
Notes



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3. This drawing should be read in conjunction with all other relevant drawings and specifications.

## SURVEY KEY

| | | | |
|---|---|---|---|
| AV | AIR VALVE | LB | LETTER BOX |
| BL | BOLLARD | LP | LAMP POST |
| BM | BENCH MARK | L/L | LARCH LAP |
| BN | BEACON | MC | MULTI DIRTH |
| BS | BUS STOP SIGN | MH | MANHOLE |
| BT | BRITISH TELECOM COVER | MK | MARKER POST |
| B/W | BARBED WIRE | MW | MONITORING WELL |
| CB | CONTROL BOX | NP | NAME PLATE |
| CCTV | CLOSED CIRCUIT TV | OH | OAK |
| CL | COVER LEVEL | P/WM | POST AND WIRE MESH |
| C/I | CORRUGATED IRON | P/R | POST AND RAIL |
| C/L | CHAIN LINK | P/W | POST AND WIRE |
| CONC | CONCRETE | RE | RODDING EYE |
| CPS | CONCRETE PAVING SLABS | RS | ROAD SIGN |
| COL | COLUMN | RW | RETAINING WALL |
| C/B | CLOSE BOARDED | SC | STOP COCK |
| CNP | CHESTNUT PALING | SF | SOFFIT LEVEL |
| C/P | CONCRETE PANEL | SP | SIGN POST |
| CTV | CABLE TV | S/R | STEEL RAILING |
| D | TRUNK DIAMETER | ST | STUMP |
| DP | DOWN PIPE | SV | STOP VALVE |
| DPC | DAMP PROOF COURSE | SW | SURFACE WATER |
| EB | ELECTRICITY BOX | TACT | TACTILE PAVING |
| EC | ELECTRICITY COVER | TC | TOP OF CUT |
| EP | ELECTRICITY POLE | TL | TRAFFIC LIGHT |
| ER | EARTH ROD | TLC | TRAFFIC LIGHT IC COVER |
| FL | FINISHED FLOOR LEVEL | TP | TELEPHONE POLE |
| FH | FIRE HYDRANT | TW | TOP OF WALL LEVEL |
| FW | FOUL WATER | UTL | UNABLE TO LIFT |
| GL | GROUND LIGHT | VC | UNKNOWN VALVE COVER |
| GM | GAS METER | VP | VENT PIPE |
| GP | GATE POST | WCL | WINDOW CILL LEVEL |
| GV | GAS VALVE | WHL | WINDOW HEAD LEVEL |
| GY | GULLY | WL | WATER LEVEL |
| IC | INSPECTION COVER | WM | WATER METER |
| IL | INVERT LEVEL | W/M | WIRE MESH |
| MW | MONITORING WELL | WO | WOOD SLIT VALVE |
| I/R | IRON RAIL | W/P | WOOD PANEL |
| KO | KERB OUTLET | | |

1. UNDERGROUND DRAINAGE INFORMATION HAS BEEN MEASURED FROM SURFACE INSPECTION ONLY AND SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
3. SURVEY GRID & LEVELS RELATED TO ORDNANCE SURVEY NATIONAL GRID. OBTAINED THROUGH REAL TIME GPS OBSERVATIONS. SCALE FACTOR 0.99970 HAS BEEN USED.
4. LEVEL CONTOURS AND 3D TRIANGLES ARE ON FROZEN LAYER.

| Station | Easting | Northing | Level |
|---|---|---|---|
| S1 | 308075.325 | 167982.525 | 70.502 |
| S2 | 308048.739 | 167937.650 | 71.435 |
| S3 | 308037.056 | 167982.090 | 70.041 |
| S4 | 307435.394 | 167437.439 | 63.086 |
| S5 | 307433.675 | 167507.989 | 63.168 |
| S6 | 307433.916 | 167537.928 | 63.451 |
| S7 | 307400.472 | 167542.956 | 63.355 |
| D1 | 307591.011 | 167619.354 | 62.549 |
| D2 | 307751.936 | 167745.308 | 62.229 |
| D3 | 307921.622 | 167852.199 | 67.105 |

| Rev. | Description | By | Ckd | Date |
|---|---|---|---|---|
| A | ORIGINAL DRAWING ISSUE | DJR | AHP | 13:12:18 |

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Client

Project LAND NEAR CARDIFF AIRPORT, MODEL FARM, RHOOSE.

Title TOPOGRAPHICAL SURVEY

| Status | Scale | Date Created |
|---|---|---|
| FINAL | 1:500 @A0 | 13th Dec 2018 |
| Project Leader | Drawn By | Checked by |
| AHP | PMC/JL/DJR | AHP |

| Document Number | Revision | Suitability |
|---|---|---|
| JKK9669 – 06 | A | |
| Project Number | Originator - Zone - Level - Type - Role - Drawing Number | |

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# Appendix C – GI - Infiltration Report

# 1 INTRODUCTION

Legal & General Homes are planning to develop land near Cardiff Airport at Model Farm, Rhoose. RPS undertook a Hydrological Appraisal (HA) fulfilling the requirements of the Planning Policy Wales (PPW) and the Technical Advice Note 15 (TAN15). The HA indicated that SuDS measures would be required to provide an appropriate standard of surface water management taking into account the proposed development type.

This report provides the methodology and results for ground investigation works undertaken to provide factual information for the development of SuDS and soakaways design according to BS 8301. This comprised soakaway testing which was undertaken in accordance with BRE Digest 365 guidance.

The British Geological Survey (BGS) identified the geology underlying the site as Porthkerry Member comprising interbedded limestone and mudstone and Lavernock Shales Member comprising mudstone. Alluvium has also been indicated around the stream in the southwest of the site. The geology reported is indicative of a potentially large variation in the infiltration potential of the site.

# 2 SAMPLING METHODOLOGY

Soakaway infiltration tests were planned for five no locations as indicated on Drawing JER1849-SI-001 (Appendix B). These were undertaken in accordance with Building Research Establishment (BRE) Digest 365 Soakaway Design 2003.

Three tests were planned at each location to gather a representative dataset on the same day or consecutive days. The test duration varied depending on the nature of the substrata.

A subcontractor was used to operate an 8-tonne mini excavator with toothed bucket to excavate the trial pits and operate a tractor and water bowser which was required to fill each trial pit with water. An RPS engineer attended site to undertake the soil logging and infiltration test measurements. Water was released into each trial pit following excavation and filled to ground level before the water level measurements were collected. The water level readings were collected with a combination of manual measure using a tape measure and water level loggers which were corrected for atmospheric pressure using a barometric logger.

The works were undertaken between 9th and 12th April 2019.

# 3 RESULTS

## 3.1 Ground Conditions

Trial pits were excavated to depths of between 0.5 metres below ground level (mbgl) and 2.6 mbgl. Trial pits were typically terminated on refusal due to hard ground.

The general geological strata encountered was as follows:

- Topsoil comprising dark brown slightly sandy silty clay with grass cover with occasional gravel of limestone;
- Firm to very stiff light brown and grey gravelly clay with medium to high cobble content and occasional boulders of mudstone and limestone. Gravel, cobble and boulders are typically grey angular to subrounded stone including limestone and mudstone (0.2 – 2.2 mbgl – trial pits TP1, TP2, TP3, TP5).
- Weak grey and brown mudstone (trial pit TP5 2.1 – 2.3 mbgl) with medium strong to very strong grey limestone (trial pit TP2 at 2.2 – 2.6 mbgl);
- Medium strong to very strong grey limestone (at trial pit TP4 at 0.4 mbgl).

## 3.2 Infiltration Test Results

The results are provided in Appendix A with the summary of results provided in Table 1 below.

There were test failures at two locations (TP2, TP3) indicating very low infiltration rates. Where results were obtained these ranged from 3.86 x $10^{-6}$ metres per second (m/s) (at TP1) to 2.05 x $10^{-5}$ m/s (at TP4).

**Table 1**: **Summary of Infiltration Test Results**

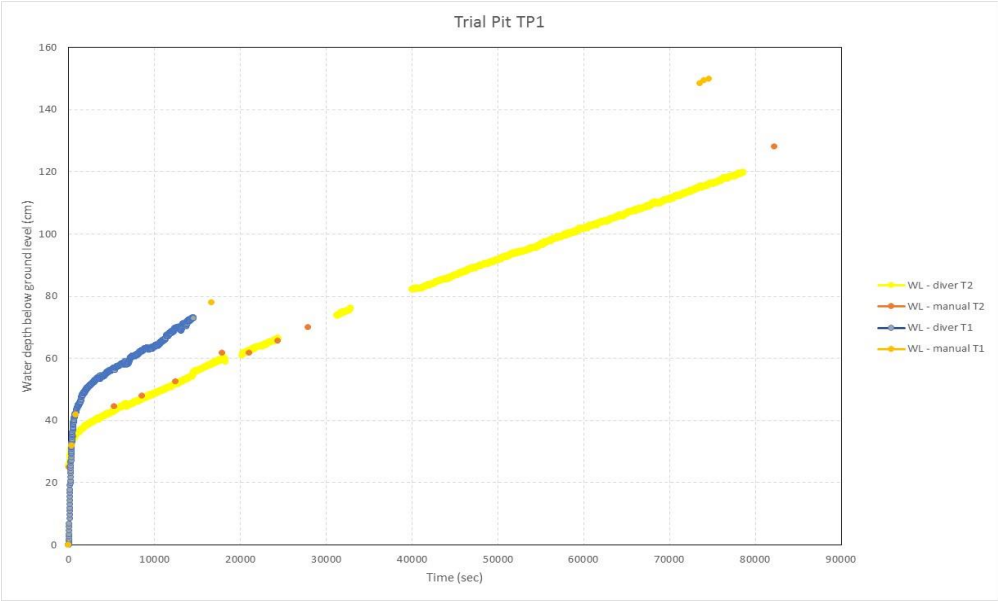
| | Test Depth (m) | Time Taken [$t_{75\%-25\%}$] (hrs) | Infiltration Rate (m/s) | Comments |
|---|---|---|---|---|
| TP1 (Test 1) | 2.0 | 20.14 | 4.37 x $10^{-6}$ | Test completed with all water drained out of trial pit. |
| TP1 (Test 2) | 2.0 | 22.79 | 3.86 x $10^{-6}$ | Trial pit showed collapsed to below 1.3 mbgl at end of second test therefore no further testing was undertaken. For test 2, the test duration was calculated between 36% and 86% of original base of trial pit due to collapse and 25% depth not being reached by falling water level. |
| TP2 | 2.6 | 19.0 | NA (<<5.18 x $10^{-6}$) | Soil infiltration rate could not be calculated. Water level dropped 0.12m in 19.0 hours. Soakaway test failure. No repeat test could be undertaken due to water level. |
| TP3 | 2.0 | 6.4 | NA (<<1.20 x $10^{-5}$) | Soil infiltration rate could not be calculated. Water level dropped 0.071m in 6.4 hours and appeared to stabilise. Soakaway test failure. No repeat test could be undertaken due to water level. |
| TP4 (Test 1) | 0.5 | 1.85 | 2.05 x $10^{-5}$ | Tests completed with all water drained out of trial pit. |
| TP4 (Test 2) | | 1.90 | 1.99 x $10^{-5}$ | |
| TP4 (Test 3) | | 2.47 | 1.54 x $10^{-5}$ | |
| TP5 (Test 1) | 2.3 | 15.30 | 5.66 x $10^{-6}$ | Linear trend line was used to estimate time for water level at 25% effective depth of trial pit. |
| TP5 (Test 2) | | NA | NA | Repeat test was not competed due to trial collapse from 0.3 mbgl to 1.4 mbgl. |

It should be noted that the trial pits were terminated at shallow depths (up to 2.6 mbgl). If penetration further through the bedrock could be achieved, it may indicate a greater variation in permeability with higher permeabilities along bedding or fractures where present.

# Soakaway Test - TP1

**Date:** 9th and 10th April 2019

**Project Name: Model Farm, Rhoose**
**Project No: JER1849**
**Location:** TP1




T = No. of test (e.g T1 = test 1)

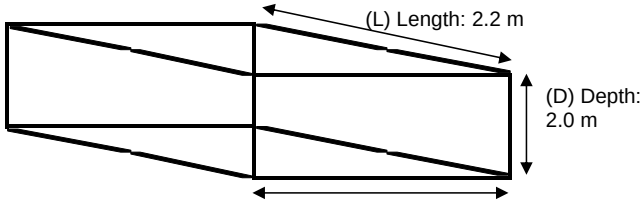
**Test Date**: 9th and 10th April 2019 (T1), 10th April (T2)

**Comments:**

Trial pit showed collapsed to below 1.3 mbgl at end of second test therefore no further testing was undertaken. For test 2, the test duration was calculated between 36% and 86% of original base of trial pit due to collapse and 25% depth not being reached by falling water level.

## Soakaway Description \ Dimensions

| | |
|---|---|
| 0-0.2 mbgl | Dark brown slightly sandy silty CLAY with grass cover. (TOPSOIL) |
| 0.2-2.0 mbgl | Stiff to very stiff light brown and grey gravelly CLAY with medium cobble content and occasional boulders of mudstone and limestone. Cobbles and gravel are grey angular to subrounded stone including limestone and mudstone. Gravel is fine to coarse. |
| 2.0 mbgl | Trial pit terminated due to hard ground. |




Infiltration Rate Calculations

**Effective Depth: $V_{p75}$**

L **x** W **x** D(25% - 75%) **3.5200 m³**

**Mean Surface Area Outflow: $a_{p50}$**

(L x D(25%-75%) x 2) + (W x D(25%-75%) x 2) + (L x W)

**11.1200 m²**

**Test Duration / Outflow time: $t_{p75-25}$** **sec**

| | Test 1 | Test 2 | |
|---|---|---|---|
| **75%** | 2070 | 170 | -86% |
| **25%** | 74580 | 82200 | -36% |
| **Duration** | **72510** | **82030** | |

**Soil Infiltration Rate , *f***

$$\frac{V_{p75}}{a_{p50} \times t_{p75-25}}$$

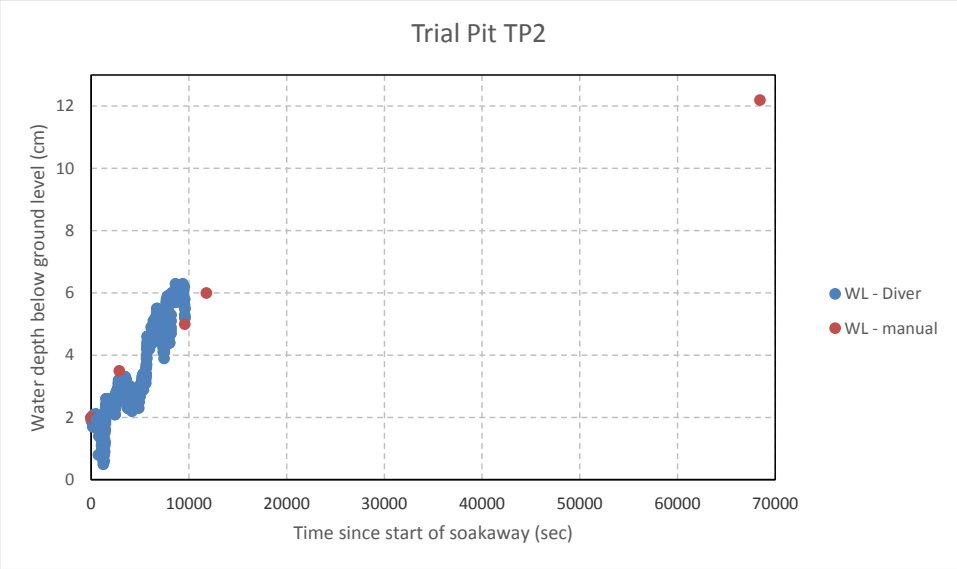
| Test 1 | Test 2 | Test 3 | |
|---|---|---|---|
| **4.37E-06** | **3.86E-06** | **-** | **m/sec** |

(Used $t_{p86-36}$)

# Soakaway Test - TP2

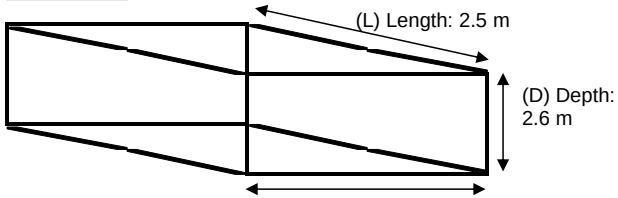
**Date:** 9th and 10th April 2019

**Project Name: Model Farm, Rhoose**
**Project No: JER1849**
**Location:** TP2




## Soakaway Description \ Dimensions

| | |
|---|---|
| 0-0.2 mbgl | Dark brown slightly sandy silty CLAY with grass cover. (TOPSOIL) |
| 0.2-2.2 mbgl | Stiff to very stiff light brown and grey gravelly CLAY with medium to high cobble content and occasional boulders. Gravel, cobble and boulders are grey angular to subrounded stone including limestone and mudstone . Gravel is fine to coarse. |
| 2.2-2.6 mbgl | Weak grey and brown MUDSTONE and medium strong to very strong LIMESTONE with stiff clay bands. Recovered as clayey angular to subangular gravel and cobbles of angular to subrounded limestone and mudstone. |




Infiltration Rate Calculations

**Effective Depth: $V_{p75}$**

L **x** W **x** D(25% - 75%) **5.2000 m³**

**Mean Surface Area Outflow: $a_{p50}$**

(L x D(25%-75%) x 2) + (W x D(25%-75%) x 2) + (L x W)

**14.6600 m²**

**Test Duration / Outflow time: $t_{p75-25}$** **sec**

| | Test 1 | Test 2 | Test 3 |
|---|---|---|---|
| **75%** | NA | - | - |
| **25%** | NA | - | - |
| **Duration** | **>68450** | **-** | **-** |

**Soil Infiltration Rate , $f$**

$$\frac{V_{p75}}{a_{p50} \times t_{p75-25}}$$

| Test 1 | Test 2 | Test 3 | |
|---|---|---|---|
| NA | - | - | m/sec |

(<< 5.182E-06 )

**Test Date**: 9th and 10th April 2019

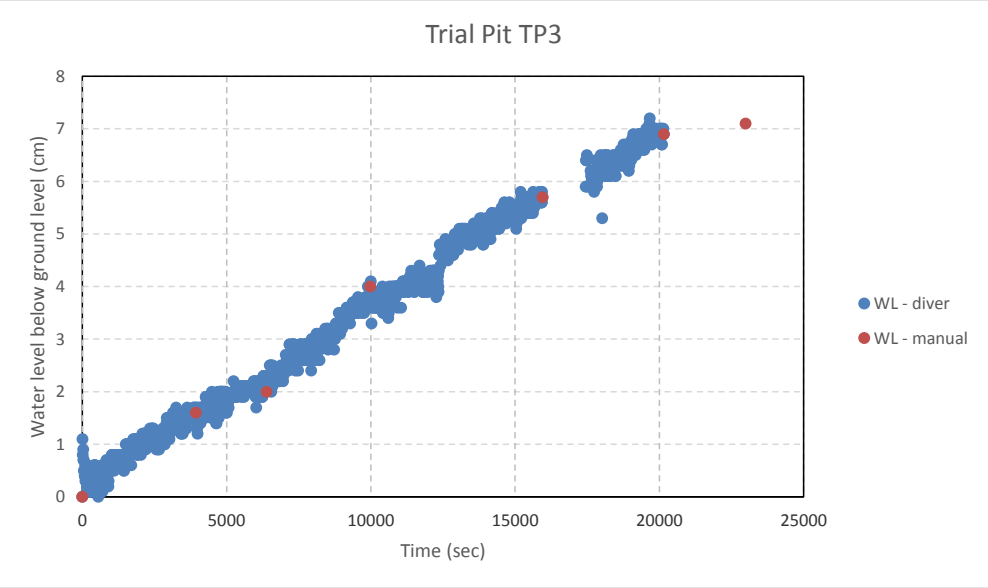
**Comments:**

Soil infiltration rate could not be calculated. Water level dropped 12.2cm in 68450 secs (19.0 hours). Soakaway test failure. No repeat tests could be undertaken due to water level.

# Soakaway Test - TP3

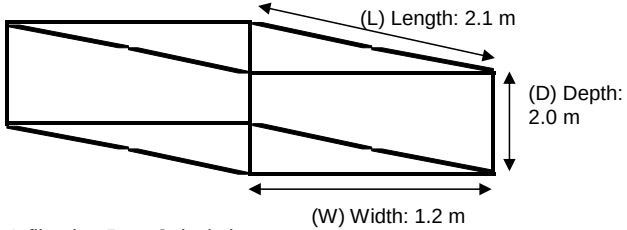
**Date:** 10th April 2019

**Project Name: Model Farm, Rhoose**
**Project No: JER1849**
**Location:** TP3




## Soakaway Description \ Dimensions

| | |
|---|---|
| 0-0.2 mbgl | Dark brown slightly sandy silty CLAY with grass cover. (TOPSOIL) |
| 0.2-2.0 mbgl | Stiff to very stiff light brown and grey gravelly CLAY with medium cobble content. Cobbles and gravel are grey angular to subrounded stone including limestone and mudstone . Gravel is fine to coarse. |
| | Trial pit terminated due to hard ground. |




Infiltration Rate Calculations

**Effective Depth: $V_{p75}$**
L x W x D(25% - 75%) **2.5200 m³**

**Mean Surface Area Outflow: $a_{p50}$**
(L x D(25%-75%) x 2) + (W x D(25%-75%) x 2) + (L x W)
**9.1200 m²**

**Test Duration / Outflow time: $t_{p75-25}$** **sec**

| | Test 1 | Test 2 | Test 3 |
|---|---|---|---|
| **75%** | NA | - | - |
| **25%** | NA | - | - |
| **Duration** | **>22990** | **-** | **-** |

**Soil Infiltration Rate , $f$**

$$\frac{V_{p75}}{a_{p50} \times t_{p75-25}}$$

| Test 1 | Test 2 | Test 3 | |
|---|---|---|---|
| NA | - | - | m/sec |

(<< 1.202E-05 )

**Test Date**: 10th April 2019

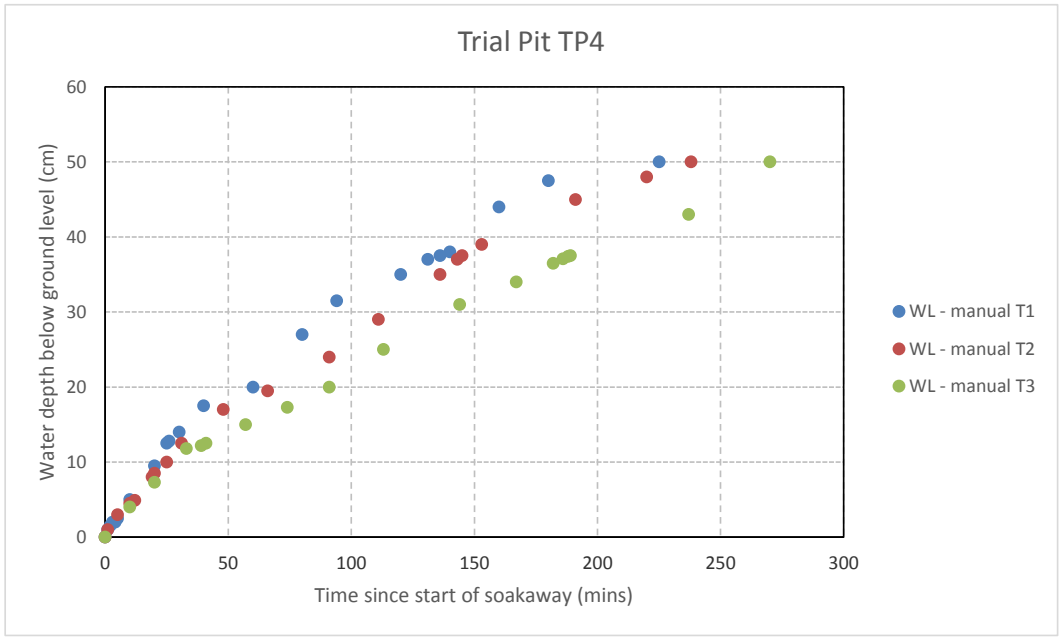
**Comments:**

Soil infiltration rate could not be calculated. Water level dropped 7.1cm in 22990 secs (6.4 hours) and appeared to stabilise. Soakaway test failure. No repeat tests could be undertaken due to water level.

# Soakaway Test - TP4

**Date:** 11th and 12th April 2019

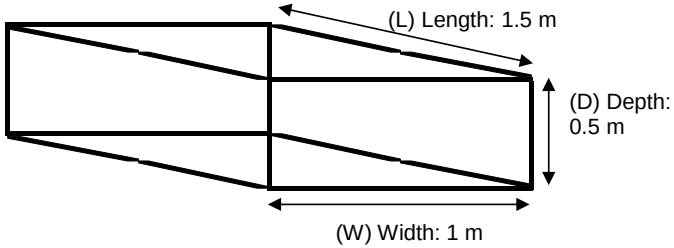
**Project Name: Model Farm, Rhoose**
**Project No: JER1849**
**Location:** TP4




**Test Date**: 11th April 2019 (T1, T2), 12th April 2019 (T3)

## Soakaway Description \ Dimensions

| | |
|---|---|
| 0-0.4 | Dark brown slightly gravelly slightly silty CLAY. Gravel is angular limestone. |
| 0.4-0.5 mbgl | Medium strong to very strong grey fine grained LIMESTONE with extremely closely spaced horizontal bedding factures. |
| | Trial pit terminated due to hard ground. |




Infiltration Rate Calculations

**Effective Depth: $V_{p75}$**

L **x** W **x** D(25% - 75%) **0.3750 m³**

**Mean Surface Area Outflow: $a_{p50}$**

(L x D(25%-75%) x 2) + (W x D(25%-75%) x 2) + (L x W)

**2.7500 m²**

**Test Duration / Outflow time: $t_{p75-25}$**

| | Test 1 | Test 2 | Test 3 |
|---|---|---|---|
| **75%** | 1500 | 1860 | 2460 |
| **25%** | 8160 | 8700 | 11340 |
| **Duration** | **6660** | **6840** | **8880** |

**Soil Infiltration Rate , $f$**

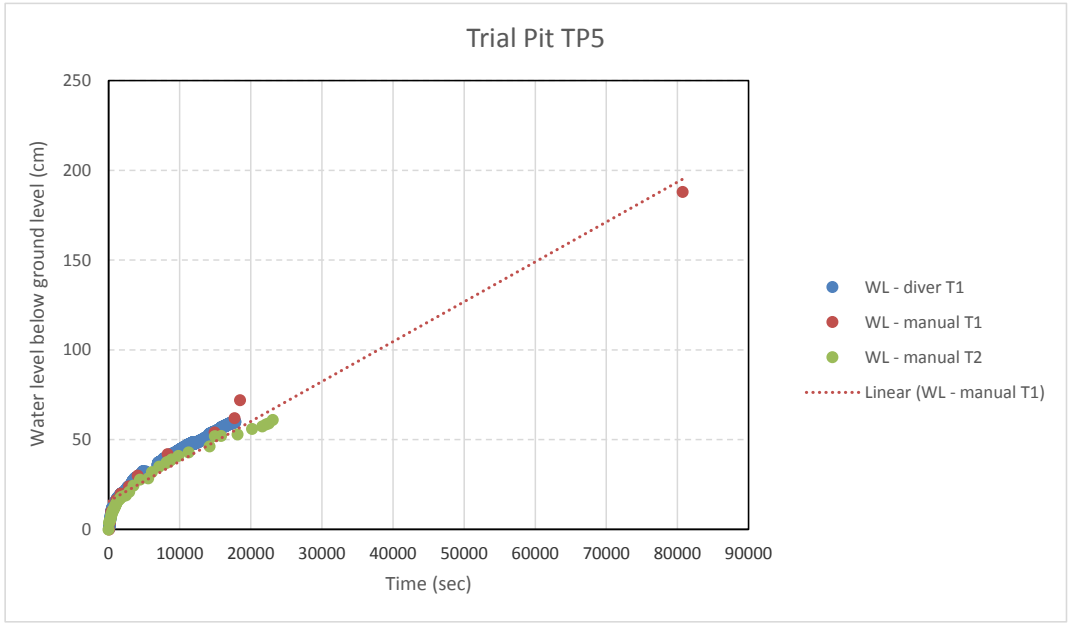
$$\frac{V_{p75}}{a_{p50} \times t_{p75-25}}$$

| Test 1 | Test 2 | Test 3 | |
|---|---|---|---|
| 2.05E-05 | 1.99E-05 | 1.54E-05 | m/sec |

# Soakaway Test - TP5

**Date:** 11th and 12th April 2019

**Project Name: Model Farm, Rhoose**
**Project No: JER1849**
**Location:** TP5



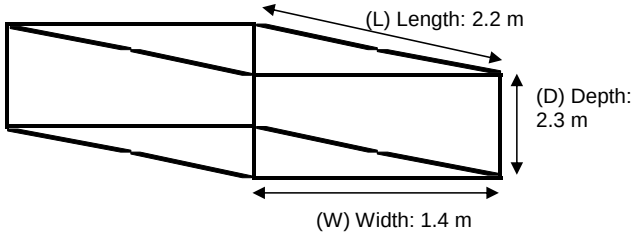

**Test Date**: 11th April 2019 (T1), 12th April 2019 (T2)

**Comments:**

Linear trendline was used to estimate time for water level at 25% of trial pit depth. Repeat test was not completed due to trial pit collapse between 0.3 mbgl and 1.4 mbgl.

## Soakaway Description \ Dimensions

| | |
|---|---|
| 0-0.4 mbgl | Dark brown slightly sandy silty CLAY with grass cover. (TOPSOIL) |
| 0.4-2.3 mbgl | Firm to very stiff light brown and grey gravelly CLAY with medium to high cobble content and occasional boulders. Gravel, cobbles and boulders are grey angular to subrounded stone including limestone and mudstone. Gravel is fine to coarse. |
| 2.1-2.3 mbgl | Weak dark grey and brown MUDSTONE. |




Infiltration Rate Calculations

**Effective Depth: $V_{p75}$**

L x W x D(25% - 75%) **3.5420 $m^3$**

**Mean Surface Area Outflow: $a_{p50}$**

(L x D(25%-75%) x 2) + (W x D(25%-75%) x 2) + (L x W)

**11.3600 $m^2$**

**Test Duration / Outflow time: $t_{p75-25}$**

| | Test 1 | Test 2 | Test 3 |
|---|---|---|---|
| **75%** | 16210 | NA | |
| **25%** | 71283.6 | NA | |
| **Duration** | **55073.6** | | |

**Soil Infiltration Rate , $f$**

$$\frac{V_{p75}}{a_{p50} \times t_{p75-25}}$$

| Test 1 | Test 2 | Test 3 | |
|---|---|---|---|
| 5.66E-06 | NA | | m/sec |

# Appendix D – Greenfield Discharge Rates

## ICP SUDS Mean Annual Flood

Input

| | | | |
|---|---|---|---|
| Return Period (years) | 1 | Soil | 0.450 |
| Area (ha) | 1.000 | Urban | 0.000 |
| SAAR (mm) | 967 | Region Number | Region 9 |

**Results l/s**

| | |
|---|---|
| QBAR Rural | 6.4 |
| QBAR Urban | 6.4 |
| Q1 year | 5.6 |
| Q1 year | 5.6 |
| Q30 years | 11.3 |
| Q100 years | 14.0 |

# Appendix E – SAB's Pre-Application Response Letter

# MEMORANDUM / COFNOD

The Vale of Glamorgan Council
The Alps, Wenvoe, CF5 6AA

VALE of GLAMORGAN
BRO MORGANNWG

| | |
|---|---|
| To / I: | Tono Perales |
| Dept / Adran: | |
| Date / Dyddiad: | 10/05/2019 |
| Your Ref / Eich Cyf: | |

| | |
|---|---|
| From / Oddi Wrth: | Vale of Glamorgan County Council<br>SuDS Approval Body |
| My Ref / Cyf: | SAB/PRE/2019/009 |
| Tel / Ffôn: | 02920 673 235 |
| Fax / Ffacs: | 02920 673 114 |

Subject / Testyn: **Pre-Application No. SAB/PRE/2019/009 Model Farm, Rhoose.**
Proposal: **Development of new enterprise zone situated immediately to the east of Cardiff Airport.**

The Flood and Water Management Act 2010 (Schedule 3), implemented in Wales on January 7th 2019 requires all new developments to include Sustainable Drainage System features that are compliant with national standards.

**Overview:**
Information submitted to support this pre-application suggests that surface waters generated by the development will be disposed of via a combination of rainwater harvesting, infiltration together with discharge to a surface watercourse (Bullhouse Brook and Whitelands Brook).

**Standard S1 – Surface Water Runoff Destination**

**Priority Level 1: Collection for Use:**
The submitted pre-application form indicates that rainwater harvesting will be utilised where possible by the inclusion of rainwater harvesting tanks at individual property units. It is recognised that water is a valuable resource and we would be in favour of the collection of rainwater for non-portable use where practicable.

**Priority Level 2: Discharge of surface water into ground:**
The submitted pre-application form also indicates that surface water will be disposed of through the use of infiltration techniques. Infiltration test results submitted in support of this application indicate that infiltration at shallow depths to be generally poor. It has been stated within Infiltration Testing Report (RPS April 2019) that further penetration through the bedrock may indicate a greater variation in permeability. In line with the Environment Agency's Approach to Groundwater Protection (February 2018) adopted by NRW we would discourage the use of any infiltration system that bypasses the soil layer, limiting the ability of the ground to attenuate pollutants.

Where the use of shallow infiltration features are to be used all testing should be undertaken at the proposed site of infiltration inclusive of permeable surfaces. Where larger infiltration systems are to be used we would require additional testing to be undertaken on a 25m grid basis. Infiltration testing should be completed at an appropriate depth to that of the proposed design.

**Priority Level 3: Discharge to a Surface Water Body:**
It has also been suggested within the pre-application form that surface waters not collected or discharged to ground under priority levels 1 and 2 will be discharged to Bullhouse / whitelands Brook. Although we have no objection to this method of disposal in principle, on full application further information will be required with regard to the location of proposed discharge point.

The design of any off-site drainage system should demonstrate that the scheme does not adversely affect off-site flood risk elsewhere. Documented evidence of a right to discharge will also be required with the riparian owner at the proposed point of discharge.

**Priority Level 4: Discharge to surface water sewer or highway:**

It has been acknowledged that the submitted pre-application does not propose to discharge surface water directly into surface water sewer, highway drain or any other drainage system.

**Priority Level 5: Discharge to combined sewer:**

It has been acknowledged that the submitted pre-application does not propose to discharge surface waters directly to combined sewer.

**Standard S2 – Surface Water Runoff Hydraulic Control**

It has been indicated that the drainage scheme will provide hydraulic control up to a 1 in 100 year return period + 30% allowance for climate change. No hydraulic calculations have been provided at this stage and will be required to be submitted on full application. The surface water drainage scheme should be designed so that flooding does not occur on any part of the site for a 1 in 30 year return period plus climate change (30%) and not in any part of any building for a 1 in 100 year return period plus climate change with consideration made to any receiving flows from outside of the catchment. The submitted calculations should also include the volume of storage utilised within the drainage system.

It is accepted that the proposed drainage system would manage flows for the majority of rainfall events of less than 5mm through infiltration and interception.

It is stated within the Preliminary Sustainable Drainage Strategy (RPS April 2019) that surface waters not collected or discharged to ground under priority levels 1 and 2 will be discharged at a controlled rate to match that of existing greenfield runoff rates to both the Whitelands and Bullhouse Brooks. We find this discharge rate acceptable in principle and would request further hydraulic calculations demonstrating the proposed discharge to both watercourses.

No Flood Exceedance Plan has been submitted with this pre-application and will be required on full submission. the plan must consider the risks associated with events exceeding the capacity of the drainage system. The design of the site and its drainage system should be integrated so that flooding is appropriately managed.

**Standard S3 – Water Quality**

The proposed drainage scheme has the potential to allow the effective management of sediment and other pollutants, ensuring discharges from the system are of an acceptable quality and will not cause a pollution risk. Given the use of features allowing interception throughout the system together with the inclusion of shallower infiltration features we are in general agreement that the drainage scheme proposed will adequately manage water quality. The various stages in the SuDS also increase the potential for managing pollution incidents close to source before they discharge offsite. No hydraulic calculations have been provided at this stage and will be required to be

submitted, demonstrating adequate residency times for flows to allow appropriate treatment within the system.

**Standard S4 – Amenity**

We acknowledge that the proposed drainage scheme provides amenity benefits through the promotion of green space whilst also providing enhanced visual character. It would be requested on full application that an appropriate risk assessment is submitted that considers the design and location of the basins and that any such risk is appropriately managed. We offer no objection to the amenity benefits the scheme will bring.

**Standard S5 – Biodiversity**

We acknowledge that the proposed drainage scheme has the potential to provide a self – sustaining ecosystem which will contribute to the delivery of local biodiversity objectives. It is requested that additional biodiverse planting is included on final design. Such planting should be easily maintained, resilient to its proposed environment and native to the region where possible. The introduction of invasive species will not be permitted. We offer no objection to the biodiversity benefits the scheme will bring.

It should be noted that the creation of permanent water bodies could provide habitats for protected species such as Great Crested Newts. As such appropriate consideration should be given to reduce or mitigate the potential risk of fatalities in features such as highway gully pots and oil interceptors.

**Standard S6 – Design**

At this pre-application stage limited information has been provided with regard to the construction, operation and maintenance of the drainage system. All elements of the surface water drainage system should be designed to ensure maintenance and operation can be undertaken by the responsible body easily, safely, cost effectively and in a timely manner.

**Conclusion**

An appraisal of this application has been made by the SuDS Approval Body in line with Welsh Governments Statutory Standards for Sustainable Drainage Systems. From the details provided as part of this pre-application we offer no objection in principle to the proposed drainage scheme.

Gareth Thelwell-Davies
Engineer – Environment

for Operational Manager Environment and Engineering
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# Appendix F – MicroDrainage Source Control Storage Volume Calculations

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

Half Drain Time : 249 minutes.

| 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 |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 0.644 | 0.644 | 0.0 | 170.4 | 170.4 | 2028.8 | O K |
| 30 min Summer | 0.846 | 0.846 | 0.0 | 170.8 | 170.8 | 2735.9 | O K |
| 60 min Summer | 1.046 | 1.046 | 0.0 | 170.8 | 170.8 | 3468.5 | O K |
| 120 min Summer | 1.215 | 1.215 | 0.0 | 170.8 | 170.8 | 4114.3 | Flood Risk |
| 180 min Summer | 1.272 | 1.272 | 0.0 | 170.8 | 170.8 | 4335.2 | Flood Risk |
| 240 min Summer | 1.284 | 1.284 | 0.0 | 170.8 | 170.8 | 4385.5 | Flood Risk |
| 360 min Summer | 1.293 | 1.293 | 0.0 | 170.8 | 170.8 | 4418.4 | Flood Risk |
| 480 min Summer | 1.282 | 1.282 | 0.0 | 170.8 | 170.8 | 4376.5 | Flood Risk |
| 600 min Summer | 1.261 | 1.261 | 0.0 | 170.8 | 170.8 | 4292.5 | Flood Risk |
| 720 min Summer | 1.233 | 1.233 | 0.0 | 170.8 | 170.8 | 4182.6 | Flood Risk |
| 960 min Summer | 1.164 | 1.164 | 0.0 | 170.8 | 170.8 | 3915.7 | O K |
| 1440 min Summer | 1.006 | 1.006 | 0.0 | 170.8 | 170.8 | 3319.8 | O K |
| 2160 min Summer | 0.795 | 0.795 | 0.0 | 170.8 | 170.8 | 2554.8 | O K |
| 2880 min Summer | 0.635 | 0.635 | 0.0 | 170.3 | 170.3 | 1999.7 | O K |
| 4320 min Summer | 0.454 | 0.454 | 0.0 | 163.6 | 163.6 | 1397.1 | O K |
| 5760 min Summer | 0.392 | 0.392 | 0.0 | 138.0 | 138.0 | 1196.5 | O K |
| 7200 min Summer | 0.354 | 0.354 | 0.0 | 119.0 | 119.0 | 1074.9 | O K |
| 8640 min Summer | 0.326 | 0.326 | 0.0 | 104.9 | 104.9 | 985.7 | O K |
| 10080 min Summer | 0.304 | 0.304 | 0.0 | 94.1 | 94.1 | 917.5 | O K |
| 15 min Winter | 0.718 | 0.718 | 0.0 | 170.8 | 170.8 | 2282.6 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 111.414 | 0.0 | 2086.0 | 24 |
| 30 min Summer | 76.298 | 0.0 | 2881.4 | 38 |
| 60 min Summer | 49.937 | 0.0 | 3842.4 | 66 |
| 120 min Summer | 31.521 | 0.0 | 4859.4 | 124 |
| 180 min Summer | 23.680 | 0.0 | 5479.9 | 180 |
| 240 min Summer | 19.162 | 0.0 | 5915.0 | 214 |
| 360 min Summer | 14.247 | 0.0 | 6599.6 | 278 |
| 480 min Summer | 11.521 | 0.0 | 7117.8 | 344 |
| 600 min Summer | 9.762 | 0.0 | 7539.7 | 414 |
| 720 min Summer | 8.520 | 0.0 | 7897.5 | 484 |
| 960 min Summer | 6.867 | 0.0 | 8486.8 | 620 |
| 1440 min Summer | 5.055 | 0.0 | 9366.1 | 880 |
| 2160 min Summer | 3.711 | 0.0 | 10363.4 | 1240 |
| 2880 min Summer | 2.976 | 0.0 | 11076.0 | 1588 |
| 4320 min Summer | 2.175 | 0.0 | 12119.7 | 2252 |
| 5760 min Summer | 1.742 | 0.0 | 12992.5 | 2944 |
| 7200 min Summer | 1.468 | 0.0 | 13676.4 | 3680 |
| 8640 min Summer | 1.276 | 0.0 | 14258.4 | 4408 |
| 10080 min Summer | 1.134 | 0.0 | 14756.5 | 5144 |
| 15 min Winter | 111.414 | 0.0 | 2344.4 | 25 |

## 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 | 0.943 | 0.943 | 0.0 | 170.8 | 170.8 | 3086.6 | O K |
| 60 min Winter | 1.168 | 1.168 | 0.0 | 170.8 | 170.8 | 3929.6 | O K |
| 120 min Winter | 1.355 | 1.355 | 0.0 | 170.8 | 170.8 | 4665.9 | Flood Risk |
| 180 min Winter | 1.422 | 1.422 | 0.0 | 170.8 | 170.8 | 4937.7 | Flood Risk |
| 240 min Winter | 1.438 | 1.438 | 0.0 | 170.8 | 170.8 | 5004.8 | Flood Risk |
| 360 min Winter | 1.436 | 1.436 | 0.0 | 170.8 | 170.8 | 4994.6 | Flood Risk |
| 480 min Winter | 1.416 | 1.416 | 0.0 | 170.8 | 170.8 | 4916.1 | Flood Risk |
| 600 min Winter | 1.382 | 1.382 | 0.0 | 170.8 | 170.8 | 4777.8 | Flood Risk |
| 720 min Winter | 1.339 | 1.339 | 0.0 | 170.8 | 170.8 | 4605.1 | Flood Risk |
| 960 min Winter | 1.238 | 1.238 | 0.0 | 170.8 | 170.8 | 4203.7 | Flood Risk |
| 1440 min Winter | 0.989 | 0.989 | 0.0 | 170.8 | 170.8 | 3254.9 | O K |
| 2160 min Winter | 0.675 | 0.675 | 0.0 | 170.7 | 170.7 | 2135.6 | O K |
| 2880 min Winter | 0.483 | 0.483 | 0.0 | 165.3 | 165.3 | 1491.9 | O K |
| 4320 min Winter | 0.376 | 0.376 | 0.0 | 130.1 | 130.1 | 1143.6 | O K |
| 5760 min Winter | 0.326 | 0.326 | 0.0 | 105.1 | 105.1 | 986.4 | O K |
| 7200 min Winter | 0.294 | 0.294 | 0.0 | 88.8 | 88.8 | 885.8 | O K |
| 8640 min Winter | 0.271 | 0.271 | 0.0 | 77.5 | 77.5 | 813.6 | O K |
| 10080 min Winter | 0.253 | 0.253 | 0.0 | 69.2 | 69.2 | 758.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 30 min Winter | 76.298 | 0.0 | 3235.0 | 38 |
| 60 min Winter | 49.937 | 0.0 | 4307.7 | 66 |
| 120 min Winter | 31.521 | 0.0 | 5446.8 | 122 |
| 180 min Winter | 23.680 | 0.0 | 6141.8 | 178 |
| 240 min Winter | 19.162 | 0.0 | 6629.2 | 232 |
| 360 min Winter | 14.247 | 0.0 | 7396.0 | 292 |
| 480 min Winter | 11.521 | 0.0 | 7976.5 | 368 |
| 600 min Winter | 9.762 | 0.0 | 8449.0 | 446 |
| 720 min Winter | 8.520 | 0.0 | 8849.8 | 522 |
| 960 min Winter | 6.867 | 0.0 | 9509.9 | 674 |
| 1440 min Winter | 5.055 | 0.0 | 10497.5 | 940 |
| 2160 min Winter | 3.711 | 0.0 | 11610.5 | 1284 |
| 2880 min Winter | 2.976 | 0.0 | 12409.5 | 1588 |
| 4320 min Winter | 2.175 | 0.0 | 13583.2 | 2252 |
| 5760 min Winter | 1.742 | 0.0 | 14553.9 | 2992 |
| 7200 min Winter | 1.468 | 0.0 | 15320.8 | 3680 |
| 8640 min Winter | 1.276 | 0.0 | 15974.5 | 4416 |
| 10080 min Winter | 1.134 | 0.0 | 16538.2 | 5144 |

## 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) | 19.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.314 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +30 |

## Time Area Diagram

Total Area (ha) 10.370

| Time (mins) From: | To: | Area (ha) | Time (mins) From: | To: | Area (ha) | Time (mins) From: | To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 3.000 | 4 | 8 | 4.370 | 8 | 12 | 3.000 |

## Model Details

Storage is Online Cover Level (m) 1.500

## Infiltration Basin Structure

Invert Level (m) 0.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 2900.0 | 1.500 | 4150.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0488-1708-1450-1708 |
| Design Head (m) | 1.450 |
| Design Flow (l/s) | 170.8 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 488 |
| Invert Level (m) | 0.000 |
| Minimum Outlet Pipe Diameter (mm) | 500 |
| Suggested Manhole Diameter (mm) | Site Specific Design (Contact Hydro International) |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.450 | 170.8 |
| Flush-Flo™ | 0.709 | 170.8 |
| Kick-Flo® | 1.173 | 154.1 |
| Mean Flow over Head Range | - | 134.5 |

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 | 12.4 | 1.200 | 155.8 | 3.000 | 243.7 | 7.000 | 369.3 |
| 0.200 | 45.5 | 1.400 | 167.9 | 3.500 | 262.8 | 7.500 | 382.1 |
| 0.300 | 92.0 | 1.600 | 179.2 | 4.000 | 280.6 | 8.000 | 394.4 |
| 0.400 | 141.6 | 1.800 | 189.8 | 4.500 | 297.3 | 8.500 | 406.4 |
| 0.500 | 166.2 | 2.000 | 199.8 | 5.000 | 313.0 | 9.000 | 418.0 |
| 0.600 | 169.7 | 2.200 | 209.4 | 5.500 | 328.1 | 9.500 | 429.3 |
| 0.800 | 170.2 | 2.400 | 218.5 | 6.000 | 342.4 | | |
| 1.000 | 164.7 | 2.600 | 227.2 | 6.500 | 356.1 | | |

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

Half Drain Time : 278 minutes.

| 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 |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 0.659 | 0.659 | 0.0 | 292.6 | 292.6 | 4510.2 | O K |
| 30 min Summer | 0.861 | 0.861 | 0.0 | 340.2 | 340.2 | 6051.7 | O K |
| 60 min Summer | 1.068 | 1.068 | 0.0 | 340.2 | 340.2 | 7723.7 | O K |
| 120 min Summer | 1.242 | 1.242 | 0.0 | 340.2 | 340.2 | 9194.2 | Flood Risk |
| 180 min Summer | 1.307 | 1.307 | 0.0 | 347.1 | 347.1 | 9758.8 | Flood Risk |
| 240 min Summer | 1.329 | 1.329 | 0.0 | 349.9 | 349.9 | 9951.3 | Flood Risk |
| 360 min Summer | 1.355 | 1.355 | 0.0 | 353.3 | 353.3 | 10179.1 | Flood Risk |
| 480 min Summer | 1.360 | 1.360 | 0.0 | 354.0 | 354.0 | 10229.9 | Flood Risk |
| 600 min Summer | 1.354 | 1.354 | 0.0 | 353.2 | 353.2 | 10175.0 | Flood Risk |
| 720 min Summer | 1.340 | 1.340 | 0.0 | 351.4 | 351.4 | 10052.5 | Flood Risk |
| 960 min Summer | 1.301 | 1.301 | 0.0 | 346.3 | 346.3 | 9703.2 | Flood Risk |
| 1440 min Summer | 1.201 | 1.201 | 0.0 | 340.2 | 340.2 | 8844.1 | Flood Risk |
| 2160 min Summer | 1.044 | 1.044 | 0.0 | 340.2 | 340.2 | 7524.1 | O K |
| 2880 min Summer | 0.872 | 0.872 | 0.0 | 340.2 | 340.2 | 6143.8 | O K |
| 4320 min Summer | 0.701 | 0.701 | 0.0 | 308.7 | 308.7 | 4826.1 | O K |
| 5760 min Summer | 0.602 | 0.602 | 0.0 | 269.1 | 269.1 | 4088.8 | O K |
| 7200 min Summer | 0.537 | 0.537 | 0.0 | 239.4 | 239.4 | 3609.6 | O K |
| 8640 min Summer | 0.488 | 0.488 | 0.0 | 214.8 | 214.8 | 3261.9 | O K |
| 10080 min Summer | 0.454 | 0.454 | 0.0 | 195.7 | 195.7 | 3020.9 | O K |
| 15 min Winter | 0.732 | 0.732 | 0.0 | 319.9 | 319.9 | 5055.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 111.414 | 0.0 | 4364.8 | 25 |
| 30 min Summer | 76.298 | 0.0 | 6083.8 | 39 |
| 60 min Summer | 49.937 | 0.0 | 8277.8 | 68 |
| 120 min Summer | 31.521 | 0.0 | 10488.8 | 124 |
| 180 min Summer | 23.680 | 0.0 | 11837.1 | 180 |
| 240 min Summer | 19.162 | 0.0 | 12782.1 | 214 |
| 360 min Summer | 14.247 | 0.0 | 14268.0 | 278 |
| 480 min Summer | 11.521 | 0.0 | 15391.6 | 344 |
| 600 min Summer | 9.762 | 0.0 | 16305.1 | 412 |
| 720 min Summer | 8.520 | 0.0 | 17078.9 | 482 |
| 960 min Summer | 6.867 | 0.0 | 18349.7 | 618 |
| 1440 min Summer | 5.055 | 0.0 | 20235.9 | 888 |
| 2160 min Summer | 3.711 | 0.0 | 22521.7 | 1280 |
| 2880 min Summer | 2.976 | 0.0 | 24062.7 | 1616 |
| 4320 min Summer | 2.175 | 0.0 | 26286.0 | 2304 |
| 5760 min Summer | 1.742 | 0.0 | 28277.1 | 3016 |
| 7200 min Summer | 1.468 | 0.0 | 29757.1 | 3752 |
| 8640 min Summer | 1.276 | 0.0 | 31006.6 | 4488 |
| 10080 min Summer | 1.134 | 0.0 | 32050.3 | 5152 |
| 15 min Winter | 111.414 | 0.0 | 4923.5 | 25 |

## 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 | 0.958 | 0.958 | 0.0 | 340.2 | 340.2 | 6827.0 | O K |
| 60 min Winter | 1.185 | 1.185 | 0.0 | 340.2 | 340.2 | 8706.5 | O K |
| 120 min Winter | 1.379 | 1.379 | 0.0 | 356.3 | 356.3 | 10395.0 | Flood Risk |
| 180 min Winter | 1.455 | 1.455 | 0.0 | 365.9 | 365.9 | 11081.4 | Flood Risk |
| 240 min Winter | 1.481 | 1.481 | 0.0 | 369.1 | 369.1 | 11316.9 | Flood Risk |
| 360 min Winter | 1.497 | 1.497 | 0.0 | 371.0 | 371.0 | 11459.0 | Flood Risk |
| 480 min Winter | 1.495 | 1.495 | 0.0 | 370.8 | 370.8 | 11441.6 | Flood Risk |
| 600 min Winter | 1.477 | 1.477 | 0.0 | 368.6 | 368.6 | 11282.8 | Flood Risk |
| 720 min Winter | 1.451 | 1.451 | 0.0 | 365.4 | 365.4 | 11041.2 | Flood Risk |
| 960 min Winter | 1.383 | 1.383 | 0.0 | 356.9 | 356.9 | 10433.5 | Flood Risk |
| 1440 min Winter | 1.228 | 1.228 | 0.0 | 340.2 | 340.2 | 9071.0 | Flood Risk |
| 2160 min Winter | 0.975 | 0.975 | 0.0 | 340.2 | 340.2 | 6962.4 | O K |
| 2880 min Winter | 0.769 | 0.769 | 0.0 | 330.8 | 330.8 | 5340.2 | O K |
| 4320 min Winter | 0.597 | 0.597 | 0.0 | 266.8 | 266.8 | 4046.3 | O K |
| 5760 min Winter | 0.502 | 0.502 | 0.0 | 222.2 | 222.2 | 3362.1 | O K |
| 7200 min Winter | 0.446 | 0.446 | 0.0 | 190.6 | 190.6 | 2960.8 | O K |
| 8640 min Winter | 0.408 | 0.408 | 0.0 | 166.8 | 166.8 | 2695.0 | O K |
| 10080 min Winter | 0.379 | 0.379 | 0.0 | 148.9 | 148.9 | 2493.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 30 min Winter | 76.298 | 0.0 | 6847.5 | 39 |
| 60 min Winter | 49.937 | 0.0 | 9289.8 | 66 |
| 120 min Winter | 31.521 | 0.0 | 11766.4 | 122 |
| 180 min Winter | 23.680 | 0.0 | 13276.8 | 178 |
| 240 min Winter | 19.162 | 0.0 | 14335.4 | 232 |
| 360 min Winter | 14.247 | 0.0 | 16000.1 | 292 |
| 480 min Winter | 11.521 | 0.0 | 17259.0 | 368 |
| 600 min Winter | 9.762 | 0.0 | 18282.5 | 446 |
| 720 min Winter | 8.520 | 0.0 | 19149.7 | 522 |
| 960 min Winter | 6.867 | 0.0 | 20573.8 | 670 |
| 1440 min Winter | 5.055 | 0.0 | 22689.8 | 954 |
| 2160 min Winter | 3.711 | 0.0 | 25239.1 | 1360 |
| 2880 min Winter | 2.976 | 0.0 | 26968.7 | 1648 |
| 4320 min Winter | 2.175 | 0.0 | 29476.0 | 2344 |
| 5760 min Winter | 1.742 | 0.0 | 31680.3 | 3056 |
| 7200 min Winter | 1.468 | 0.0 | 33341.4 | 3752 |
| 8640 min Winter | 1.276 | 0.0 | 34748.1 | 4496 |
| 10080 min Winter | 1.134 | 0.0 | 35938.1 | 5240 |

## 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) | 19.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.314 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +30 |

## Time Area Diagram

Total Area (ha) 22.600

| Time (mins) From: | To: | Area (ha) | Time (mins) From: | To: | Area (ha) | Time (mins) From: | To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 7.000 | 4 | 8 | 8.600 | 8 | 12 | 7.000 |

## Model Details

Storage is Online Cover Level (m) 1.500

## Infiltration Basin Structure

Invert Level (m) 0.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 6240.0 | 1.500 | 9175.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-CHE-0576-3724-1450-3724 |
| Design Head (m) | 1.450 |
| Design Flow (l/s) | 372.4 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 576 |
| Invert Level (m) | 0.000 |
| Minimum Outlet Pipe Diameter (mm) | Site Specific Design (Contact Hydro International) |
| Suggested Manhole Diameter (mm) | Site Specific Design (Contact Hydro International) |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.450 | 365.3 |
| Flush-Flo™ | 0.843 | 340.2 |
| Kick-Flo® | 0.993 | 307.6 |
| Mean Flow over Head Range | - | 238.6 |

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 | 13.1 | 1.200 | 332.8 | 3.000 | 522.3 | 7.000 | 792.6 |
| 0.200 | 48.9 | 1.400 | 359.0 | 3.500 | 563.5 | 7.500 | 820.0 |
| 0.300 | 101.2 | 1.600 | 383.4 | 4.000 | 601.8 | 8.000 | 846.5 |
| 0.400 | 162.0 | 1.800 | 406.3 | 4.500 | 637.7 | 8.500 | 872.1 |
| 0.500 | 221.0 | 2.000 | 427.9 | 5.000 | 671.6 | 9.000 | 897.0 |
| 0.600 | 268.2 | 2.200 | 448.4 | 5.500 | 703.9 | 9.500 | 921.2 |
| 0.800 | 336.3 | 2.400 | 468.0 | 6.000 | 734.7 | | |
| 1.000 | 307.8 | 2.600 | 486.8 | 6.500 | 764.2 | | |

# Appendix G – DC Welsh Water Sewer Map and Pre-Development Enquiry

Dŵr Cymru
Welsh Water

PPA0003927

N
W E
S

## LEGEND(Representative of most common features)

**Waste network:**

- Foul chamber
- Surface water chamber
- Combined chamber
- Combined sewer overflow
- Special purpose chamber
- Treatment works
- Pumping station
- Outfall
- Lamphole (LH)
- Storm Overflow
- Rising main
- Gravity sewer
- Private sewer
- Private sewer subject to Sect. 104 adoption agreement (S 104)
- 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



| | |
|---|---|
| Map Ref: | 308042,167337 |
| Map scale: | 1:1250 |
| Printed by: | Motley Louise |
| Printed on: | 08 Apr 2019 |

Dŵr Cymru
Welsh Water

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Tono Perales
RPS Consulting Services Ltd
20 Western Avenue
Abingdon
Oxon
OX14 4SH

**Date: 10/04/2019**
**Our Ref: PPA0003927**

Dear Sir/Madam,

**Grid Ref: 308066 167351**
**Site Address: Model Farm, Rhoose, Vale of Glamorgan**
**Development: New Mixed Use Development**

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.

## APPRAISAL

Firstly, we note that the proposal relates to a new mixed use development on Model Farm, land adjacent to Cardiff International Airport, and acknowledge that part of the site is located in a wider strategic employment allocation (Ref: MG 9(2)) within the Local Development Plan (LDP) for B1, B2 and B8 uses. In reference to our representations during the LDP consultation process, namely the 'Statement of Common Ground', we can confirm that an assessment has been undertaken of the public sewerage system to accommodate an allocation of 76.64 ha for employment use and informs our appraisal as follows.

Please note, notwithstanding the following assessment, we would advise there is also a mandatory requirement to undertake pre-application consultation with all 'Specialist Consultees', including Dwr Cymru Welsh Water as the statutory water and sewerage undertaker, in accordance with Schedule 4 of Town & Country Planning (Development Management Procedure) (Wales) (Amendment) Order 2016. As a major development, amounting to an area greater than 1 ha, you will be statutorily required to consult Welsh Water and a substantive response will be issued within 28 days from the date of the notice as per the requirements of Article 2E.

## Public Sewerage Network

The proposed development site is located in the immediate vicinity of a separate sewerage system, comprising foul and surface water public sewers, which drains to Cog Moors Wastewater Treatment Works (WwTW) via a series of Sewerage Pumping Stations (SPS') including Porthkerry SPS located on site.

Whilst we acknowledge proposals for an *"Allocated Porthkerry Park Extension"* in this vicinity, we would advise the developer that no habitable buildings be constructed within a 15m vicinity of the SPS, as to minimise any effects of noise and odour nuisance.

The site is crossed by a foul water public sewer, along with the rising main from Porthkerry SPS, and their approximate positions are marked on the attached Statutory Public Sewer Record. In accordance with the Water Industry Act 1991, Dwr Cymru Welsh Water requires access to its apparatus at all times in order to carry out maintenance and repairs. However, having regard to the current masterplan (Drawing No. JCD0064-010 Rev. D), certain parcels of land for *"B1 Small Business Units, Office, Ancillary Development and Leisure"* would be situated within the protection zone of the public sewer, measured 3 metres either side of the centreline, in addition to an element of the *"Allocated Porthkerry Park Extension"* which is also located in the protection zone of the rising main, measured 3 metres either side of the centreline as well. Our strong recommendation is that your site layout is updated to take into account the location of the assets crossing the site and should be referred to in any master-planning exercises or site layout plans submitted as part of any subsequent planning application. Alternatively, it may be possible to divert assets if the developer applies under Section 185 of the Water Industry Act and we request that they contact us to discuss and consider possible solutions. Further information regarding Asset Protection is provided in the attached Advice & Guidance note.

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.

**Foul Water Drainage**

No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site. Notwithstanding this, we have considered the impact of foul flows generated by the proposed development upon the local public sewerage network and concluded that it is unlikely that sufficient capacity exists to accommodate your development without causing detriment to the existing services we provide to our customers, or in regard to the protection of the environment. No improvements are planned within Dwr Cymru Welsh Water's Capital Investment Programme.

Accordingly, we are unable at this stage to provide you with a point of adequacy on the network and our recommendation is that you instruct us to undertake a Hydraulic Modelling Assessment of the local public sewerage network, which is at the developer's expense and consistent with our representations to the LDP consultation process. This Assessment will examine the existing network and consider the impact of the introduction of flows from your development upon its performance. Where required and appropriate, the Assessment will then identify solutions and points of communication to ensure that your site can be accommodated within the system.

Please note that we will seek to control the outcomes of the Hydraulic Modelling Assessment via appropriate planning conditions. However in the absence of known solutions to accommodate your site we will not be able to support your development through the planning process. We therefore recommend that the Assessment is undertaken in advance of the planning application being submitted in order to avoid any subsequent delays. Further information on Hydraulic Modelling Assessments as well as any implications on the planning process is provided in the attached Advice & Guidance note.

Furthermore, if the development will give rise to a new discharge (or alter an existing discharge) of trade effluent, directly or indirectly to the public sewerage system, then a Discharge Consent under Section 118 of the Water Industry Act 1991 is required from Dwr Cymru / Welsh Water. Please note that the issuing of a Discharge Consent is independent of the planning process and a consent may be refused although planning permission is granted.

**Surface Water Drainage**

As of 7th January 2019, this proposed development is subject to Schedule 3 of the Flood and Water Management Act 2010. The development therefore requires approval of Sustainable Drainage Systems (SuDS) features, in accordance with the 'Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems'. As highlighted in these standards, the developer is required to explore and fully exhaust all surface water drainage options in accordance with a hierarchy which states that discharge to a combined sewer shall only be made as a last resort. Disposal should be made through the hierarchical approach, preferring infiltration and, where infiltration is not possible, disposal to a surface water drainage body in liaison with the Land Drainage Authority and/or Natural Resources Wales.

With respect to additional information received by e-mail 27th March 2019, we acknowledge that a surface water drainage strategy is currently being prepared and based on a hybrid concept in agreement with the Vale of Glamorgan Council, as the determining SuDS Approval Body (SAB). However, your e-mail refers to SuDS guidance in the Welsh Government FAQs and we believe is misconstrued on sections *'3.4 – What drainage systems are approved but not adopted by the SAB?'* and *'4.23 – Who maintains SuDS which are in or beside a publically maintained road?'*. Section 3.4 refers to developments which may be exempt from adoption, albeit approved by the SAB, whereas section 4.23 highlights that the responsibility of surface water drainage along a publically maintained road in isolation, and therefore highway drainage flows, is the highways authority and not the SAB. In this instance your proposals relates to a new development with a drainage system serving both highways and property, which subsequently requires SAB approval and adoption and therefore, we recommended that you engage in further liaison with Vale of Glamorgan Council in relation to your proposals for SuDS features. Please note, DCWW is a statutory consultee to the SAB application process and will provide comments to any SuDS proposals, by response to SAB consultation, but would not be responsible for adoption of your proposed surface water drainage network. 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.

**Potable Water Supply**

As part of this pre-planning enquiry submission, we acknowledge receipt of the 'Cardiff Airport and St Athan Enterprise Zone – Strategic Land Use Infrastructure Plan Working Draft' which indicates *"a daily water consumption demand of 890m3 and a preliminary peak flowrate of 122 l/s"*. However, the proposed development is in an area where there are water supply problems for which there are no improvements planned within our current Capital Investment Programme AMP7 (years 2020 to 2025). Therefore, notwithstanding our reference to domestic water supply as part of our LDP representations, it will be necessary for the developer to fund the undertaking of a hydraulic modelling assessment on the water supply network, in order to establish what would be required to serve the site with an adequate water supply. For the developer to obtain a quotation for the hydraulic modelling assessment, we will require a fee of £250 + VAT.

In addition, the proposed development is crossed by a trunk/distribution watermain, the approximate position being shown on the attached plan. Dwr Cymru Welsh Water as Statutory Undertaker has statutory powers to access our apparatus at all times. I enclose our Conditions for Development near Watermain(s). It may be possible for this watermain to be diverted under Section 185 of the Water Industry Act 1991, the cost of which will be re-charged to the developer. The developer must consult Dwr Cymru Welsh Water before any development commences on site.

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@dwrcymru.com**

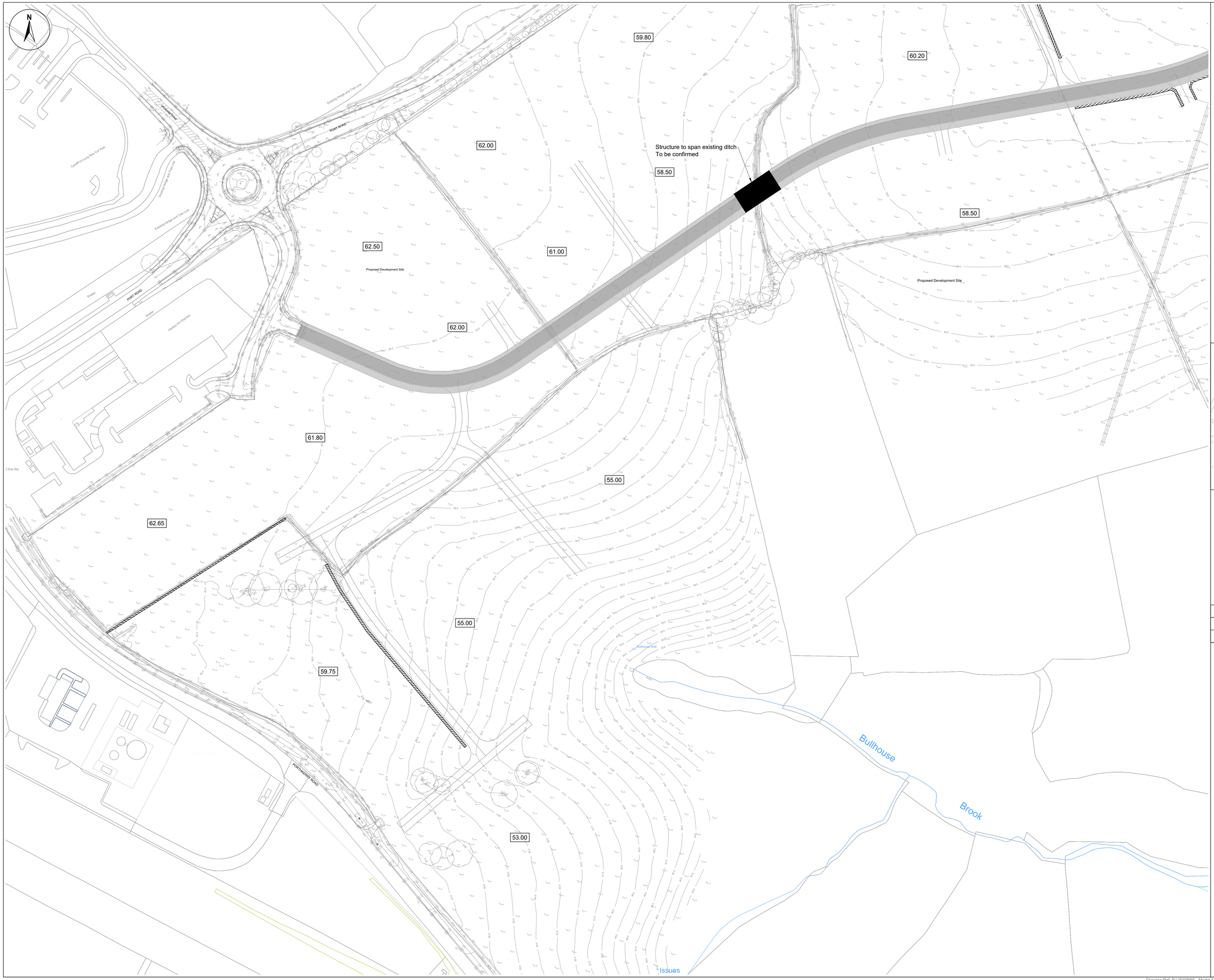
Please quote our reference number in all communications and correspondence.

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 H – Preliminary Levels Strategy Layout



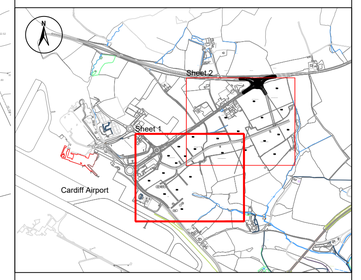



NOTES

1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing is to be read in conjunction with all relevant scheme drawings.
4. Drawing based on topographical survey undertaken by RPS drawing number JKK9669-03-06.
5. Unit boundaries taken from RPS masterplan drawing number JCD0064-L&G-001.

KEY

- Proposed Carriageway
- Proposed Footway
- Proposed Retaining Structure
- 71.00 Proposed Boundary and Level




| Rev | Description | By | CB | Date |
|---|---|---|---|---|
| B | Retaining structures and slopes added | CA | SJ | 10.05.19 |
| A | Proposed plot boundaries updated | DH | SJ | 25.04.19 |

MAKING COMPLEX EASY

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**T:** +44(0)1235 432 190 **E:** transport@rpsgroup.com

Client: Legal & General (Strategic Land) Ltd

Project: Model Farm, Rhoose

Title: Preliminary Site Levels (Sheet 1 of 2)

| Status | Drawn By | PM/Checked by |
|---|---|---|
| INFORMATION | DH | MB |

| Project Number | Scale @ A1 | Date Created |
|---|---|---|
| JNY9969 | 1:1000 | 01/04/2019 |

RPS Drawing/Figure Number: JNY9969-RPS-0100-005

Rev: B

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