

DRAINAGE STRATEGY REPORT
RESIDENTIAL DEVELOPMENT AT
PARC MAEN HIR,
LETTERSTON,
PEMBROKESHIRE
SA62 5AQ

JOB No.: 20057

VERSION: 02

REPORT REF.: 20057I/001/RCA/CE/RP/001

Roger Casey Associates
Consulting Civil & Structural Engineers

Ty Mansel 6 Mansel Street Carmarthen
Carmarthenshire SA31 1PX
Tel: +44 (0) 1267 22 26 46

Units 10 & 11 Merlin's Court Winch Lane
Haverfordwest Pembrokeshire SA61 1SB
Tel: +44 (0) 1437 76 27 95

Email: office@rca-eng.co.uk
Website: <http://www.rca-eng.co.uk>



DRAINAGE STRATEGY REPORT

FOR

RESIDENTIAL DEVELOPMENT AT




PARC MAEN HIR,

LETTERSTON,

PEMBROKESHIRE

SA62 5AQ

Job No.: 20057

| | |
|---|----------|
| Prepared By: | Date: |
|  | May 2019 |
| Checked By: | Date: |
|  | May 2019 |
| Approved By: | Date: |
|  | May 2019 |



Roger Casey Associates

Consulting Civil & Structural Engineers

Ty Mansel 6 Mansel Street Carmarthen Carmarthenshire SA31 1PX

Tel: +44 (0) 1267 22 26 46

Fax: +44 (0) 1267 22 13 77

Email: office@rca-eng.co.uk

DOCUMENT REVISION RECORD

| Version | Description | Date | Originator | Approver |
|----------------|--------------------------|-------------|-------------------|-----------------|
| 01 | Draft issue for comments | 21/11/2018 | DM | PWJL |
| 02 | Issue for PAC | 01/05/2019 | DM | PWJL |
| | | | | |
| | | | | |
| | | | | |

CONTENTS

| | |
|------------|---|
| 1.0 | Introduction |
| 2.0 | Site Description and Topography |
| 3.0 | Flood Risk |
| 4.0 | Existing Drainage and Site Investigations |
| 5.0 | Proposed Drainage Strategy and Summary |
| Appendix A | - Site Location Plan |
| Appendix B | - Topographical Survey Plan |
| Appendix C | - Proposed Architectural Site Plan |
| Appendix D | - Natural Resources Wales Flood Risk Map and Welsh Government TAN 15 Development Advice Map |
| Appendix E | - Dwr Cymru Welsh Water Pre-Planning Enquiry Response and Mapping |
| Appendix F | - Intégral Géotechnique Soakaway Test Results |
| Appendix G | - Initial Surface Water Soakaway Calculations |
| Appendix H | - Foul & Surface Water Drainage Strategy Site Plan |

1.0 **Introduction**

Roger Casey Associates has been instructed to prepare a Drainage Strategy Report in respect of the construction of phase 2 of a residential development on a greenfield area of land adjacent to Parc Maen Hir, Letterston, Pembrokeshire.

This report has been prepared on behalf of ateb group limited who is the Applicant and Developer of the proposed development area. The Report is intended to support the planning application process only to inform Planning Condition scope relating to proposed drainage solutions.

The purpose of this report is to describe the existing site and associated drainage infrastructure and to identify a sustainable solution for the proposed foul and surface water drainage to serve the new development.

The National Grid Reference of the approximate centre point of the proposed development site is SM 94900 29720, Easting 194900, Northing 229720.

This document relies upon geotechnical and geoenvironmental site investigations undertaken by Intégral Géotechnique (Wales) Ltd acting as Geotechnical Engineers on behalf of the original applicant of the land.

This Drainage Strategy Report is purely for information only and outlines the proposals to ensure all foul and surface water drainage design and management is carried out in accordance with current best practice and statutory guidelines and inform the detail drainage design stage.

2.0 Site Conditions and Topography

The site is located to the south of the phase 1 development at Parc Maen Hir in the village of Letterston, Pembrokeshire. The site is currently used for the storage of large quantities of spoil, underneath which the land comprises greenfield land with soft landscaping and vegetation. It is bounded by the phase 1 development to the north, hedge banks with open agricultural land beyond to the south and east, and residential dwellings to the west.

The total site area is approximately 0.8 hectares.

A copy of the site location plan is included in Appendix A.

The site is currently used for storing large amounts of spoil which is subject to removal off site. The underlying topography of the land is relatively flat and generally slopes downwards in level in a northly-easterly direction. The site survey, to Ordnance Survey Datum, shows an approximate gradient of 1:60 or 1.67% from bottom of bank at the south-western boundary to the fence-line of the residential development at the north-eastern boundary.

A copy of the topographical site survey is included in Appendix B.

3.0 Flood Risk

The proposed use of the site being for a residential development will classify the risk as being a 'Highly Vulnerable Development' (TAN 15, Figure 2). However, in accordance with Natural Resources Wales Flood and Welsh Government TAN 15 Development Advice Maps the site is located within an area designated being in Flood Zone A.

A copy of the proposed architectural site plan is included in Appendix C.

In accordance with guidance contained within TAN 15, Figure 1, further flood risks and justification tests are not required to sites located within Zone A and sound drainage design incorporating aspects of Sustainable Urban Drainage Systems (SuDS) is applicable to the development.

National Resources Wales Flood Risk Map and Welsh Government TAN 15 Development Advice Map are included in Appendix D.

Planning Policy and Technical Advice Note (TAN) 15 lists six sources of flooding which need to be considered in the assessment of flood risk and the probability of flooding at the Site Location.

Flooding from Rivers or Fluvial

Not applicable due to Site Location and demonstrated on Flood Maps in Appendix D.

Flooding from the Sea or Tidal Flooding

Not applicable due to Site Location and demonstrated on Flood Maps in Appendix D.

Flooding from Land

Not applicable due to surface water management within the proposed drainage strategy leading to detail design. Proposed external ground formation/levels must form appropriate informal overland flow routes within the landscaping and external area design to safely transfer any flood water away from the proposed dwellings and any other existing premises.

Flooding from Groundwater

No groundwater was observed during the investigations by Intégral Géotechnique (Wales) Ltd in trial pits dug to a depth of approximately 2-3m.

Flooding from Sewers

Not applicable due to foul and surface water management within drainage design. Notwithstanding blockage or catastrophic failure of drainage systems upstream of development site resulting in overland flows not being contained within kerb upstand heights, surface gradients, etc. This will assist in reducing the current low surface water flood risk at the site location.

Flooding from Reservoirs, Canals and Other Artificial Sources

Not applicable due to Site Location and demonstrated on Flood Maps in Appendix D.

4.0 **Existing Drainage and Site Investigations**

Foul Water Drainage

Dwr Cymru Welsh Water (DCWW) mapping indicates the presence of a public foul water sewer located in Station Road to the north of the development. A Pre-Planning Enquiry response from DCWW, reference PPA0002818, confirms that sufficient capacity exists within the public sewer network and treatment process to accept development flows and identifies Station Road as a suitable point of connection.

We assume that the existing foul water sewer network serving Phase 1 development of Parc Maen Hir to be public, and yet to be added to DCWW Asset Record Maps. There is an existing foul water sewer manhole chamber adjacent to the proposed site entrance which we propose to be the preferred point of foul water connection

A copy of the Pre-Planning Enquiry response and sewer plans are available in Appendix E.

Surface Water Drainage

On 7 January 2019, the Welsh Government implemented Schedule 3 of the Flood and Water Management Act (2010). The new mandatory regulations make the incorporation of sustainable drainage systems (SuDS) compulsory in new developments in order to help reduce flood risk and improve water quality. SuDS on new developments must be designed and built in accordance with the Statutory SuDS Standards published by the Welsh Ministers. Schemes must be approved by the Local Authority acting in the role of SuDS Approving Body (SAB) before construction begins.

It is anticipated that a separate Pre-Application Form will need to be submitted to the SAB which will include a preliminary surface water drainage scheme designed to meet the Statutory SuDS Standards. For the purposes of this Drainage Strategy Report only the surface water runoff destination will be explored to provide evidence to the LPA that a surface water drainage scheme on this site is achievable.

With reference to Standard S1 of the Statutory Sustainable Drainage Systems Standards, surface water runoff destination is considered in five priority levels:

| Priority Level | Flow Destination |
|----------------|--|
| 1 | Surface water run-off is collected for use; |
| 2 | Surface water runoff is infiltrated to ground; |
| 3 | Surface water runoff is discharged to a surface water body; |
| 4 | Surface water runoff is discharged to a surface water sewer, highway drainage, or another drainage system; |
| 5 | Surface water runoff is discharged to a combined sewer. |

Following investigations and in response to each of the Priority Levels:

1. At this stage it is not envisaged that rainwater harvesting will be used due to capital installation costs and also passing whole life costs of a collection system including its maintenance on to dwelling purchasers. To comply with WG Standards, rainwater harvesting butts will be provided to one rainwater downpipe per Plot. These butts will have an overflow provision into the general rainwater collection pipework serving each plot.
2. Geotechnical site investigations were undertaken by Intégral Géotechnique (Wales) Ltd in February 2008. These investigations included soakaway testing within trial pits to a depth of between 2m – 3m. Results from the soakaway testing concluded that there is a good infiltration potential of the subsoils with results ranging from 1.135×10^{-3} m/s to 1.79×10^{-5} m/s, thus infiltration-based drainage appears a viable and suitable means of surface water disposal. Intégral Géotechnique comment that soakaways should be designed to connect into the underlying weathered shaley mudstones or the overlying gravels, noting that the latter may give lower infiltration rates.
3. Not considered due to available surface water drainage destination at Priority Level 2.
4. Not considered due to available surface water drainage destination at Priority Level 2.
5. Not considered due to available surface water drainage destination at Priority Level 2.

5.0 Proposed Drainage Strategy and Summary

The site will be served by new separate foul and surface water drainage systems discharging as follows based on existing drainage and site investigations outlined above (Refer to Appendix F for Proposed Drainage Strategy Site Plan and Appendix G for Initial Surface Water Soakaway Calculations):

Foul Water Drainage

All foul water only drainage flows will be collected from the proposed residential development via a new gravity sealed pipe system and connected into the existing public foul water sewer network located in Parc Maen Hir.

Where the new foul water drainage system lies outside of the legal curtilage of each proposed dwelling, it will need to be adopted by Dwr Cymru Welsh Water under a Water Industry Act Section 104 Adoption Agreement between DCWW and the Developer.

Surface Water Drainage

Due to the high silt content in the shallow underlying subsoils it is unlikely that permeable surfacing will be effective in draining drive/parking areas via infiltration. However, permeable surfacing is still effective as part of a treatment train to improve water quality, therefore parking and private driveway areas are proposed to be constructed from permeable surfacing with an overflow pipe into the plot drainage.

Dwelling roof and drive/parking area surface water run-off will be collected via on-plot gravity sealed piped networks and discharged into soakaways constructed within the rear garden area of each dwelling. Depending on the soil conditions encountered at soakaway formation level, these will either comprise lined soakaways or cellular unit soakaways.

Surface water from the adoptable carriageway and footpaths will be collected via gully pots with silt traps into a sealed pipe network with further silt traps at catchpit type manhole structures at changes in direction and pipe gradients. The adoptable surface water drainage network will discharge into an adoptable soakaway structure located under the landscaped open space adjacent Plots 1/2. This soakaway will be designed for events up to 1 in 30 year, with a shallow detention basin proposed above to store any additional surface water runoff for events up to and including 1 in 100 year (+30% allowance for climate change).

The carriageways and footpaths, inclusive of surface water drainage serving the same, along with the street lighting will be offered for Adoption by Pembrokeshire County Council (PCC) under a Highway Act Section 38 Agreement between PCC and ateb group ltd.

Flooding

The site is generally located in a low flood risk location considered by TAN 15.



**Daniel Mulgrew BSc (Hons) GMICE
Graduate Civil Engineer
for Roger Casey Associates**

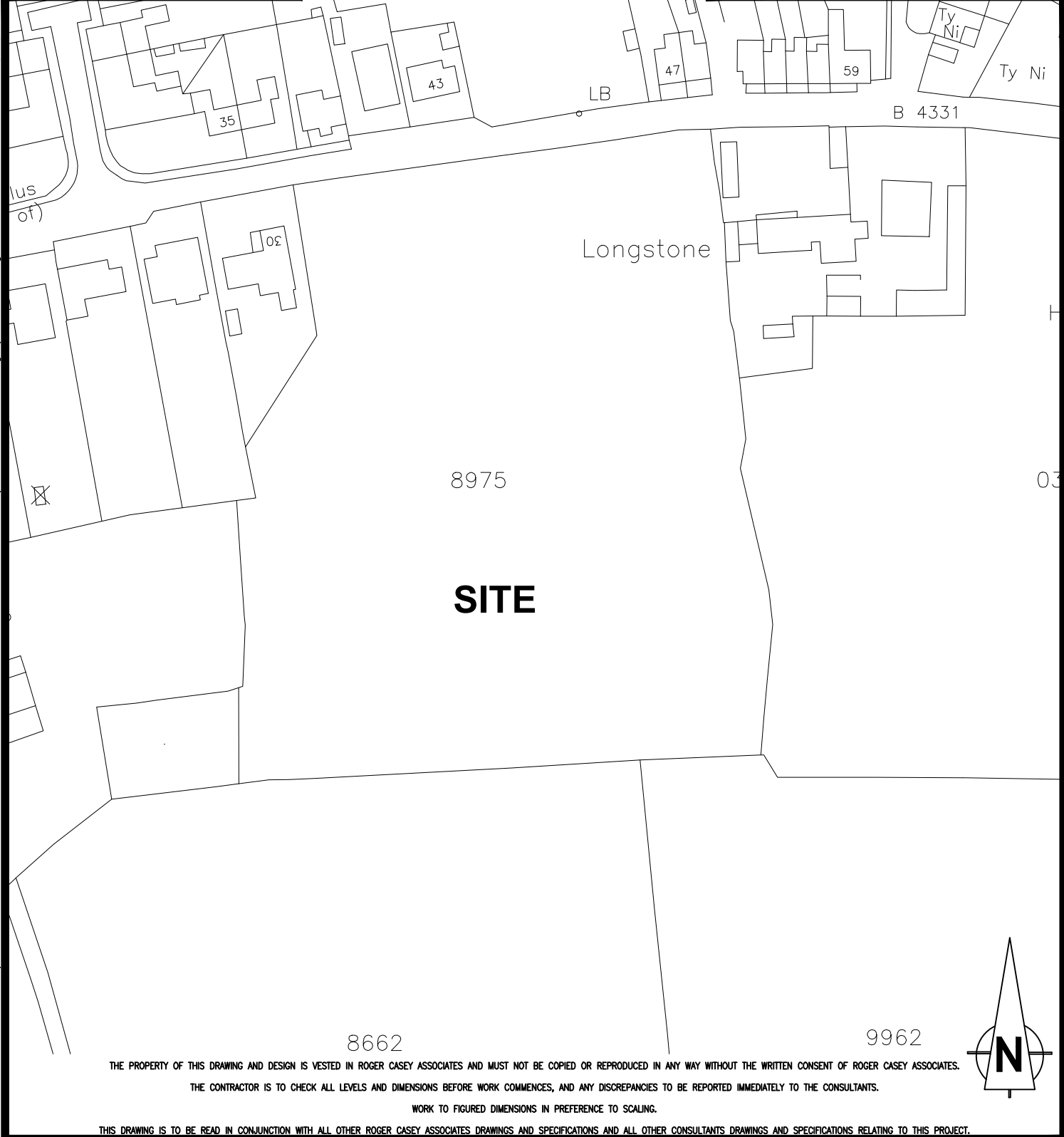
Appendix A - Site Location Plan

25/11/2018 10:06:42

M:\RCA Job Files\200 Job Files\2005\Phase 2 Residential Development at Parc Maen Hir, Letterston, Haverfordwest, Pembrokeshire SA62 5BW\1 - RCA Civil Drawings\2005\02.dwg

DO NOT SCALE
STATUS: OS

ORIGINAL DRAWING A4
© Roger Casey Associates Limited 2018



THE PROPERTY OF THIS DRAWING AND DESIGN IS VESTED IN ROGER CASEY ASSOCIATES AND MUST NOT BE COPIED OR REPRODUCED IN ANY WAY WITHOUT THE WRITTEN CONSENT OF ROGER CASEY ASSOCIATES.

THE CONTRACTOR IS TO CHECK ALL LEVELS AND DIMENSIONS BEFORE WORK COMMENCES, AND ANY DISCREPANCIES TO BE REPORTED IMMEDIATELY TO THE CONSULTANTS.

WORK TO FIGURED DIMENSIONS IN PREFERENCE TO SCALING.

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER ROGER CASEY ASSOCIATES DRAWINGS AND SPECIFICATIONS AND ALL OTHER CONSULTANTS DRAWINGS AND SPECIFICATIONS RELATING TO THIS PROJECT.

CLIENT:
ateb group limited

PROJECT:
**RESIDENTIAL DEVELOPMENT AT
PARC MAEN HIR, LETTERSTON,
HAVERFORDWEST SA62 5BW**



Roger Casey Associates
Consulting Civil & Structural Engineers

Ty Mansel, 6 Mansel Street,
Carmarthen,
Carmarthenshire SA31 1PX
T: 01267 222 646

Units 10 & 11, Merlin's Court,
Winch Lane, Haverfordwest,
Pembrokeshire SA61 1SB
T: 01437 762 795

E: office@rca-eng.co.uk
W: www.rca-eng.co.uk

DRAWING TITLE:
SITE LOCATION PLAN

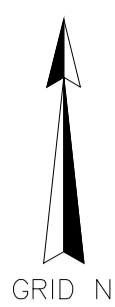
| | | |
|---------------------------|--------------------------|--------------------------|
| DRAWN BY: PWJL | DATE: 02/07/18 | SCALES: 1:1250 |
| DESIGN BY: - | DRAWING No.: | REVISION: |
| CHECKED BY: RSC | 20057/02 | |

Appendix B - Topographical Survey Plan

02/07/2018 14:00:18
RCA Document Reference: RCA A1 Landscape Version 1
RCA Job File: 20057_01.dwg - Phase 2 Residential Development at Parc Maen Hir, Letterston, Haverfordwest, Pembrokeshire SA62 5AW - RCA Civil Drawings 20057-01.dwg

DO NOT SCALE

| | | |
|--|---|--|
| | M.W. SURVEYS Land and Engineering Surveys Electronic measurements and setting out. Tel: 01342 801241 Fax: 01342 801240 Email: mws@mw-surveys.co.uk | CLIENT JONATHAN COLE PEMBROKESHIRE HOUSING, MULLEN HOUSE, ST THOMAS GREEN, HAVERFORDWEST, PEMBROKESHIRE, SA61 1QP |
| | PROJECT TOPOGRAPHICAL SURVEY OF PROPOSED RESIDENTIAL SITE AT LONGSTONE FARM, STATION ROAD, LETTERSTON, PEMBROKESHIRE | SCALE 240:1:18 |
| DRAWN BY GOSWIS G.P.S. ORDNANCE SURVEY GRID & DATUM | DATE 18/01/2018 | DRAWN BY SAMR JEM |



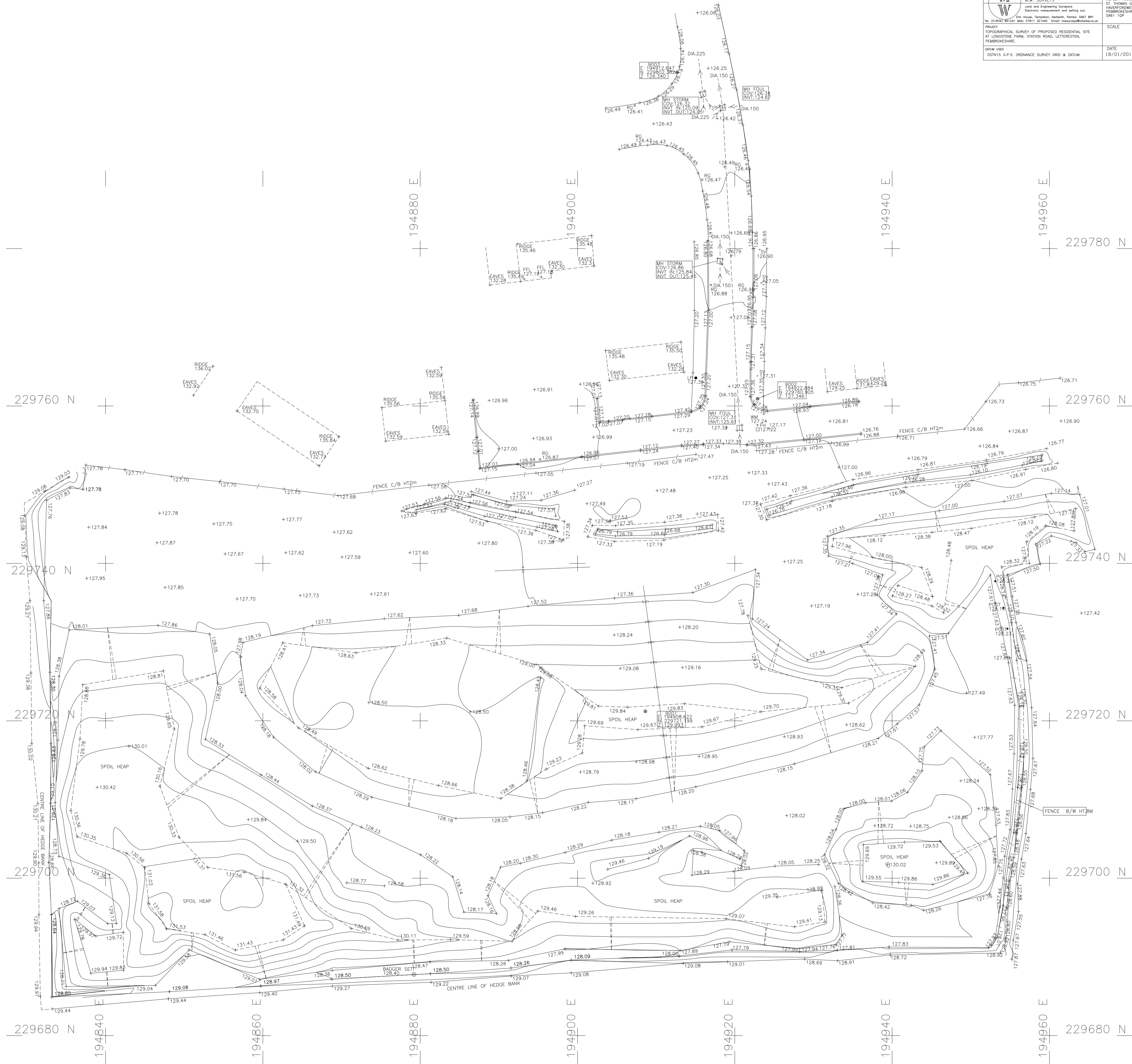
NOTES:

THE PROPERTY OF THIS DRAWING AND DESIGN IS VESTED IN ROGER CASEY ASSOCIATES AND MUST NOT BE COPIED OR REPRODUCED IN ANY WAY WITHOUT THE WRITTEN CONSENT OF ROGER CASEY ASSOCIATES.

THE CONTRACTOR IS TO CHECK ALL LEVELS AND DIMENSIONS BEFORE WORK COMMENCES, AND ANY DISCREPANCIES TO BE REPORTED IMMEDIATELY TO THE CONSULTANTS.

WORK TO FIGURED DIMENSIONS IN PREFERENCE TO SCALING.

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER ROGER CASEY ASSOCIATES DRAWINGS AND SPECIFICATIONS AND ALL OTHER CONSULTANTS DRAWINGS AND SPECIFICATIONS RELATING TO THIS PROJECT.



| REV | DESCRIPTION | DRAWING STATUS | DRAWN | CHECK | DATE |
|-----|-------------|----------------|-------|-------|------|
|-----|-------------|----------------|-------|-------|------|

DRAWING STATUS: SURVEY

Roger Casey Associates
Consulting Civil & Structural Engineers

Ty Mansel, 6 Mansel Street,
Carmarthen,
Carmarthenshire SA31 1PX
T: 01267 222 646

Units 10 & 11, Merlin's Court,
Winch Lane, Haverfordwest,
Pembrokeshire SA61 1SB
T: 01437 762 795

E: office@rca-eng.co.uk
W: www.rca-eng.co.uk

CLIENT:
ateb group limited

ARCHITECT:
LEWIS PARTNERSHIP
LLANELLI

PROJECT:
RESIDENTIAL DEVELOPMENT AT
PARC MAEN HIR, LETTERSTON,
HAVERFORDWEST SA62 5AW

DRAWING TITLE:
EXISTING SITE SURVEY PLAN

| | | | |
|-------------------|-------------------------|--------------------|---------------------|
| DRAWN BY: PWJL | DESIGN BY: - | CHECKED BY: RSC | DATE: 02/07/2018 |
| SCALE: 1:250 | DRAWING No: 20057/01 | REVISION: | |

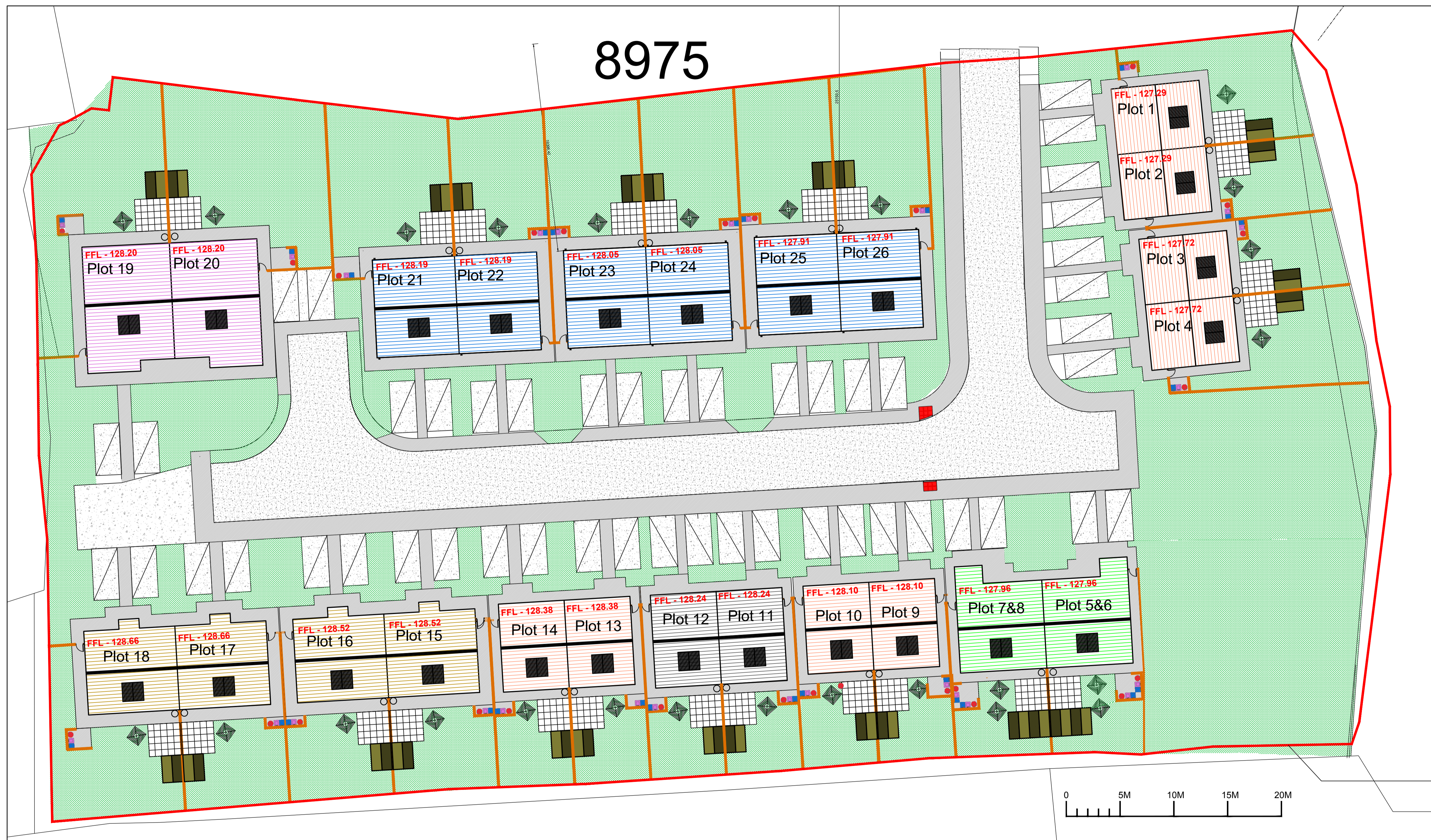
ORIGINAL DRAWING A1
© Roger Casey Associates Limited 2018

Appendix C - Proposed Architectural Site Plan

PROPOSED SITE LAYOUT

LAND AT LONGSTONE FARM, LETTERSTON - PHASE 2

8975



Site Boundary Based on centre line of hedgebank

Notes

- all boundaries to be enclosed with 1800mm high timber close boarded fence
- fenceline between dwellings to be 1200mm high close boarded fence
- houses to have a rotary line, bin stores, external store, 40sq m of useable garden, 9 sq m patio area
- bungalows to have a rotary line, bin stores, external store, 30sq m of useable garden, 9 sq m patio area
- flats to have a rotary line, bin stores, external store, 9 sq m patio area
- all driveways to be tarmac
- all paths to be concrete - 900mm around houses, 1200mm around bungalows
- sheds to be timber construction and to be sized to suit Code for Sustainable Homes (CSH) requirements
- rear garden areas to be finished in turf
- every dwelling is have water butt connected to the surface disposal system
- every dwelling is to have a designated composting area
- any services indicated are approximate only and need to be verified by a suitable investigation

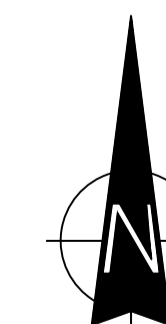
All finished floor levels to be agreed following receipt of an up to date topographical survey and input from structural engineer / road / drainage designer

- timber storage shed - 1.5 x 2.7 useable sq m required per dwelling
- area for refuse and recycling bins on hardstanding with turning circle for a wheelchair
- car parking space
- PV pannels to south facing roofs

- 9 sq m paved patio
- rotary line

Housing Mix - 26 units

- 8 no. 4 person 2 bedroom houses - plots 1,2,3,4,9,10,13,14
- 2 no. 4 person 3 bedroom houses - plots 11,12
- 6 no. 3 person 2 bedroom bungalows - plots 21-26 inc.
- 2 no. 3 person 2 bedroom disabled bungalows - plots 19,20
- 4 no. 2 person 1 bedroom flats - plots 5,6,7,8
- 6 no. 2 person 1 bedroom bungalows - plots 15-18













| | | | | | | | | | |
|---|--|--|--|--|---|--|---|--------------------------------------|--|
| <small>Only use figured dimensions. Any discrepancies must be reported to LEWIS PARTNERSHIP LIMITED. The copyright of this drawing remains the property of LEWIS PARTNERSHIP LIMITED. Lewis Partnership Limited, registered in Wales, reg no. 3913005</small> | | 13 Park Crescent LLANELLI Carmarthenshire SA15 3AE 01554 777998 enquiries@lewispartnership.co.uk WWW.lewispartnership.co.uk | Chartered Practice RIBA no. 27954 | Rev Amendments Date Ckd By | LEWIS PARTNERSHIP architects - penseiri | Rev Amendments Date Ckd By | Project PROPOSED RESIDENTIAL DEVELOPMENT Location : LAND AT STATION ROAD, LETTERSTON Client : JONATHAN COLE, ATEB | Title PROPOSED SITE LAYOUT | Date Drawn 12/17 By pjl |
| | | | | A Topographical Survey added 07/02/18 pjl | | B Minor amendments to site setting out 22/06/18 pjl | | | C Minor amendments to site setting out 03/07/18 pjl |
| | | | | Project Number 1840 Drawing Number 03 Rev. D Scale 1:200 Status FEASIBILITY | | | | | |

Appendix D - Natural Resources Wales Flood Risk Map and Welsh Government TAN 15
Development Advice Map

Letterston, Pembrokeshire

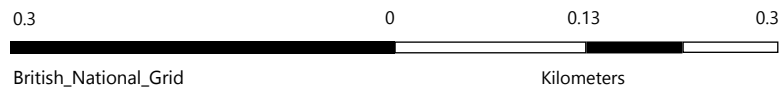
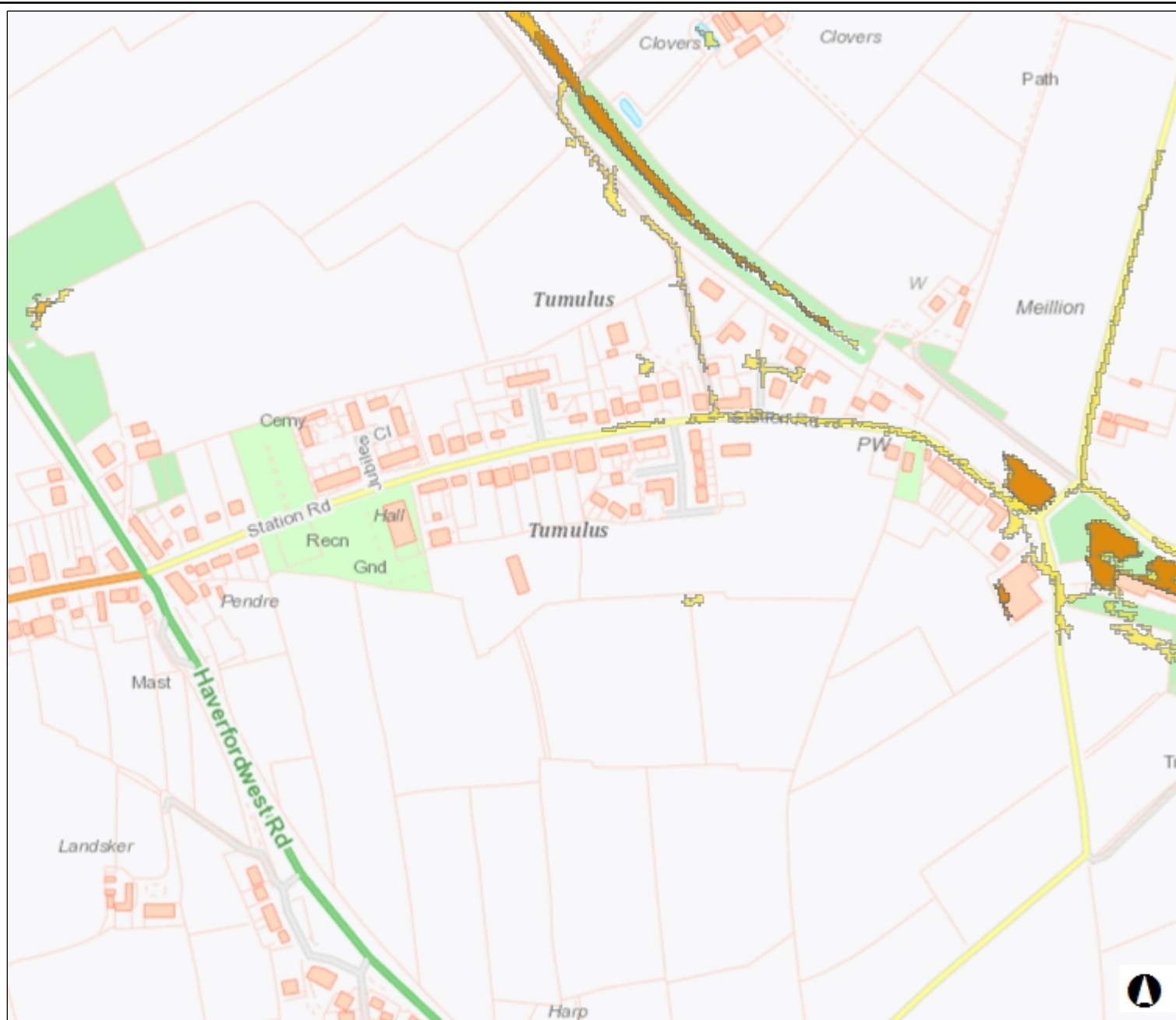
Map Perygl Llifogydd / Flood Risk Map

Allwedd / Map Key

- Main Rivers
- Flood Defences
-  Areas Benefiting from Flood Defences
-  Flood Storage Areas
-  Floodmap Flood Zone 3
-  Floodmap Flood Zone 2
- Reservoir Depths
-  0 - 0.3m
-  0.3 - 2.0m
-  Greater than 2.0m
-  High Surface Water Flood Risk - Extent
-  Medium Surface Water Flood Risk - Extent
-  Low Surface Water Flood Risk - Extent

Graddfa / Scale 1: 5,001

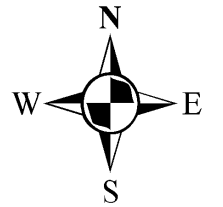
Dyddiad / Date
19/11/2018



Ceir rhestr lawn o delerau ac amondau yn <https://naturalresources.wales/rhybuddsafonol> neu drwy gysylltu ag ymholiada@cyfoethnaturiolcymru.gov.uk. A full list of terms and conditions is available from the <https://naturalresources.wales/StandardNotice> or by contacting enquire@naturalresourceswales.gov.uk © Crown copyright and database rights 2017 Ordnance Survey 100019741. Geological Mapping: British Geological Survey ©NERC. Centre for Ecology & Hydrology © NERC (CEH). Defra and Met Office © Crown copyright. © Cranfield University. © James Hutton Institute. Land & Property Services © Crown copyright and database right.

Appendix E - Dwr Cymru Welsh Water Pre-Planning Enquiry Response and Mapping

PPA0002818



LEGEND (Representative of most common features)

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

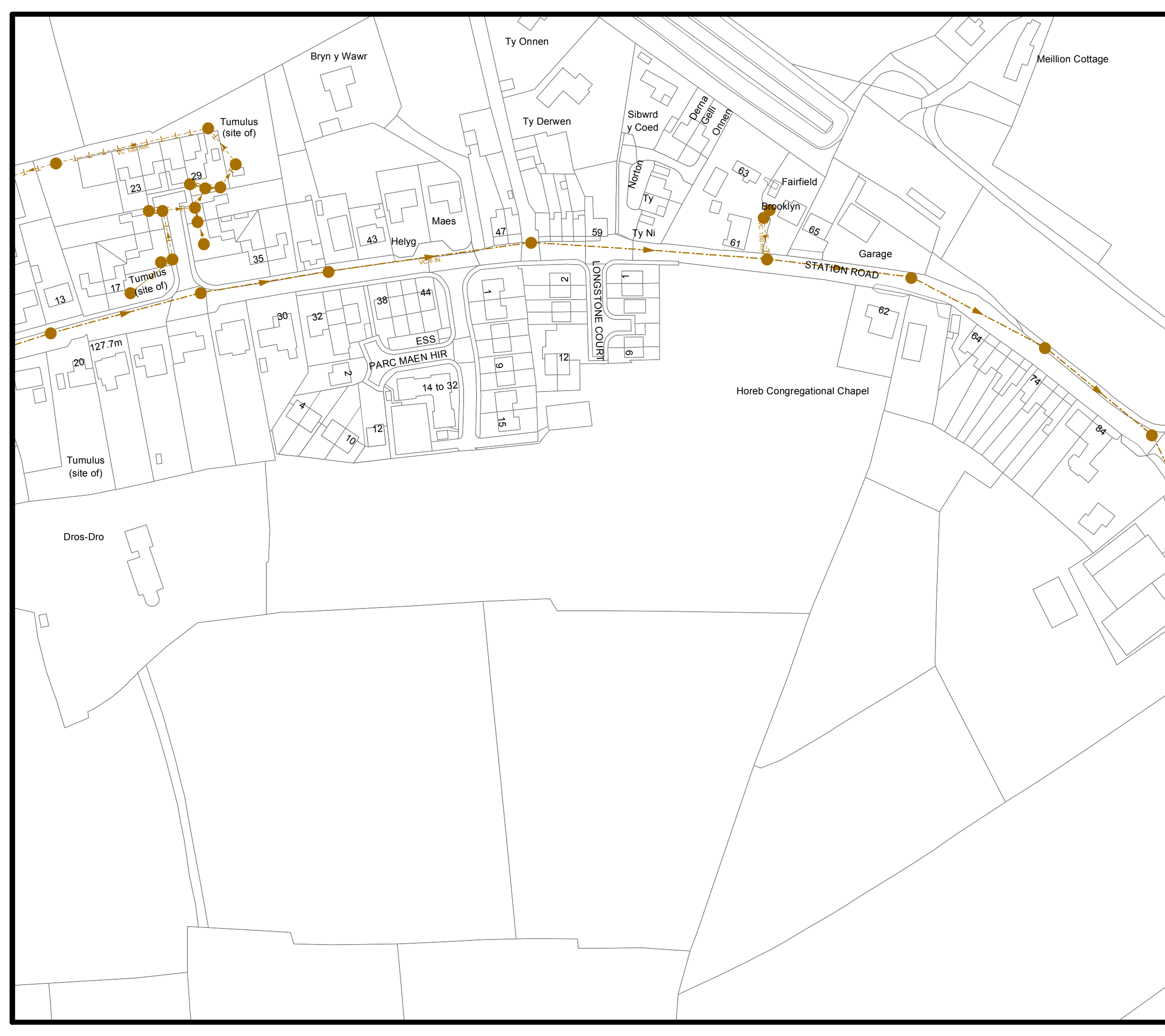
Dŵr Cymru Cylfyngedig (the Company) gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations 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.

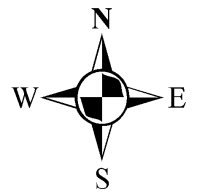
Service pipes are not generally shown but their presence should be anticipated.

EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

Reproduced by permission of the Ordnance Survey on behalf of HMSO. © Crown copyright and database right 2017. All rights reserved. Ordnance Survey Licence number 100019534

Map Ref: 194973,229725
 Map scale: 1:1500
 Printed by: Harris Cerianne
 Printed on: 23 Feb 2018





LEGEND

| | | | |
|--|-------------------------|--|-----------------------|
| | Sluice valve | | Stop tap |
| | Pressure reducing valve | | Water Treatment Works |
| | Meter | | Water Pumping Station |
| | Bulk meter | | Existing main |
| | Hydrant | | Non-operational main |
| | Cap end | | Raw Water |
| | Air valve | NB: Water main symbol colour indicates the type. | |
| | | LIGHT BLUE | - Trunk |
| | | DARK BLUE | - Distribution |
| | | YELLOW | - Raw Water |

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.

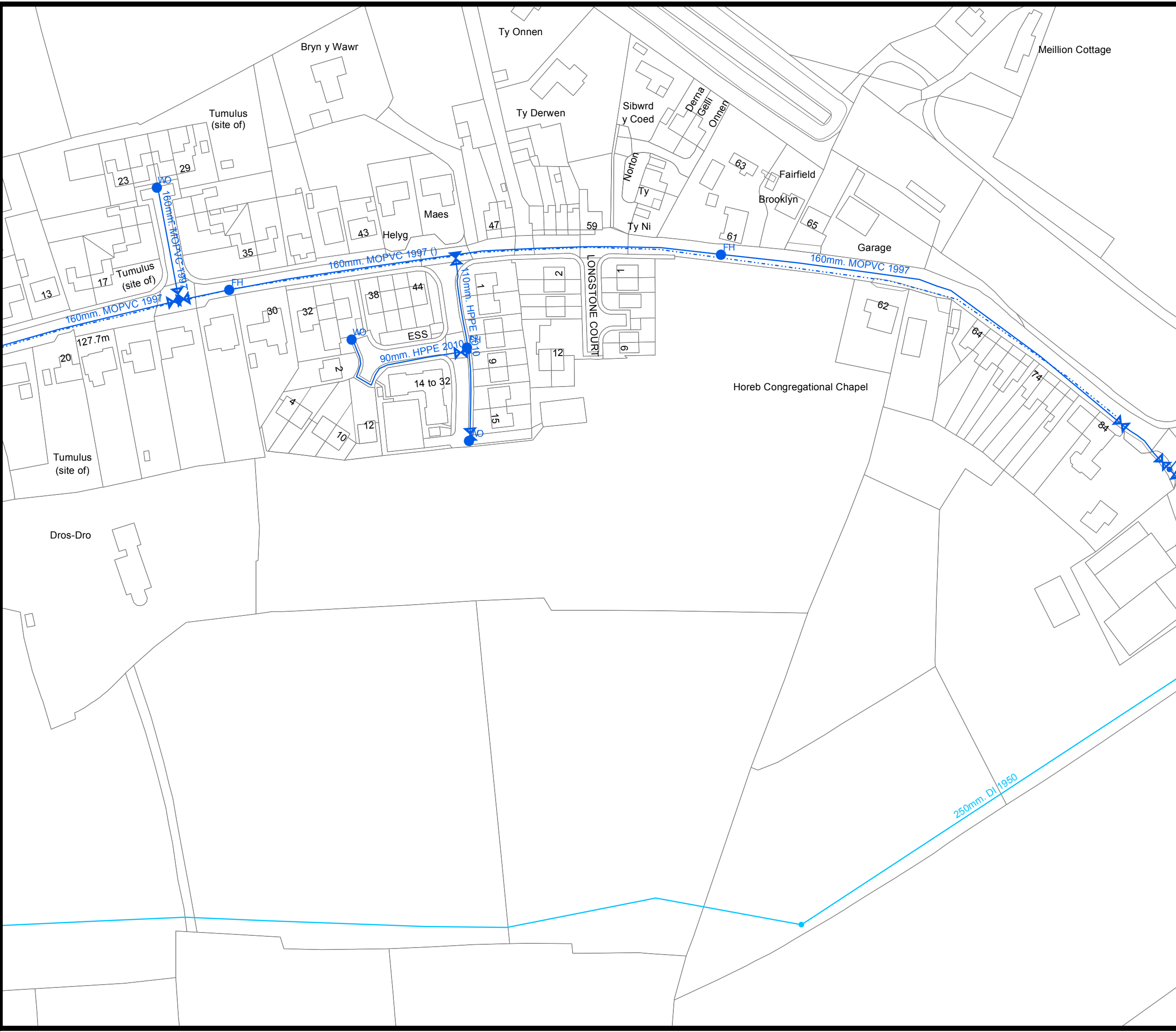
Dŵr Cymru Cyfyngedig (the Company) gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations 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.

Reproduced by permission of the Ordnance Survey on behalf of HMSO. © Crown copyright and database right 2017. All rights reserved. Ordnance Survey Licence number 100019534

Map Ref: 194973,229725
Map scale: 1:1500
Printed by: Harris Cerianne
Printed on: 23 Feb 2018



Mr Philip Lawrence
Pembrokeshire Housing Association c/o
Ty Mansel 6
Mansel Street
Carmarthen
Carmarthenshire
SA31 1PX

Date: 28/02/2018
Our Ref: PPA0002818

Dear Mr Lawrence

Grid Ref: 194894 229719
Site Address: Parc Maen Hir Letterston, Haverfordwest
Development: Phase 2, Parc Maen Hir

I refer to your pre-planning enquiry received relating to the above site, seeking our views on the capacity of our network of assets and infrastructure to accommodate your proposed development. Having reviewed the details submitted I can provide the following comments which should be taken into account within any future planning application for the development.

SEWERAGE

The foul flows only from the proposed development can be accommodated within the public sewerage system. We advise that the flows should be communicated with to the foul/combined sewer between manholes SM94298898 and SM94299801 located in Station Road.

Should a planning application be submitted for this development we will seek to control these points of communication via appropriate planning conditions and therefore recommend that any drainage layout or strategy submitted as part of your application takes this into account.

However, should you wish for an alternative connection point to be considered please provide further information to us in the form of a drainage strategy, preferably in advance of a planning application being submitted.

With reference to the surface water flows from the proposed development, you are required to fully exhaust all technical options outlined under Sections 3.2 and 3.4 of Part H of the publication 'Building Regulations 2000; Disposal should be made through the hierarchical approach, preferring infiltration and, where infiltration is not possible, disposal to watercourses in liaison with the Land Drainage Authority and/or Natural Resources Wales. Discharge of surface water to the public sewer is only to be made as a last resort. Please refer to further detailed advice relating to surface water management included in our attached Advice & Guidance note.

In addition, please note that no highway or land drainage run-off will be permitted to discharge directly or indirectly into the public sewerage system.

You may need to apply to Dwr Cymru Welsh Water for any connection to the public sewer under Section 106 of the Water industry Act 1991. However, if the connection to the public sewer network is either via a lateral drain (i.e. a drain which extends beyond the connecting property boundary) or via a new sewer (i.e. serves more than one property), it is now a mandatory requirement to first enter into a Section 104 Adoption Agreement (Water Industry Act 1991). The design of the sewers and lateral drains must also conform to the Welsh Ministers Standards for Foul Sewers and Lateral Drains, and conform with the publication "Sewers for Adoption"- 7th Edition. Further information can be obtained via the Developer Services pages of www.dwrcymru.com

You are also advised that some public sewers and lateral drains may not be recorded on our maps of public sewers because they were originally privately owned and were transferred into public ownership by nature of the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011. The presence of such assets may affect the proposal. In order to assist you may contact Dwr Cymru Welsh Water on 0800 085 3968 to establish the location and status of the apparatus in and around your site. Please be mindful that under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times.

SEWAGE TREATMENT

No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site.

WATER SUPPLY

A water supply can be made available to service this proposed development. Initial indications are that a connection can be made from the 110mm diameter distribution watermain in Parc Maen Hir. The cost of providing new on-site watermains can be calculated upon the receipt of detailed site layout plans which should be sent to the above address.



I trust the above information is helpful and will assist you in forming water and drainage strategies that should accompany any future planning application. I also attach copies of our water and sewer extract plans for the area, and a copy of our Planning Guidance Note which provides further information on our approach to the planning process, making connections to our systems and ensuring any existing public assets or infrastructure located within new development sites are protected.

Please note that our response is based on the information provided in your enquiry and should the information change we reserve the right to make a new representation. Should you have any queries or wish to discuss any aspect of our response please do not hesitate to contact our dedicated team of planning officers, either on 0800 917 2652 or via email at developer.services@dwrwymru.com

Please quote our reference number in all communications and correspondence.

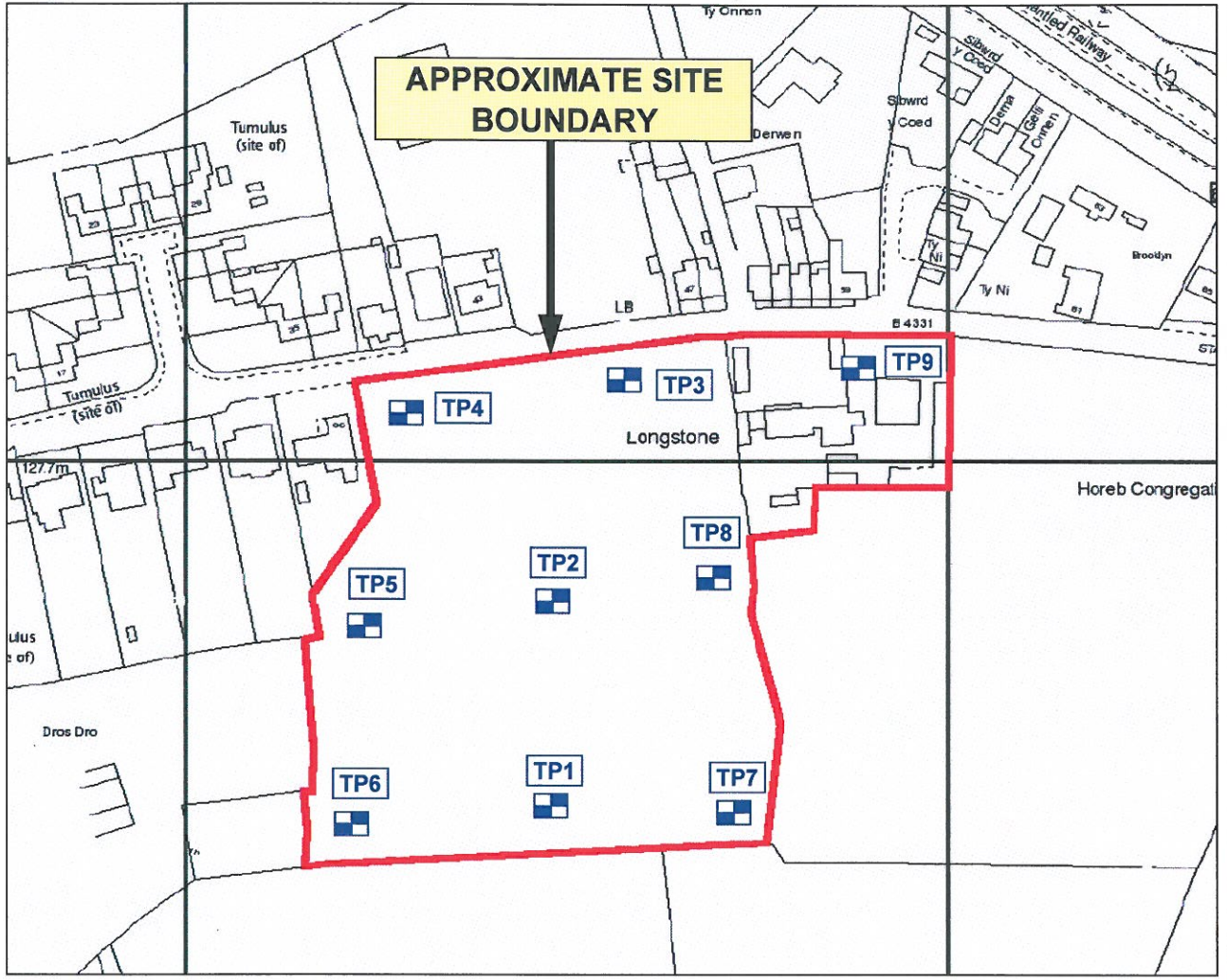
Yours faithfully,



Owain George
Planning Liaison Manager
Developer Services

Please Note that demands upon the water and sewerage systems change continually; consequently the information given above should be regarded as reliable for a maximum period of 12 months from the date of this letter.

Appendix F - Intégral Géotechnique Soakaway Test Results



0 100 m

LEGEND
■ Location of Trial Pits (approx.)

Crown Copyright Reserved

FIGURE 2 - SITE LAYOUT
Longstone Farm, Station Road, Letterston

Intégral
Géotechnique

50 Cathedral Road
Cardiff
CF11 9LL
Tel: 029 2022 0462
Fax: 029 2034 0789

Appendix G - Initial Soakaway Calculations

Ty Mansel 6 Mansel Street
 Carmarthen
 Wales SA31 1PX

Residential development at
 Parc Maen Hir, Letterston,
 Pembrokeshire SA62 5AQ



Date 23/11/2018 11:18
 File Plot SA - 1-100+30%.SRCX

Designed by DM
 Checked by PWJL

Micro Drainage

Source Control 2018.1.1

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

Half Drain Time : 2 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m ³) | Status |
|----------------------|---------------|---------------|------------------------|------------------------------|-------------------|
| 15 min Summer | 9.810 | 0.310 | 3.1 | 0.4 | Flood Risk |
| 30 min Summer | 9.852 | 0.352 | 3.3 | 0.5 | Flood Risk |
| 60 min Summer | 9.792 | 0.292 | 3.0 | 0.4 | Flood Risk |
| 120 min Summer | 9.655 | 0.155 | 2.5 | 0.2 | O K |
| 180 min Summer | 9.566 | 0.066 | 2.1 | 0.1 | O K |
| 240 min Summer | 9.545 | 0.045 | 1.8 | 0.1 | O K |
| 360 min Summer | 9.534 | 0.034 | 1.4 | 0.0 | O K |
| 480 min Summer | 9.529 | 0.029 | 1.2 | 0.0 | O K |
| 600 min Summer | 9.525 | 0.025 | 1.0 | 0.0 | O K |
| 720 min Summer | 9.522 | 0.022 | 0.9 | 0.0 | O K |
| 960 min Summer | 9.518 | 0.018 | 0.7 | 0.0 | O K |
| 1440 min Summer | 9.513 | 0.013 | 0.5 | 0.0 | O K |
| 2160 min Summer | 9.510 | 0.010 | 0.4 | 0.0 | O K |
| 2880 min Summer | 9.508 | 0.008 | 0.3 | 0.0 | O K |
| 4320 min Summer | 9.506 | 0.006 | 0.3 | 0.0 | O K |
| 5760 min Summer | 9.505 | 0.005 | 0.2 | 0.0 | O K |
| 7200 min Summer | 9.505 | 0.005 | 0.2 | 0.0 | O K |
| 8640 min Summer | 9.504 | 0.004 | 0.2 | 0.0 | O K |
| 10080 min Summer | 9.504 | 0.004 | 0.2 | 0.0 | O K |
| 15 min Winter | 9.866 | 0.366 | 3.3 | 0.5 | Flood Risk |
| 30 min Winter | 9.866 | 0.366 | 3.3 | 0.5 | Flood Risk |
| 60 min Winter | 9.741 | 0.241 | 2.8 | 0.3 | Flood Risk |
| 120 min Winter | 9.563 | 0.063 | 2.1 | 0.1 | O K |
| 180 min Winter | 9.541 | 0.041 | 1.7 | 0.1 | O K |
| 240 min Winter | 9.533 | 0.033 | 1.4 | 0.0 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m ³) | Time-Peak (mins) |
|----------------------|---------------|----------------------------------|------------------|
| 15 min Summer | 98.906 | 0.0 | 15 |
| 30 min Summer | 69.761 | 0.0 | 22 |
| 60 min Summer | 47.182 | 0.0 | 38 |
| 120 min Summer | 30.784 | 0.0 | 68 |
| 180 min Summer | 23.535 | 0.0 | 96 |
| 240 min Summer | 19.259 | 0.0 | 124 |
| 360 min Summer | 14.533 | 0.0 | 186 |
| 480 min Summer | 11.875 | 0.0 | 244 |
| 600 min Summer | 10.140 | 0.0 | 302 |
| 720 min Summer | 8.906 | 0.0 | 364 |
| 960 min Summer | 7.246 | 0.0 | 482 |
| 1440 min Summer | 5.403 | 0.0 | 720 |
| 2160 min Summer | 4.015 | 0.0 | 1072 |
| 2880 min Summer | 3.245 | 0.0 | 1416 |
| 4320 min Summer | 2.407 | 0.0 | 2164 |
| 5760 min Summer | 1.949 | 0.0 | 2952 |
| 7200 min Summer | 1.655 | 0.0 | 3568 |
| 8640 min Summer | 1.450 | 0.0 | 4344 |
| 10080 min Summer | 1.297 | 0.0 | 5232 |
| 15 min Winter | 98.906 | 0.0 | 15 |
| 30 min Winter | 69.761 | 0.0 | 22 |
| 60 min Winter | 47.182 | 0.0 | 38 |
| 120 min Winter | 30.784 | 0.0 | 66 |
| 180 min Winter | 23.535 | 0.0 | 92 |
| 240 min Winter | 19.259 | 0.0 | 128 |

Ty Mansel 6 Mansel Street
 Carmarthen
 Wales SA31 1PX

Residential development at
 Parc Maen Hir, Letterston,
 Pembrokeshire SA62 5AQ



Date 23/11/2018 11:18
 File Plot SA - 1-100+30%.SRCX

Designed by DM
 Checked by PWJL

Micro Drainage

Source Control 2018.1.1

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m ³) | Status |
|------------------|---------------|---------------|------------------------|------------------------------|--------|
| 360 min Winter | 9.526 | 0.026 | 1.0 | 0.0 | O K |
| 480 min Winter | 9.521 | 0.021 | 0.8 | 0.0 | O K |
| 600 min Winter | 9.518 | 0.018 | 0.7 | 0.0 | O K |
| 720 min Winter | 9.516 | 0.016 | 0.6 | 0.0 | O K |
| 960 min Winter | 9.513 | 0.013 | 0.5 | 0.0 | O K |
| 1440 min Winter | 9.510 | 0.010 | 0.4 | 0.0 | O K |
| 2160 min Winter | 9.507 | 0.007 | 0.3 | 0.0 | O K |
| 2880 min Winter | 9.506 | 0.006 | 0.3 | 0.0 | O K |
| 4320 min Winter | 9.505 | 0.005 | 0.2 | 0.0 | O K |
| 5760 min Winter | 9.504 | 0.004 | 0.2 | 0.0 | O K |
| 7200 min Winter | 9.504 | 0.004 | 0.2 | 0.0 | O K |
| 8640 min Winter | 9.503 | 0.003 | 0.1 | 0.0 | O K |
| 10080 min Winter | 9.503 | 0.003 | 0.1 | 0.0 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m ³) | Time-Peak (mins) |
|------------------|--------------|----------------------------------|------------------|
| 360 min Winter | 14.533 | 0.0 | 188 |
| 480 min Winter | 11.875 | 0.0 | 242 |
| 600 min Winter | 10.140 | 0.0 | 302 |
| 720 min Winter | 8.906 | 0.0 | 356 |
| 960 min Winter | 7.246 | 0.0 | 480 |
| 1440 min Winter | 5.403 | 0.0 | 722 |
| 2160 min Winter | 4.015 | 0.0 | 1052 |
| 2880 min Winter | 3.245 | 0.0 | 1472 |
| 4320 min Winter | 2.407 | 0.0 | 2220 |
| 5760 min Winter | 1.949 | 0.0 | 2840 |
| 7200 min Winter | 1.655 | 0.0 | 3648 |
| 8640 min Winter | 1.450 | 0.0 | 4032 |
| 10080 min Winter | 1.297 | 0.0 | 4720 |

Ty Mansel 6 Mansel Street
Carmarthen
Wales SA31 1PX

Residential development at
Parc Maen Hir, Letterston,
Pembrokeshire SA62 5AQ



Date 23/11/2018 11:18
File Plot SA - 1-100+30%.SRCX

Designed by DM
Checked by PWJL

Micro Drainage

Source Control 2018.1.1

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) | 18.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.265 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +30 |

Time Area Diagram

Total Area (ha) 0.012

| Time (mins) | Area | Time (mins) | Area |
|--------------------|-------------|--------------------|-------------|
| From: To: | (ha) | From: To: | (ha) |
| 0 | 4 0.006 | 4 | 8 0.006 |

Ty Mansel 6 Mansel Street
Carmarthen
Wales SA31 1PX

Residential development at
Parc Maen Hir, Letterston,
Pembrokeshire SA62 5AQ



Date 23/11/2018 11:18
File Plot SA - 1-100+30%.SRCX

Designed by DM
Checked by PWJL

Micro Drainage

Source Control 2018.1.1

Model Details

Storage is Online Cover Level (m) 10.000

Lined Soakaway Structure

| | | | |
|--------------------------------------|---------|----------------------------|-------|
| Infiltration Coefficient Base (m/hr) | 4.06800 | Ring Diameter (m) | 0.90 |
| Infiltration Coefficient Side (m/hr) | 4.06800 | Pit Multiplier | 2.0 |
| Safety Factor | 2.0 | Number Required | 1 |
| Porosity | 0.30 | Cap Volume Depth (m) | 0.000 |
| Invert Level (m) | 9.500 | Cap Infiltration Depth (m) | 0.500 |

Ty Mansel 6 Mansel Street
 Carmarthen
 Wales SA31 1PX

Residential development at
 Parc Maen Hir, Letterston,
 Pembrokeshire SA62 5AQ



Date 23/11/2018 11:20
 File Plot Cell SA - 1-100+30%.SRCX

Designed by DM
 Checked by PWJL

Micro Drainage

Source Control 2018.1.1

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

Half Drain Time : 346 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m ³) | Status |
|------------------|---------------|---------------|------------------------|------------------------------|------------|
| 15 min Summer | 9.433 | 0.233 | 0.1 | 1.8 | O K |
| 30 min Summer | 9.523 | 0.323 | 0.1 | 2.5 | O K |
| 60 min Summer | 9.623 | 0.423 | 0.1 | 3.2 | O K |
| 120 min Summer | 9.719 | 0.519 | 0.1 | 3.9 | Flood Risk |
| 180 min Summer | 9.761 | 0.561 | 0.1 | 4.3 | Flood Risk |
| 240 min Summer | 9.777 | 0.577 | 0.1 | 4.4 | Flood Risk |
| 360 min Summer | 9.793 | 0.593 | 0.1 | 4.5 | Flood Risk |
| 480 min Summer | 9.798 | 0.598 | 0.1 | 4.5 | Flood Risk |
| 600 min Summer | 9.798 | 0.598 | 0.1 | 4.5 | Flood Risk |
| 720 min Summer | 9.793 | 0.593 | 0.1 | 4.5 | Flood Risk |
| 960 min Summer | 9.779 | 0.579 | 0.1 | 4.4 | Flood Risk |
| 1440 min Summer | 9.743 | 0.543 | 0.1 | 4.1 | Flood Risk |
| 2160 min Summer | 9.685 | 0.485 | 0.1 | 3.7 | O K |
| 2880 min Summer | 9.631 | 0.431 | 0.1 | 3.3 | O K |
| 4320 min Summer | 9.539 | 0.339 | 0.1 | 2.6 | O K |
| 5760 min Summer | 9.466 | 0.266 | 0.1 | 2.0 | O K |
| 7200 min Summer | 9.408 | 0.208 | 0.1 | 1.6 | O K |
| 8640 min Summer | 9.362 | 0.162 | 0.1 | 1.2 | O K |
| 10080 min Summer | 9.325 | 0.125 | 0.1 | 1.0 | O K |
| 15 min Winter | 9.462 | 0.262 | 0.1 | 2.0 | O K |
| 30 min Winter | 9.564 | 0.364 | 0.1 | 2.8 | O K |
| 60 min Winter | 9.678 | 0.478 | 0.1 | 3.6 | O K |
| 120 min Winter | 9.790 | 0.590 | 0.1 | 4.5 | Flood Risk |
| 180 min Winter | 9.841 | 0.641 | 0.1 | 4.9 | Flood Risk |
| 240 min Winter | 9.864 | 0.664 | 0.1 | 5.0 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m ³) | Time-Peak (mins) |
|------------------|--------------|----------------------------------|------------------|
| 15 min Summer | 98.906 | 0.0 | 22 |
| 30 min Summer | 69.761 | 0.0 | 36 |
| 60 min Summer | 47.182 | 0.0 | 66 |
| 120 min Summer | 30.784 | 0.0 | 124 |
| 180 min Summer | 23.535 | 0.0 | 182 |
| 240 min Summer | 19.259 | 0.0 | 238 |
| 360 min Summer | 14.533 | 0.0 | 294 |
| 480 min Summer | 11.875 | 0.0 | 360 |
| 600 min Summer | 10.140 | 0.0 | 426 |
| 720 min Summer | 8.906 | 0.0 | 496 |
| 960 min Summer | 7.246 | 0.0 | 636 |
| 1440 min Summer | 5.403 | 0.0 | 912 |
| 2160 min Summer | 4.015 | 0.0 | 1320 |
| 2880 min Summer | 3.245 | 0.0 | 1704 |
| 4320 min Summer | 2.407 | 0.0 | 2468 |
| 5760 min Summer | 1.949 | 0.0 | 3224 |
| 7200 min Summer | 1.655 | 0.0 | 3960 |
| 8640 min Summer | 1.450 | 0.0 | 4664 |
| 10080 min Summer | 1.297 | 0.0 | 5344 |
| 15 min Winter | 98.906 | 0.0 | 22 |
| 30 min Winter | 69.761 | 0.0 | 36 |
| 60 min Winter | 47.182 | 0.0 | 64 |
| 120 min Winter | 30.784 | 0.0 | 122 |
| 180 min Winter | 23.535 | 0.0 | 178 |
| 240 min Winter | 19.259 | 0.0 | 234 |

Ty Mansel 6 Mansel Street
 Carmarthen
 Wales SA31 1PX

Residential development at
 Parc Maen Hir, Letterston,
 Pembrokeshire SA62 5AQ



Date 23/11/2018 11:20
 File Plot Cell SA - 1-100+30%.SRCX

Designed by DM
 Checked by PWJL

Micro Drainage

Source Control 2018.1.1

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m ³) | Status |
|------------------|---------------|---------------|------------------------|------------------------------|------------|
| 360 min Winter | 9.881 | 0.681 | 0.1 | 5.2 | Flood Risk |
| 480 min Winter | 9.886 | 0.686 | 0.1 | 5.2 | Flood Risk |
| 600 min Winter | 9.884 | 0.684 | 0.1 | 5.2 | Flood Risk |
| 720 min Winter | 9.876 | 0.676 | 0.1 | 5.1 | Flood Risk |
| 960 min Winter | 9.852 | 0.652 | 0.1 | 5.0 | Flood Risk |
| 1440 min Winter | 9.793 | 0.593 | 0.1 | 4.5 | Flood Risk |
| 2160 min Winter | 9.704 | 0.504 | 0.1 | 3.8 | Flood Risk |
| 2880 min Winter | 9.624 | 0.424 | 0.1 | 3.2 | O K |
| 4320 min Winter | 9.495 | 0.295 | 0.1 | 2.2 | O K |
| 5760 min Winter | 9.400 | 0.200 | 0.1 | 1.5 | O K |
| 7200 min Winter | 9.328 | 0.128 | 0.1 | 1.0 | O K |
| 8640 min Winter | 9.276 | 0.076 | 0.1 | 0.6 | O K |
| 10080 min Winter | 9.250 | 0.050 | 0.1 | 0.4 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m ³) | Time-Peak (mins) |
|------------------|--------------|----------------------------------|------------------|
| 360 min Winter | 14.533 | 0.0 | 334 |
| 480 min Winter | 11.875 | 0.0 | 378 |
| 600 min Winter | 10.140 | 0.0 | 456 |
| 720 min Winter | 8.906 | 0.0 | 534 |
| 960 min Winter | 7.246 | 0.0 | 686 |
| 1440 min Winter | 5.403 | 0.0 | 984 |
| 2160 min Winter | 4.015 | 0.0 | 1408 |
| 2880 min Winter | 3.245 | 0.0 | 1816 |
| 4320 min Winter | 2.407 | 0.0 | 2596 |
| 5760 min Winter | 1.949 | 0.0 | 3344 |
| 7200 min Winter | 1.655 | 0.0 | 4032 |
| 8640 min Winter | 1.450 | 0.0 | 4672 |
| 10080 min Winter | 1.297 | 0.0 | 5104 |

Ty Mansel 6 Mansel Street
 Carmarthen
 Wales SA31 1PX

Residential development at
 Parc Maen Hir, Letterston,
 Pembrokeshire SA62 5AQ



Date 23/11/2018 11:20
 File Plot Cell SA - 1-100+30%.SRCX

Designed by DM
 Checked by PWJL

Micro Drainage

Source Control 2018.1.1

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) | 18.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.265 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +30 |

Time Area Diagram

Total Area (ha) 0.010

| Time (mins) | Area | Time (mins) | Area |
|--------------------|-------------|--------------------|-------------|
| From: To: | (ha) | From: To: | (ha) |
| 0 | 4 0.005 | 4 | 8 0.005 |

Ty Mansel 6 Mansel Street
Carmarthen
Wales SA31 1PX

Residential development at
Parc Maen Hir, Letterston,
Pembrokeshire SA62 5AQ



Date 23/11/2018 11:20
File Plot Cell SA - 1-100+30%.SRCX

Designed by DM
Checked by PWJL

Micro Drainage

Source Control 2018.1.1

Model Details

Storage is Online Cover Level (m) 10.000

Cellular Storage Structure

Invert Level (m) 9.200 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.06444 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.06444

| Depth (m) | Area (m ²) | Inf. Area (m ²) | Depth (m) | Area (m ²) | Inf. Area (m ²) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000 | 8.0 | 8.0 | 0.900 | 0.0 | 17.6 |
| 0.800 | 8.0 | 17.6 | | | |

Ty Mansel 6 Mansel Street
 Carmarthen
 Wales SA31 1PX

Residential development at
 Parc Maen Hir, Letterston,
 Pembrokeshire SA62 5AQ



Date 16/05/2019 15:59
 File HIGHWAY SA AND BASIN - 1-100+30%...

Designed by DM
 Checked by PWJL

Micro Drainage

Source Control 2018.1.1

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

Half Drain Time : 463 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (1/s) | Max Volume (m ³) | Status |
|------------------|---------------|---------------|------------------------|------------------------------|------------|
| 15 min Summer | 8.794 | 0.394 | 0.6 | 20.6 | O K |
| 30 min Summer | 8.953 | 0.553 | 0.7 | 28.9 | O K |
| 60 min Summer | 9.137 | 0.737 | 0.7 | 38.5 | O K |
| 120 min Summer | 9.572 | 1.172 | 1.5 | 47.2 | O K |
| 180 min Summer | 9.620 | 1.220 | 1.5 | 51.2 | O K |
| 240 min Summer | 9.641 | 1.241 | 1.5 | 53.1 | O K |
| 360 min Summer | 9.667 | 1.267 | 1.6 | 55.4 | O K |
| 480 min Summer | 9.681 | 1.281 | 1.6 | 56.7 | O K |
| 600 min Summer | 9.688 | 1.288 | 1.6 | 57.4 | O K |
| 720 min Summer | 9.691 | 1.291 | 1.6 | 57.6 | O K |
| 960 min Summer | 9.687 | 1.287 | 1.6 | 57.3 | O K |
| 1440 min Summer | 9.666 | 1.266 | 1.6 | 55.3 | O K |
| 2160 min Summer | 9.626 | 1.226 | 1.5 | 51.7 | O K |
| 2880 min Summer | 9.589 | 1.189 | 1.5 | 48.6 | O K |
| 4320 min Summer | 9.544 | 1.144 | 1.3 | 45.1 | O K |
| 5760 min Summer | 9.524 | 1.124 | 1.0 | 43.5 | O K |
| 7200 min Summer | 9.501 | 1.101 | 0.7 | 41.9 | O K |
| 8640 min Summer | 9.116 | 0.716 | 0.7 | 37.4 | O K |
| 10080 min Summer | 9.038 | 0.638 | 0.7 | 33.3 | O K |
| 15 min Winter | 8.843 | 0.443 | 0.6 | 23.1 | O K |
| 30 min Winter | 9.022 | 0.622 | 0.7 | 32.5 | O K |
| 60 min Winter | 9.520 | 1.120 | 1.0 | 43.2 | O K |
| 120 min Winter | 9.642 | 1.242 | 1.5 | 53.2 | O K |
| 180 min Winter | 9.697 | 1.297 | 1.6 | 58.2 | O K |
| 240 min Winter | 9.723 | 1.323 | 1.6 | 60.8 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m ³) | Time-Peak (mins) |
|------------------|--------------|----------------------------------|------------------|
| 15 min Summer | 98.769 | 0.0 | 26 |
| 30 min Summer | 69.713 | 0.0 | 41 |
| 60 min Summer | 47.182 | 0.0 | 70 |
| 120 min Summer | 30.804 | 0.0 | 124 |
| 180 min Summer | 23.556 | 0.0 | 182 |
| 240 min Summer | 19.281 | 0.0 | 240 |
| 360 min Summer | 14.554 | 0.0 | 296 |
| 480 min Summer | 11.895 | 0.0 | 360 |
| 600 min Summer | 10.159 | 0.0 | 426 |
| 720 min Summer | 8.923 | 0.0 | 496 |
| 960 min Summer | 7.262 | 0.0 | 634 |
| 1440 min Summer | 5.416 | 0.0 | 908 |
| 2160 min Summer | 4.025 | 0.0 | 1304 |
| 2880 min Summer | 3.254 | 0.0 | 1684 |
| 4320 min Summer | 2.415 | 0.0 | 2432 |
| 5760 min Summer | 1.956 | 0.0 | 3288 |
| 7200 min Summer | 1.662 | 0.0 | 4248 |
| 8640 min Summer | 1.455 | 0.0 | 5016 |
| 10080 min Summer | 1.302 | 0.0 | 5752 |
| 15 min Winter | 98.769 | 0.0 | 26 |
| 30 min Winter | 69.713 | 0.0 | 40 |
| 60 min Winter | 47.182 | 0.0 | 68 |
| 120 min Winter | 30.804 | 0.0 | 124 |
| 180 min Winter | 23.556 | 0.0 | 180 |
| 240 min Winter | 19.281 | 0.0 | 234 |

Ty Mansel 6 Mansel Street
 Carmarthen
 Wales SA31 1PX

Residential development at
 Parc Maen Hir, Letterston,
 Pembrokeshire SA62 5AQ



Date 16/05/2019 15:59
 File HIGHWAY SA AND BASIN - 1-100+30%...

Designed by DM
 Checked by PWJL

Micro Drainage

Source Control 2018.1.1

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m ³) | Status |
|------------------|---------------|---------------|------------------------|------------------------------|------------|
| 360 min Winter | 9.748 | 1.348 | 1.7 | 63.3 | Flood Risk |
| 480 min Winter | 9.761 | 1.361 | 1.7 | 64.7 | Flood Risk |
| 600 min Winter | 9.766 | 1.366 | 1.7 | 65.3 | Flood Risk |
| 720 min Winter | 9.767 | 1.367 | 1.7 | 65.3 | Flood Risk |
| 960 min Winter | 9.758 | 1.358 | 1.7 | 64.4 | Flood Risk |
| 1440 min Winter | 9.723 | 1.323 | 1.6 | 60.8 | Flood Risk |
| 2160 min Winter | 9.660 | 1.260 | 1.6 | 54.8 | O K |
| 2880 min Winter | 9.604 | 1.204 | 1.5 | 49.9 | O K |
| 4320 min Winter | 9.544 | 1.144 | 1.3 | 45.0 | O K |
| 5760 min Winter | 9.521 | 1.121 | 1.0 | 43.3 | O K |
| 7200 min Winter | 9.165 | 0.765 | 0.7 | 40.0 | O K |
| 8640 min Winter | 9.042 | 0.642 | 0.7 | 33.6 | O K |
| 10080 min Winter | 8.935 | 0.535 | 0.6 | 27.9 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m ³) | Time-Peak (mins) |
|------------------|--------------|----------------------------------|------------------|
| 360 min Winter | 14.554 | 0.0 | 334 |
| 480 min Winter | 11.895 | 0.0 | 380 |
| 600 min Winter | 10.159 | 0.0 | 456 |
| 720 min Winter | 8.923 | 0.0 | 534 |
| 960 min Winter | 7.262 | 0.0 | 684 |
| 1440 min Winter | 5.416 | 0.0 | 974 |
| 2160 min Winter | 4.025 | 0.0 | 1388 |
| 2880 min Winter | 3.254 | 0.0 | 1764 |
| 4320 min Winter | 2.415 | 0.0 | 2508 |
| 5760 min Winter | 1.956 | 0.0 | 3408 |
| 7200 min Winter | 1.662 | 0.0 | 4480 |
| 8640 min Winter | 1.455 | 0.0 | 5280 |
| 10080 min Winter | 1.302 | 0.0 | 6048 |

Ty Mansel 6 Mansel Street
 Carmarthen
 Wales SA31 1PX

Residential development at
 Parc Maen Hir, Letterston,
 Pembrokeshire SA62 5AQ



Date 16/05/2019 15:59
 File HIGHWAY SA AND BASIN - 1-100+30%...

Designed by DM
 Checked by PWJL

Micro Drainage

Source Control 2018.1.1

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) | 18.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.264 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +30 |

Time Area Diagram

Total Area (ha) 0.115

| Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|-------------|-----------|-------------|-----------|-------------|-----------|
| From: | To: | From: | To: | From: | To: |
| 0 | 4 | 4 | 8 | 8 | 12 |
| | 0.038 | | 0.038 | | 0.039 |

Ty Mansel 6 Mansel Street
Carmarthen
Wales SA31 1PX

Residential development at
Parc Maen Hir, Letterston,
Pembrokeshire SA62 5AQ



Date 16/05/2019 15:59
File HIGHWAY SA AND BASIN - 1-100+30%...

Designed by DM
Checked by PWJL

Micro Drainage

Source Control 2018.1.1

Model Details

Storage is Online Cover Level (m) 10.000

Complex Structure

Cellular Storage

Invert Level (m) 8.400 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.06444 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.06444

| Depth (m) | Area (m ²) | Inf. Area (m ²) | Depth (m) | Area (m ²) | Inf. Area (m ²) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000 | 55.0 | 55.0 | 0.801 | 0.0 | 80.6 |
| 0.800 | 55.0 | 80.6 | | | |

Infiltration Basin

Invert Level (m) 9.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.06444 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m ²) | Depth (m) | Area (m ²) | Depth (m) | Area (m ²) |
|-----------|------------------------|-----------|------------------------|-----------|------------------------|
| 0.000 | 71.0 | 0.500 | 143.3 | 0.501 | 143.5 |

Appendix H - Drainage Strategy Site Plan

PLOT SURFACE WATER DRAINAGE STRATEGY
 PLOT SURFACE WATER DISPOSAL TO TAKE THE FORM OF EITHER LINED SOAKAWAYS OR GEOCELLULAR UNIT SOAKAWAYS DUE TO VARYING INFILTRATION RATES ACROSS SITE - WHERE GROUND IS INDICATIVE OF GOOD INFILTRATION RATES USE LINED SOAKAWAYS (RESULTS IN REGION OF 1×10^{-3} m/s) OTHERWISE USE CELLULAR UNITS - ALLOW FOR CATCHPIT CHAMBER IMMEDIATELY UPSTREAM OF SOAKAWAY

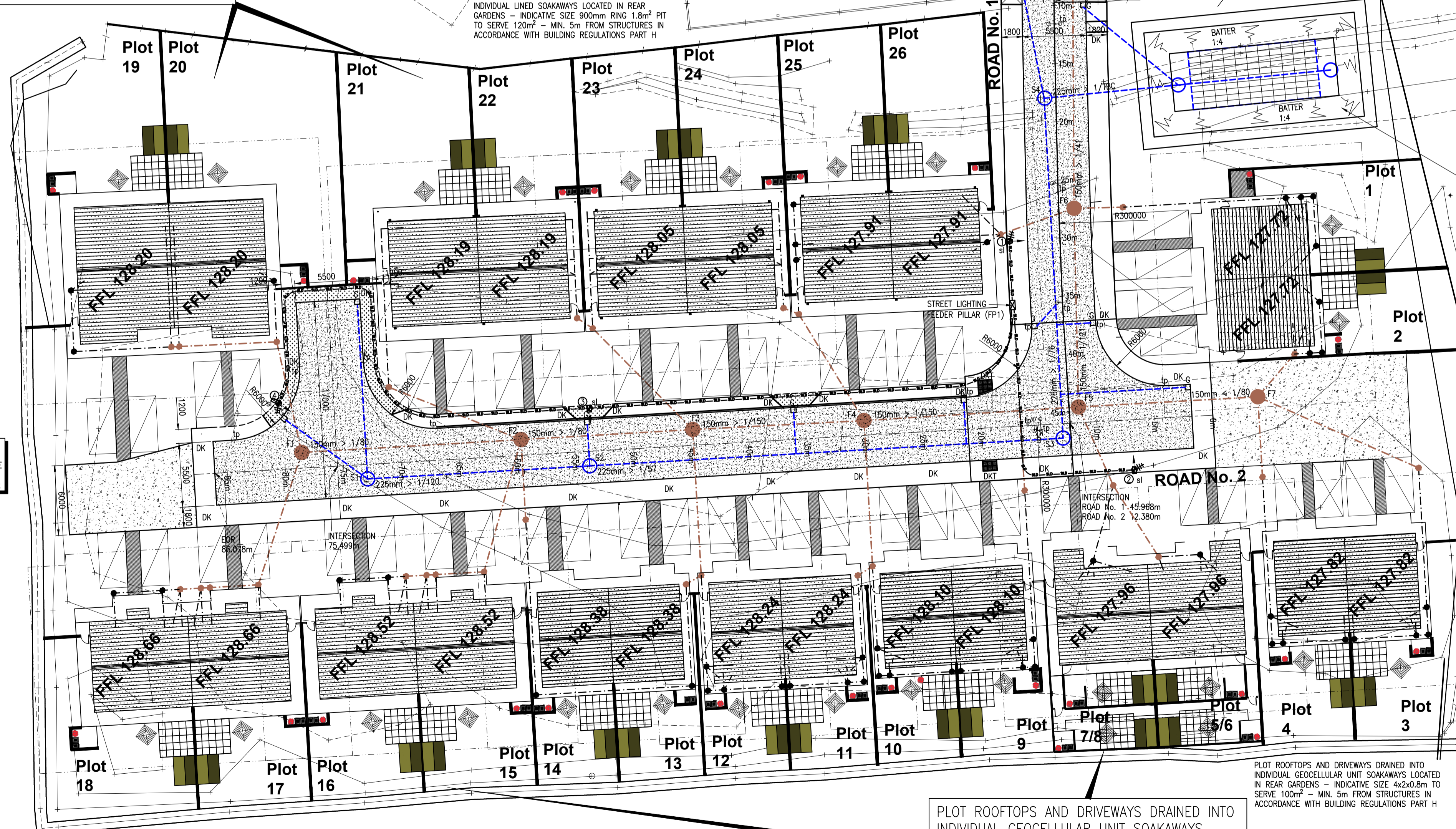
ALL FOUL WATER ONLY FLOWS FROM DEVELOPMENT TO DRAIN INTO EXISTING DCWW PUBLIC SEWER LOCATED IN PARC MAEN HIR - ALLOW FOR S.106 APPLICATION TO DCWW UPON COMPLETION OF S.104

HIGHWAY SURFACE WATER RUNOFF TO DRAIN INTO 11x5x0.8m DEEP GEOCELLULAR UNIT SOAKAWAY - SIZE BASED ON PERCOLATION RATE FROM TP1 (1.79×10^{-5} m/s) - ALLOW FOR INFILTRATION TESTING AT FORMATION LEVEL OF SOAKAWAY TO VERIFY DESIGN

PLOT ROOFTOPS AND DRIVEWAYS DRAINED INTO INDIVIDUAL LINED SOAKAWAYS LOCATED IN REAR GARDENS - INDICATIVE SIZE 900mm RING 1.8m² PIT TO SERVE 120m² - MIN. 5m FROM STRUCTURES IN ACCORDANCE WITH BUILDING REGULATIONS PART H

PLOT ROOFTOPS AND DRIVEWAYS DRAINED INTO INDIVIDUAL LINED SOAKAWAYS LOCATED IN REAR GARDENS - INDICATIVE SIZE 900mm RING 1.8m² PIT TO SERVE 120m² - MIN. 5m FROM STRUCTURES IN ACCORDANCE WITH BUILDING REGULATIONS PART H

EXISTING STREET LIGHTING COLUMN - ASSUMED TO BE AXA CLEAR P 5079 - TO BE CONFIRMED BY PCO AS PART OF APPROVAL OF STREET LIGHTING DESIGN



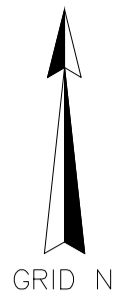
ALL PLOT AND PRIVATE DRIVEWAYS TO BE CONSTRUCTED FROM POROUS/PERMEABLE MATERIAL (E.G. POROUS TARMAC OR PERMEABLE PAVING) WITH OVERFLOW FACILITY TO PLOT DRAINAGE INCLUDING DISCHARGE TO SOAKAWAYS

ALL PLOT AND PRIVATE DRIVEWAYS TO BE CONSTRUCTED FROM POROUS/PERMEABLE MATERIAL (E.G. POROUS TARMAC OR PERMEABLE PAVING) WITH OVERFLOW FACILITY TO PLOT DRAINAGE INCLUDING DISCHARGE TO SOAKAWAYS

PLOT ROOFTOPS AND DRIVEWAYS DRAINED INTO INDIVIDUAL GEOCELLULAR UNIT SOAKAWAYS LOCATED IN REAR GARDENS - INDICATIVE SIZE 4x2x0.8m TO SERVE 100m² - MIN. 5m FROM STRUCTURES IN ACCORDANCE WITH BUILDING REGULATIONS PART H

PLOT ROOFTOPS AND DRIVEWAYS DRAINED INTO INDIVIDUAL GEOCELLULAR UNIT SOAKAWAYS LOCATED IN REAR GARDENS - INDICATIVE SIZE 4x2x0.8m TO SERVE 100m² - MIN. 5m FROM STRUCTURES IN ACCORDANCE WITH BUILDING REGULATIONS PART H

PLOT ROOFTOPS AND DRIVEWAYS DRAINED INTO INDIVIDUAL GEOCELLULAR UNIT SOAKAWAYS LOCATED IN REAR GARDENS - INDICATIVE SIZE 4x2x0.8m TO SERVE 100m² - MIN. 5m FROM STRUCTURES IN ACCORDANCE WITH BUILDING REGULATIONS PART H



NOTES:

THE PROPERTY OF THIS DRAWING AND DESIGN IS VESTED IN ROGER CASEY ASSOCIATES AND MUST NOT BE COPIED OR REPRODUCED IN ANY WAY WITHOUT THE WRITTEN CONSENT OF ROGER CASEY ASSOCIATES.

THE CONTRACTOR IS TO CHECK ALL LEVELS AND DIMENSIONS BEFORE WORK COMMENCES, AND ANY DISCREPANCIES TO BE REPORTED IMMEDIATELY TO THE CONSULTANTS.

WORK TO FIGURED DIMENSIONS IN PREFERENCE TO SCALING.

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER ROGER CASEY ASSOCIATES DRAWINGS AND SPECIFICATIONS AND ALL OTHER CONSULTANTS DRAWINGS AND SPECIFICATIONS RELATING TO THIS PROJECT.

| | | | |
|-----|--|----------|----|
| REV | DESCRIPTION | DATE | BY |
| A | DESIGN PROGRESSED FOLLOWING UPDATED ARCHITECTURAL LAYOUT | 16/05/19 | DM |

DRAWING STATUS: PLANNING



Ty Mansel, 6 Mansel Street, Carmarthen, Carmarthenshire SA31 1PX

T: 01267 222 646

Units 10 & 11, Merlin's Court, Winch Lane, Haverfordwest, Pembrokeshire SA61 1SB

T: 01437 762 795

Consulting Civil & Structural Engineers

E: office@rca-eng.co.uk

W: www.rca-eng.co.uk

CLIENT: ateb group limited

ARCHITECT: LEWIS PARTNERSHIP LLANELLI

PROJECT: RESIDENTIAL DEVELOPMENT AT PARC MAEN HIR, LETTERSTON, HAVERFORDWEST SA62 5AW

DRAWING TITLE: DRAINAGE STRATEGY SITE PLAN

| | | | |
|---------------|----------------------|------------------|------------------|
| DRAWN BY: DM | DESIGN BY: DM | CHECKED BY: PWJL | DATE: 16/05/2019 |
| SCALES: 1:250 | DRAWING No: 20057/DS | REVISION: A | |

FILE NAME: 1840-02D_03D-proposed layout (overlay).dwg
 DATE RECEIVED: 31/10/2018
 INSERTED BY: DM

ORIGINAL DRAWING A1
 © Roger Casey Associates Limited 2019