
7200 min Winter	1.627	0.0	818.9	0
8640 min Winter	1.459	0.0	881.0	0
10080 min Winter	1.330	0.0	937.1	0

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PHG Consulting		Page 3
62 Albany Road Cardiff CF24 3RR	Bryniau Road, Pant, Merthyr Tydfil S104 / 30yr SW Storage	
Date 01/12/2019 09:08 File Bryniau Road 1 in 30yr ...	Designed by SJD Checked by	
Innovyze	Source Control 2017.1.2	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	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 %	+0

Time Area Diagram

Total Area (ha) 0.499

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)		From: To: (ha)		From: To: (ha)	
0 4 0.167		4 8 0.167		8 12 0.166	

PHG Consulting		Page 4
62 Albany Road Cardiff CF24 3RR	Bryniau Road, Pant, Merthyr Tydfil S104 / 30yr SW Storage	
Date 01/12/2019 09:08 File Bryniau Road 1 in 30yr ...	Designed by SJD Checked by	
Innovyze Source Control 2017.1.2		

Model Details

Storage is Online Cover Level (m) 333.000

Cellular Storage Structure

Invert Level (m) 330.300 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	86.4	86.4	1.700	0.0	147.8
1.600	86.4	147.8			

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0140-1310-2700-1310
Design Head (m) 2.700
Design Flow (l/s) 13.1
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 140
Invert Level (m) 330.185
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.700	13.1
Flush-Flo™	0.609	11.5
Kick-Flo®	1.247	9.1
Mean Flow over Head Range	-	10.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	1.200	9.6	3.000	13.8	7.000	20.6
0.200	9.5	1.400	9.6	3.500	14.8	7.500	21.3
0.300	10.6	1.600	10.2	4.000	15.8	8.000	22.0
0.400	11.2	1.800	10.8	4.500	16.7	8.500	22.6
0.500	11.4	2.000	11.4	5.000	17.6	9.000	23.3
0.600	11.5	2.200	11.9	5.500	18.4	9.500	23.9
0.800	11.3	2.400	12.4	6.000	19.2		
1.000	10.8	2.600	12.9	6.500	19.9		

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62 Albany Road
Cardiff
CF24 3RR

Date 01/12/2019 09:07
File Bryniau Road 100yr+30% ...

Innovyze

Bryniau Road,
Pant, Merthyr Tydfil
100yrCC SW Complex

Designed by SJD
Checked by

Source Control 2017.1.2

Page 1



Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 169 minutes.

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	331.274	0.974	0.0	11.5	11.5	79.9	O K
30 min Summer	331.730	1.430	0.0	11.5	11.5	117.4	O K
60 min Summer	332.483	2.183	0.0	12.1	12.1	156.1	O K
120 min Summer	332.690	2.390	0.0	12.6	12.6	186.0	O K
180 min Summer	332.742	2.442	0.0	12.8	12.8	194.4	O K
240 min Summer	332.767	2.467	0.0	12.8	12.8	198.5	O K
360 min Summer	332.781	2.481	0.0	12.8	12.8	200.9	O K
480 min Summer	332.771	2.471	0.0	12.8	12.8	199.3	O K
600 min Summer	332.749	2.449	0.0	12.8	12.8	195.5	O K
720 min Summer	332.719	2.419	0.0	12.7	12.7	190.6	O K
960 min Summer	332.642	2.342	0.0	12.5	12.5	178.6	O K
1440 min Summer	332.463	2.163	0.0	12.1	12.1	153.5	O K
2160 min Summer	331.801	1.501	0.0	11.5	11.5	123.2	O K
2880 min Summer	331.277	0.977	0.0	11.5	11.5	80.2	O K
4320 min Summer	330.694	0.394	0.0	11.5	11.5	32.3	O K
5760 min Summer	330.492	0.192	0.0	10.6	10.6	15.8	O K
7200 min Summer	330.401	0.101	0.0	9.7	9.7	8.3	O K
8640 min Summer	330.348	0.048	0.0	8.9	8.9	3.9	O K
10080 min Summer	330.333	0.033	0.0	8.1	8.1	2.7	O K
15 min Winter	331.414	1.114	0.0	11.5	11.5	91.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	100.646	0.0	94.2	24
30 min Summer	74.363	0.0	139.1	38
60 min Summer	52.662	0.0	197.3	64
120 min Summer	35.497	0.0	265.9	120
180 min Summer	27.508	0.0	309.3	152
240 min Summer	22.929	0.0	343.8	186
360 min Summer	17.658	0.0	396.5	254
480 min Summer	14.625	0.0	437.9	326
600 min Summer	12.613	0.0	472.6	394
720 min Summer	11.163	0.0	501.6	464
960 min Summer	9.187	0.0	550.5	600
1440 min Summer	6.965	0.0	626.1	866
2160 min Summer	5.294	0.0	713.4	1276
2880 min Summer	4.365	0.0	784.8	1628
4320 min Summer	3.346	0.0	902.1	2260
5760 min Summer	2.792	0.0	1003.8	2952
7200 min Summer	2.438	0.0	1095.3	3672
8640 min Summer	2.180	0.0	1175.7	4400
10080 min Summer	1.984	0.0	1247.9	5080
15 min Winter	100.646	0.0	105.6	24

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PHG Consulting		Page 2
62 Albany Road Cardiff CF24 3RR	Bryniau Road, Pant, Merthyr Tydfil 100yrCC SW Complex	
Date 01/12/2019 09:07 File Bryniau Road 100yr+30% ...	Designed by SJD Checked by	
Innovyze	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	331.959	1.659	0.0	11.5	11.5	133.9	O K
60 min Winter	332.648	2.348	0.0	12.5	12.5	179.5	O K
120 min Winter	332.878	2.578	0.0	13.1	13.1	218.0	O K
180 min Winter	332.935	2.635	0.0	13.2	13.2	228.8	O K
240 min Winter	332.957	2.657	0.0	13.3	13.3	233.1	Flood Risk
360 min Winter	332.960	2.660	0.0	13.3	13.3	233.7	Flood Risk
480 min Winter	332.934	2.634	0.0	13.2	13.2	228.6	O K
600 min Winter	332.892	2.592	0.0	13.1	13.1	220.6	O K
720 min Winter	332.839	2.539	0.0	13.0	13.0	211.0	O K
960 min Winter	332.715	2.415	0.0	12.7	12.7	190.0	O K
1440 min Winter	332.430	2.130	0.0	12.0	12.0	149.4	O K
2160 min Winter	331.368	1.068	0.0	11.5	11.5	87.7	O K
2880 min Winter	330.713	0.413	0.0	11.5	11.5	33.9	O K
4320 min Winter	330.400	0.100	0.0	9.7	9.7	8.2	O K
5760 min Winter	330.335	0.035	0.0	8.2	8.2	2.9	O K
7200 min Winter	330.316	0.016	0.0	7.2	7.2	1.3	O K
8640 min Winter	330.304	0.004	0.0	6.4	6.4	0.3	O K
10080 min Winter	330.300	0.000	0.0	5.8	5.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	74.363	0.0	155.8	38
60 min Winter	52.662	0.0	220.6	64
120 min Winter	35.497	0.0	297.9	120
180 min Winter	27.508	0.0	346.1	172
240 min Winter	22.929	0.0	384.4	196
360 min Winter	17.658	0.0	444.1	274
480 min Winter	14.625	0.0	490.9	352
600 min Winter	12.613	0.0	528.7	428
720 min Winter	11.163	0.0	561.6	502
960 min Winter	9.187	0.0	616.4	646
1440 min Winter	6.965	0.0	700.9	922
2160 min Winter	5.294	0.0	799.2	1360
2880 min Winter	4.365	0.0	878.8	1592
4320 min Winter	3.346	0.0	1010.4	2248
5760 min Winter	2.792	0.0	1124.2	2912
7200 min Winter	2.438	0.0	1226.8	3584
8640 min Winter	2.180	0.0	1316.9	4400
10080 min Winter	1.984	0.0	1397.7	0

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Rainfall Details

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 %	+30

Time Area Diagram

Total Area (ha) 0.499

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)	From: To: (ha)	From: To: (ha)			
0 4 0.167	4 8 0.167	8 12 0.166			

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Model Details

Storage is Online Cover Level (m) 333.000

Complex Structure

Cellular Storage

Invert Level (m) 330.300 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	86.4	86.4	1.700	0.0	147.8
1.600	86.4	147.8			

Tank or Pond

Invert Level (m) 332.300

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	110.0	0.700	201.9	1.400	321.6	2.100	468.9
0.100	121.4	0.800	217.3	1.500	340.9	2.200	492.2
0.200	133.4	0.900	233.3	1.600	360.8	2.300	516.1
0.300	146.0	1.000	249.8	1.700	381.3	2.400	540.6
0.400	159.1	1.100	266.9	1.800	402.4	2.500	565.6
0.500	172.8	1.200	284.6	1.900	424.0		
0.600	187.1	1.300	302.8	2.000	446.2		

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0140-1310-2700-1310
Design Head (m) 2.700
Design Flow (l/s) 13.1
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 140
Invert Level (m) 330.185
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.700	13.1
Flush-Flo™	0.609	11.5
Kick-Flo®	1.247	9.1
Mean Flow over Head Range	-	10.6

The hydrological calculations have been based on the Head/Discharge relationship for the

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Hydro-Brake® Optimum Outflow Control

Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	1.200	9.6	3.000	13.8	7.000	20.6
0.200	9.5	1.400	9.6	3.500	14.8	7.500	21.3
0.300	10.6	1.600	10.2	4.000	15.8	8.000	22.0
0.400	11.2	1.800	10.8	4.500	16.7	8.500	22.6
0.500	11.4	2.000	11.4	5.000	17.6	9.000	23.3
0.600	11.5	2.200	11.9	5.500	18.4	9.500	23.9
0.800	11.3	2.400	12.4	6.000	19.2		
1.000	10.8	2.600	12.9	6.500	19.9		