

Flood Consequences Assessment and integrated Flood and Surface Water Drainage Report

For

Proposed Glasshouse Development at

Five Fords, Wrexham, Wales

On behalf of

Low Carbon Farming 2 Ltd

July 2020

Document History and Status

Project Number 23380

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1 Non Technical Summary

- 1.1 This Flood Consequences Assessment has been undertaken in accordance with Planning Policy Wales on behalf of Low Carbon Farming 2 Ltd in support of a Planning Application for the construction of two glasshouses, four irrigation reservoirs, a packing and welfare building, energy centre building, heat store tanks and water silos together with access road, concreted service yard, and HGV loading bays and parking areas at Five Fords, Wrexham.
- 1.2 This Assessment is to be read in conjunction with all planning, architectural and other reports that accompany the Planning Application for the proposed development.
- 1.3 The operational area of the site is located in entirely within Flood Zone 1.
- 1.4 The main site access from Cefn Road is partially located within Flood Zones 2 and 3 but secondary access is available for vehicular traffic and pedestrians entirely within Flood Zone 1.
- 1.5 The proposed development will incorporate a sustainable drainage system which will retain all surface water on site for reuse in irrigation and provide storage for all storm return periods up to and including the 1:100 storm event with an additional 40% allowance for climate change.
- 1.6 Foul drainage will be discharged to the existing 150mm diameter public foul sewer located adjacent to Bedwell Road to the east of the site.
- 1.7 This report concludes that the site is not at risk of flooding from tidal or fluvial sources, overland flows or groundwater.
- 1.8 In terms of flood risk the proposed development is suitable at this location.

2 Planning Policy Context

2.1 Planning Policy Wales

2.1.1 Planning Policy Wales was updated in December 2018.

2.1.2 With regard to water quality and flood risk the policy states that *'diffuse pollution and surface water flooding arise as a result of run-off from built surfaces, from potentially polluting development types and through sewage discharges from overloaded sewers or from private infrastructure, for example, septic tanks. Planning authorities should secure better management of drainage and surface water so as to tackle these issues by:*

- ensuring sustainable drainage systems are incorporated into development enabling surface water to be managed close to or at source; and*
- ensuring connection to the sewer in sewered areas and by minimising the proliferation of private sewage systems.'*

2.1.3 With regard to Sustainable Drainage Systems the policy states that *'new developments of more than one dwelling or where the area covered by construction work equals or exceeds 100 square metres also require approval from the SuDS Approval Body (SAB) before construction can commence. Adoption and management arrangements, including a funding mechanism for maintenance of SuDS infrastructure and all drainage elements are to be agreed by the SAB as part of this approval. This will ensure that SuDS infrastructure is properly maintained and functions effectively for its design life.*

The provision of SuDS must be considered as an integral part of the design of new development and considered at the earliest possible stage when formulating proposals for new development.'

2.1.4 With regard to Development and Flood Risk the policy states that *'development should reduce, and must not increase, flood risk arising from river and/or coastal flooding on and off the development site itself. The priority should be to protect the undeveloped or unobstructed floodplain from development and to prevent the cumulative effects of incremental development.'*

2.2 Technical Advice Note 15: Development and Flood Risk

2.2.1 Technical Advice Note 15 which was published in 2004 is one of a series of Technical Advice Notes (TANs) which supplement Planning Policy Wales.

2.2.2 Reference to flood Zones A B and C within the TAN are defined as follows and are broadly equivalent to Flood Zones 1, 2 and 3 referenced by Natural Resources Wales. The descriptions for Zones A, B and C are as follows:

Description of Zone		Use within the precautionary framework
Considered to be at little or no risk of fluvial or tidal/coastal flooding.	A	Used to indicate that justification test is not applicable and no need to consider flood risk further.
Areas known to have been flooded in the past evidenced by sedimentary deposits.	B	Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further.
Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal) test including assessment of consequences.	C	Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the justification.
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1	Used to indicate that development can take place subject to application of justification test, including acceptability of consequences.
Areas of the floodplain without significant flood defence infrastructure.	C2	Used to indicate that only less vulnerable development should be considered subject to application of justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered.

2.2.3 The TAN states that *'new development should be directed away from zone C and towards suitable land in zone A, otherwise to zone B, where river or coastal flooding will be less of an issue. In zone C the tests outlined in sections 6 and 7 will be applied, recognising, however, that highly vulnerable development and Emergency Services in zone C2 should not be permitted. All other new development should only be permitted within zones C1 and C2 if determined by the planning authority to be justified in that location.'*

2.2.4 With regard to agriculture the TAN states that *'proposals for public open space, outdoor recreational uses and agricultural developments, are likely to be acceptable in all areas where there is a risk of flooding. However, ancillary buildings or structures required for these uses, which are subject to prior approval, may not be acceptable.'*

2.2.5 Appendix 1 of the TAN sets out the requirements for assessing flood consequences and lists assessment threshold frequencies for different types of development as follows:

Type of Development	Threshold Frequency (Years)	
	Fluvial	Tidal
Residential	1%	0.5%
Commercial/Retail	1%	0.5%
Industrial	1%	0.5%
Emergency Services	0.1%	0.1%
General Infrastructure	1%	0.5%

2.2.6 In addition indicative guidance is provided on what is considered tolerable conditions for different types of developments:

Type of development	Maximum depth of flooding (mm)	Maximum rate of rise of floodwaters (m/hr)	Maximum speed of inundation of flood risk area (hrs)	Maximum velocity of floodwaters (m/sec)
	Property Access			Property Access
Residential (habitable rooms)	600 600	0.1	4	0.15 0.3
Commercial & Retail	600 600	0.3	2	0.15 0.3
Industrial	1000 1000	0.3	2	0.3 0.45
Emergency Services	450 600	0.1	4	0.15 0.3
General Infrastructure	600 600	0.3	2	0.3 0.3

2.3 Statutory National Standards for Sustainable Drainage Systems (SuDS) for Wales

2.3.1 The Statutory National Standards for Sustainable Drainage Systems (SuDS) for Wales incorporates six statutory standards.

2.3.2 **Standard S1 - Surface Water Runoff Destination** lists the preferred priorities for discharge of surface water as follows:

‘Priority Level 1: Surface water runoff is collected for use;

Priority Level 2: Surface water runoff is infiltrated to ground;

Priority Level 3: Surface water runoff is discharged to a surface water body;

Priority Level 4: Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system;

Priority Level 5: Surface water runoff is discharged to a combined sewer.’

2.3.3 **Standard S2 - Surface Water Runoff Hydraulic Control** states that:

- ‘1) Surface water should be managed to prevent, so far as possible, any discharge from the site for the majority of rainfall events of less than 5mm.*
- 2) The surface water runoff rate for the 1 in 1 year return period event (or agreed equivalent) should be controlled to help mitigate the negative impacts of the development runoff on the morphology and associated ecology of the receiving surface water bodies.*
- 3) The surface water runoff (rate and volume) for the 1% (1 in 100 year) return period event (or agreed equivalent) should be controlled to help mitigate negative impacts of the development on flood risk in the receiving water body.*
- 4) The surface water runoff for events up to the 1% (1 in 100 year) return period (or agreed equivalent) should be managed to protect people and property on and adjacent to the site from flooding from the drainage system.*
- 5) The risks (both on site and off site) associated with the surface water runoff for events greater than the 1% (1 in 100 year) return period should be considered. Where the consequences are excessive in terms of social disruption, damage or risk to life, mitigating proposals should be developed to reduce these impacts.*
- 6) Drainage design proposals should be examined for the likelihood and consequences of any potential failure scenarios (e.g. structural failure or blockage), and the associated flood risks managed where possible.’*

2.3.4 **Standard S3 - Water Quality** states that *'treatment for surface water runoff should be provided to prevent negative impacts on the receiving water quality and/or protect downstream drainage systems, including sewers.'*

2.3.5 **Standard S4 - Amenity** states that *'the design of the surface water management system should maximise amenity benefits.'*

2.3.6 **Standard S5 - Biodiversity** states that *'the design of the surface water management system should maximise biodiversity benefits.'*

2.3.7 **Standard S6 - Design of drainage for Construction, Operation and Maintenance** states that:

- '1) All elements of the surface water drainage system should be designed so that they can be constructed easily, safely, cost-effectively, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon (energy).*
- 2) All elements of the surface water drainage system should be designed to ensure maintenance and operation can be undertaken (by the relevant responsible body) easily, safely, cost-effectively, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon (energy).*
- 3) The surface water drainage system should be designed to ensure structural integrity of all elements under anticipated loading conditions over the design life of the development site, taking into account the requirement for reasonable levels of maintenance.'*

2.4 SuDS Approving Body

2.4.1 From 7 January 2019 all new developments of more than 1 house or where the construction area is of 100m² or more require sustainable drainage to manage on-site surface water.

2.4.2 These systems must be approved by Wrexham County Borough Council SuDS Approving Body (SAB) before construction work begins.

2.4.3 An application has been made to Wrexham County Borough Council SAB and this document forms a part of that application.

2.5 Lead Local Flood Authority

2.5.1 Wrexham County Borough Council became a Lead Local Flood Authority under the Flood and Water Management Act 2010 and was given a series of new responsibilities to coordinate the management of local flood risk.

2.5.2 As part of its role Wrexham County Borough Council has commissioned and produced the following documents:

- Local Flood Risk Management Strategy – April 2013
- Flood Risk Management Plan – July 2016
- Preliminary Flood Risk Assessment Addendum – November 2017

2.5.3 The above documents have been reviewed in the preparation of this report.

2.5.4 The Dee Preliminary Flood Risk Assessment dated December 2018 was prepared by The Environment Agency in partnership with Natural Resources Wales and includes the area of Wrexham which has also been reviewed.

2.6 Local Planning Policy

2.6.1 Wrexham County Borough Council is preparing the Wrexham Local Development Plan 2 (LDP2) 2013 to 2028 which will replace the current adopted Unitary Development Plan. The LDP will be a long-term land use and development strategy focused on achieving sustainable development.

2.6.2 There are no adopted policies in respect of flooding or drainage.

3 Existing Site

3.1 Site Location

3.1.1 The development site is located on land west of Sesswick Way, Wrexham at Ordnance Survey reference SJ 369 480. The nearest postcode is LL13 0PA.

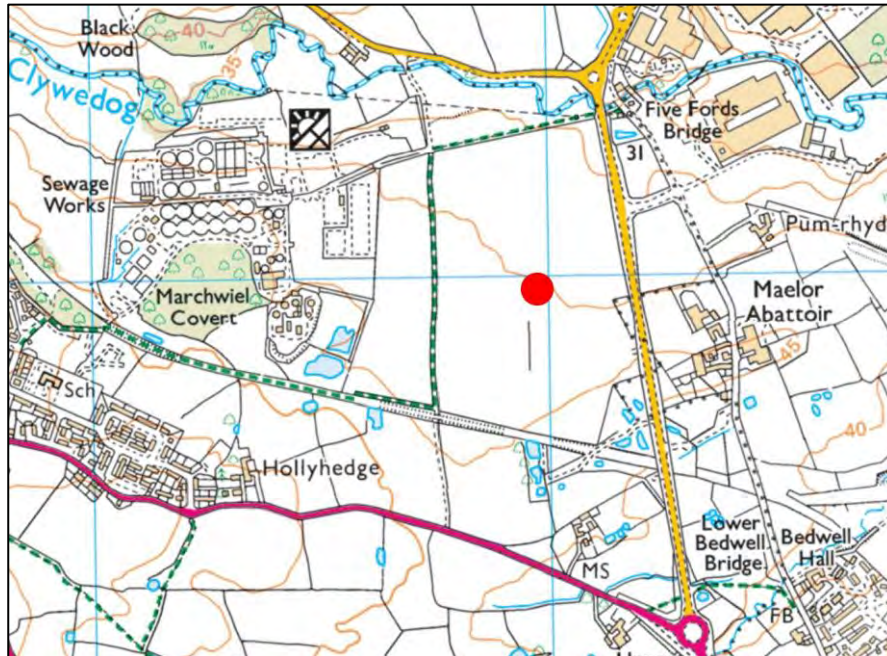


Image 1: Site Location

3.1.2 The site is predominantly surrounded by farmland. It is bounded to east by Sesswick Way, the south by the former Wrexham to Ellesmere railway line, the east by a farm track, farmland and the Five Fords wastewater treatment works beyond. The River Clywedog is located immediately to the north of the site and in part within the site boundary flowing beneath the main access to Cefn Road.

3.1.3 A copy of the site location plan is located in Appendix 1 at the rear of this report.

3.2 Site Description

3.2.1 The site is approximately 45ha in area and currently comprises undeveloped agricultural land.

3.2.2 Access to the site is available via the existing access road at the northwest corner of the site which crosses the River Clywedog immediately south of its junction with Cefn Road.

3.2.3 There are two additional vehicle access points available from Sesswick Way to the east of the site

3.2.4 Existing ground levels are highest at the southeast corner of the site at approximately 45.5m AOD. The site falls towards its northeast boundary to a level of approximately 34.2m AOD.

3.2.5 A copy of the existing site layout plan is located in Appendix 2 at the rear of this report.

3.3 Existing Drainage

3.3.1 The site currently has no positive surface water or foul water drainage infrastructure.

3.3.2 Rainfall on the site currently discharges overland as a greenfield runoff to the River Clywedog to the north of the site.

3.3.3 The existing greenfield runoff rates have been established using the HR Wallingford tool for greenfield runoff estimation and are as follows:

Q_{bar}	0.17l/s/ha
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1:100 year	0.37l/s/ha
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HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:

Site name:

Site location:

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:

Longitude:

Reference:

Date:

Runoff estimation approach

Site characteristics

Total site area (ha):

Methodology

Q_{BAR} estimation method:

SPR estimation method:

Soil characteristics

	Default	Edited
SOIL type:	1	1
HOST class:	N/A	N/A
SPR/SPRHOST:	0.1	0.1

Hydrological characteristics

	Default	Edited
SAAR (mm):	700	700
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):	0.17	0.17
1 in 1 year (l/s):	0.15	0.15
1 in 30 years (l/s):	0.3	0.3
1 in 100 year (l/s):	0.37	0.37
1 in 200 years (l/s):	0.41	0.41

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Image 2: Greenfield Runoff Calculation

- 3.3.4 There is a 150mm diameter public foul sewer located approximately 140m to the east of the site on the eastern side of Bedwell Road.
- 3.3.5 This sewer discharges to a foul pumping station located approximately 150m from the northeast corner of the site and on the eastern side of Sesswick Way.
- 3.3.6 There are two public foul rising mains located parallel to and within the northern site boundary which discharge foul water from the pumping station at the

northeast of the site to the Five Fords wastewater treatment works which is located 160m to the west of the site.

3.3.7 In addition there is a gravity fed effluent pipe from the Five Fords wastewater treatment works which crosses the site and is located 20-25m below ground level.

3.3.8 A copy of the sewer records is located in Appendix 3 at the rear of this report.

3.4 Geology and Groundwater

3.4.1 Site investigation was carried out by GeoCon Site Investigation Limited on 27 May 2020.

3.4.2 Boreholes have been sunk on site and confirm depths of topsoil of approximately 300mm over clay. There are in some cases layers of sandy clays between the topsoil and lower clay layer which vary between 0mm and 1.8m thick.

3.4.3 Soakage testing was also undertaken to BRE 365 in three locations. None of the tests could be completed sufficiently to gain an infiltration rate due to inadequate infiltration.

3.4.4 Extracts of the site investigation data together with a location plan are located in Appendix 4 at the rear of this report.

4 Flood Zone and Flood History

4.1 Flood Zone

- 4.1.1 Natural Resources Wales' online mapping confirms that the operational area of the site is located in Flood Zone 1 (equivalent to Flood Zone A as defined by Planning Policy Wales and Technical Advice Note 15: Development and Flood Risk).
- 4.1.2 The main site access from Cefn Road at the north of the site crosses the River Clywedog and is partially within an area designated as being within Flood Zones 2 and 3, (equivalent to Flood Zones B and C)
- 4.1.3 There is a secondary access available to Sesswick Way to the east of the site which is located entirely within Flood Zone 1.

4.2 Flood History

- 4.2.1 The Natural Resources Wales maps of historic flood incidents do not identify any historic incidents of flooding in the locality of the site.
- 4.2.2 The Dee Preliminary Flood Risk Assessment dated December 2018 prepared by The Environment Agency in partnership with Natural Resources Wales does not identify any historic incidents of flooding in the vicinity of the site.

4.3 Wrexham County Borough Council

- 4.3.1 Neither the Local Flood Risk Management Strategy dated April 2013 nor the Flood Risk Management Plan dated July 2016 identify any historic instances of flooding in the vicinity of the site.
- 4.3.2 The Preliminary Flood Risk Assessment Addendum dated November 2017 confirmed that *'there has been a review of flooding experienced since the publication of the first Preliminary Flood Risk Assessment Report in 2011 and there have been no floods experienced that caused locally significant harmful consequences.'*
- 4.3.3 Copies of the available flood maps are located in Appendix 5 at the rear of this report.

5 Flooding Potential

5.1 Tidal Flooding

5.1.1 The site is located 25km from the coast and is not at risk of tidal flooding.

5.2 Fluvial Flooding

5.2.1 The operational area of the site is within Flood Zone 1 and is not at risk of fluvial flooding from anything less extreme than a 1:1,000 year flood event.

5.3 Groundwater Flooding

5.3.1 Groundwater was not encountered in the site investigation works which extended to a depth of 5.45m below ground level.

5.3.2 There are no records identified within Wrexham County Borough Council's Local Flood Risk Management Strategy dated April, Flood Risk Management Plan or Preliminary Flood Risk Assessment Addendum, nor in the Dee Preliminary Flood Risk Assessment of groundwater flooding affecting the site.

5.3.3 The Dee Preliminary Flood Risk Assessment notes that *'groundwater flood events in Wales are rare. The geology (underlying rock type) and topography (steep sided valleys) mean that groundwater flooding is very unlikely to occur.'*

5.4 Overland Flow

5.4.1 The flood mapping contained within the Wrexham County Borough Local Flood Risk Management Strategy identifies areas of the site to be at risk of flooding from overland surface water.

5.4.2 The locations identified are however minimal and all are isolated and appear to be areas of potential ponding with no apparent overland flow route.

5.5 Flood Routing

5.5.1 The natural route for flood waters to dissipate, should any event occur on the site is to the River Clywedog at the northern site boundary.

5.5.2 There is no associated flood risk to the downstream catchment and there are no residual flood consequences.

6 Development Proposals

6.1 Description

6.1.1 The development proposals are for the construction of:

- Two glasshouses each approximately 7.5ha in area with a 4m wide stone access road around the outside perimeter
- A packing and welfare building approximately 0.6 ha in area incorporating the packing area, canteen/toilets, irrigation, storage rooms and site offices.
- Energy centre building with two 25m diameter 10 m high vertical heat store tanks and five 11 m diameter 6 m high water silos
- Access and parking comprising a concreted service yard, access road and turning area with ten HGV loading bays adjacent to the packhouse and parking for staff and visitors constructed as a compacted stone hardstanding.
- Rainwater reservoirs sized to meet irrigation and have adequate spare attenuation capacity at all times to meet a 1:100 +40% storm event.
- A maximum of five 11 m diameter 6 m high irrigation water storage silos located adjacent to the energy centre buildings

6.1.2 A copy of the proposed site layout plan is located in Appendix 6 at the rear of this report.

6.2 Drainage Strategy

6.2.1 All rainwater from roofs will be collected together with all treated surface water runoff from the hard paved areas of site and collected on site within reservoirs with 100% rainwater recycling for irrigation under normal circumstances.

6.2.2 The reservoirs will be sized with sufficient storage provided to accommodate a 1:100 year storm event including an additional 40% to account for the predicted effects of future climate change beyond the normal irrigation requirement.

6.2.3 Only in the event that the operational capacity of the reservoir is already full during a significant rainfall event will there be an associated restricted discharge from the site.

6.2.4 The estimated impermeable areas for various elements of the site are as follows:

- Glasshouse Roofs 15.1ha
- Perimeter access track 1.0ha
- Ancillary Buildings 0.9ha
- External Hard Standings 1.8ha
- Reservoirs 4.4ha

6.2.5 The total impermeable area of the site including the areas of the reservoirs will be approximately 23.1ha.

6.2.6 HR Wallingford recommends that where Q_{bar} greenfield runoff rates are less than 2l/s/ha a value of 2l/ha is used for limiting runoff.

6.2.7 The average irrigation requirements for the site has been established by Envireau Water as 460m³/day, (an average of 5.3l/s).

6.2.8 Preliminary calculations have been prepared in order to determine the additional storage required beyond the operational irrigation requirement and the additional freeboard required to accommodate a 1:100 year return period storm occurring at a time when the irrigation reservoirs have their maximum operational water already available.

6.2.9 Four irrigation reservoirs are proposed on the site:

- Reservoir 1 East of Glasshouse Surface Area 5,304m²
- Reservoir 2 East of Glasshouse Surface Area 10,046m²
- Reservoir 3 South of Glasshouse Surface Area 11,737m²
- Reservoir 4 Northwest of Glasshouse Surface Area 15,311m²

6.2.10 Reservoirs 1, 2 and 3 will be linked hydraulically at a level above their maximum irrigation water levels and surface water from the glasshouse roof will be discharged in direct proportion to their surface areas such that they will fill at a uniform rate and do not require large capacity hydraulic links.

6.2.11 Reservoirs 1, 2 and 3 will also accept half the water drained from the glasshouse perimeter access tracks.

6.2.12 These reservoirs will be constructed with 1:3 sloping sides. Preliminary calculations confirm that the top 850mm of these reservoirs will be required to accommodate a 1:100 year +40% storm which will be restricted to 27l/s, the minimum outflow to achieve a half empty time within 24 hours.

- 6.2.13 Reservoir 4 will accept the inflow of 27l/s from the outfall of Reservoir 3 in addition to the remaining half of the water drained from the glasshouse perimeter access tracks, and the surface water collected from the remaining building and the service yard hardstanding areas.
- 6.2.14 The gradient between the top irrigation water levels between Reservoir 3 and Reservoir 4 will be approximately 1:205. An interconnecting pipe with a minimum diameter of 225mm will be sufficient to convey the required flow and achieve a self-cleansing velocity.
- 6.2.15 This reservoir will also be constructed with 1:3 sloping sides. Preliminary calculations confirm that the top 450mm of reservoir 4 will be required to accommodate a 1:100 year +40% storm which will be restricted to 42l/s, the minimum outflow which can achieve a half empty time within 24 hours, and discharged to the River Clywedog.
- 6.2.16 This remains below the minimum 46l/s recommended by HR Wallingford Guidance.
- 6.2.17 Should an exceedance event occur floodwater would be dissipated from Reservoir 4 into the River Clywedog.
- 6.2.18 None of the three proposed reservoirs will individually hold more than 25,000m³ of escapable volume.
- 6.2.19 The drainage proposals will be further confirmed at detailed design stage.
- 6.3 Foul Water
- 6.3.1 Foul water will be discharged to the existing 150mm diameter public foul sewer located adjacent to Bedwell Road to the east of the site.
- 6.3.2 A copy of the preliminary drainage strategy plan together with calculations is located in Appendix 7 at the rear of this report.
- 6.4 Water Quality
- 6.4.1 The proposed development is for commercial use. In accordance with the Statutory National Standards for Sustainable Drainage Systems (SuDS) for Wales and CIRIA report C753 - The SuDS Manual, the pollution hazard level for this type of development ranges between low, medium and high depending on the use / area of the site.
- 6.4.2 The surface water scheme will include mitigation to ensure that surface water is suitably treated and any pollution risk adequately managed prior to irrigation reuse or in the event of a restricted discharge to the River Clywedog.

6.4.3 The Statutory National Standards for Sustainable Drainage Systems (SuDS) for Wales reference table 4.3 of the CIRIA report C753 - The SuDS Manual and the Simple Index Approach Pollution Hazard Indices which are of relevance to the development proposals are as follows:

Land Use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Individual property driveways, residential car park, low-traffic roads	Low	0.5	0.4	0.4
Commercial yards and delivery areas	Medium	0.7	0.6	0.7
Sites where chemicals and fuels are delivered, handled, stored, used or manufactured	High	0.8	0.8	0.9

Table 1: Pollution Hazard Indices

6.4.4 The Pollution Mitigation Indices which are of relevance to the development proposals are as follows:

SuDS Type	Total suspended solids (TSS)	Metals	Hydro-carbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Propriety Treatment Systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area		

Table 2: Pollution Mitigation Indices

6.4.5 Where multiple drainage components are used in series the individual mitigation index of secondary and tertiary components is lowered by 50% due to reduced performance associated with primary treatment.

6.4.6 The use of petrol interceptors, filter strips, and storage within the onsite reservoirs will achieve the necessary treatment level.

6.4.7 An outline drainage maintenance schedule is located in Appendix 8 at the rear of this report.

6.5 Amenity and Biodiversity

6.5.1 The provision of large reservoir water bodies will encourage aquatic birds and wildlife and will provide enhanced visual amenity and biodiversity to the location.

7 Safe Development

7.1 Flood Zone Compatibility

- 7.1.1 The operational area of the site is located in entirely within Flood Zone 1.
- 7.1.2 The main site access from is partially located within Flood Zones 2 and 3 but secondary access is available for vehicular traffic and pedestrians entirely within Flood Zone 1.
- 7.1.3 With reference to Planning Policy Wales is suitable in this location.

7.2 Risk to Others

- 7.2.1 The proposed surface water drainage system will be designed to current standards incorporating SuDS elements providing treatment, and storage which will minimise runoff leaving the site during times of heavy rain to zero under normal operations.
- 7.2.2 Allowance has been made for a 40% increase in rainfall.
- 7.2.3 The risk of surface water flooding to others due to the development proposals is reduced and the resultant risk is negligible.
- 7.2.4 The reservoirs will be excavated from ground level such that there is no possibility of a breach occurring.

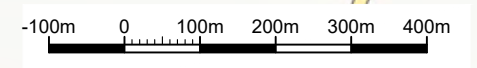
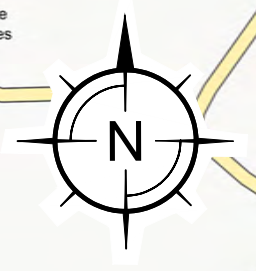
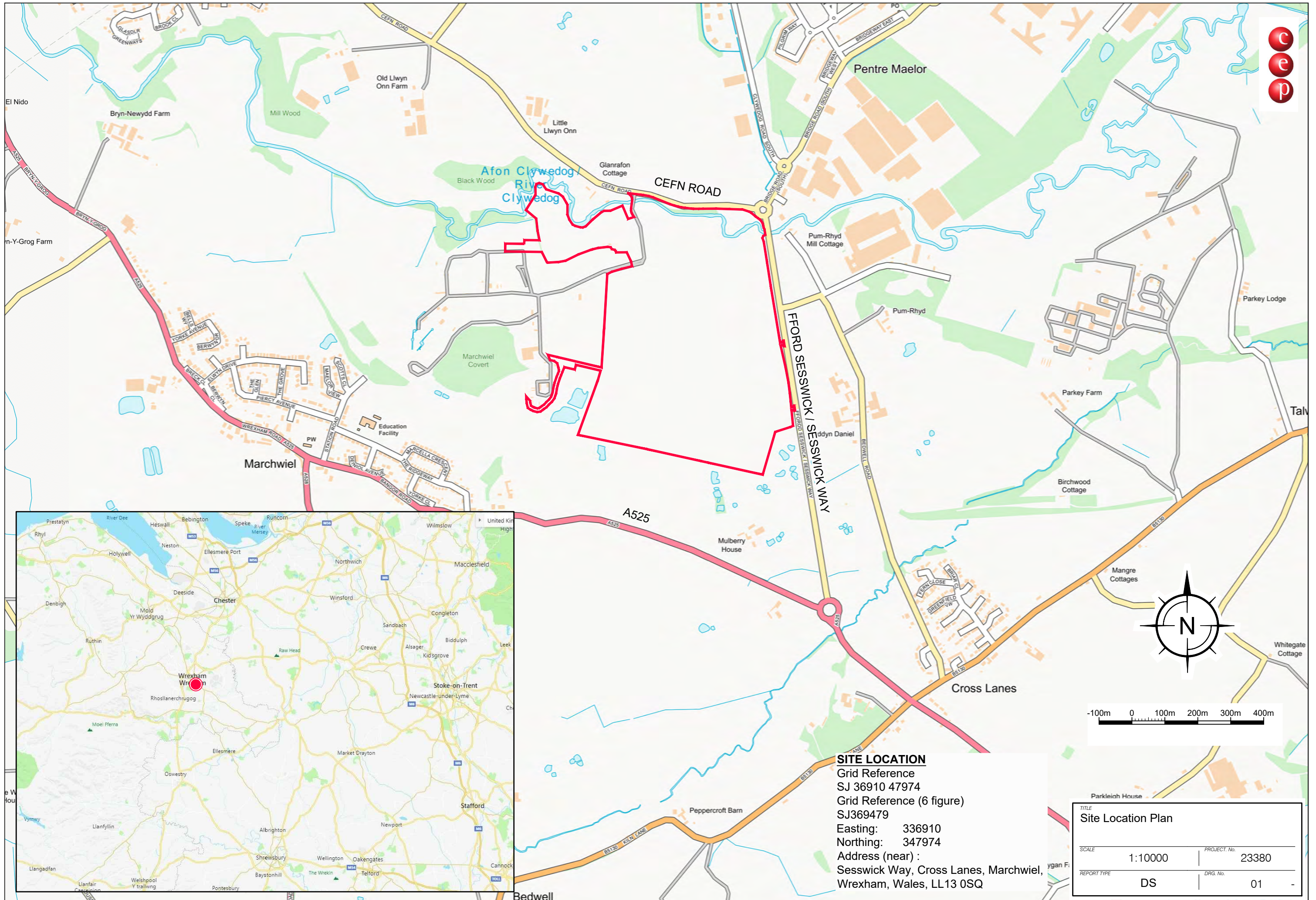
8 Conclusions

- 8.1 The operational area of the site is located within and can be accessed from Flood Zone 1 and is not at risk from any source of flooding.
- 8.2 There are no historic records of flooding from any source affecting the site or its immediate area.
- 8.3 The geology of the area is predominantly clay and does not provide suitable infiltration to support an infiltration drainage system.
- 8.4 Preliminary calculations indicate that surface water runoff generated by the proposed development can be attenuated on site for all rainfall events up to the 1:100 year event including an allowance for climate change.
- 8.5 The reservoirs will be excavated from ground level such that there is no possibility of a breach occurring.
- 8.6 Water quality improvement will be provided to mitigate against the potential risks to the River Clywedog in the event that a restricted overflow is ever required.
- 8.7 Foul drainage will be discharged to the existing 150mm diameter public foul sewer located adjacent to Bedwell Road to the east of the site.
- 8.8 A suitable SuDS drainage system is proposed which accords with the requirements of national and local policy.
- 8.9 In terms of flood risk planning the proposed development is safe and will not increase flood risk elsewhere and will provide improvement to immediately adjacent sites by managing surface water from all rainfall events up to the 100 year plus climate change event.
- 8.10 Should an exceedance event occur floodwater would be dissipated from Reservoir 4 into the River Clywedog which flows adjacent to the northeast site boundary. There are no flood consequences to the downstream catchment associated with the development proposals.
- 8.11 The development proposals are suitable at this location.

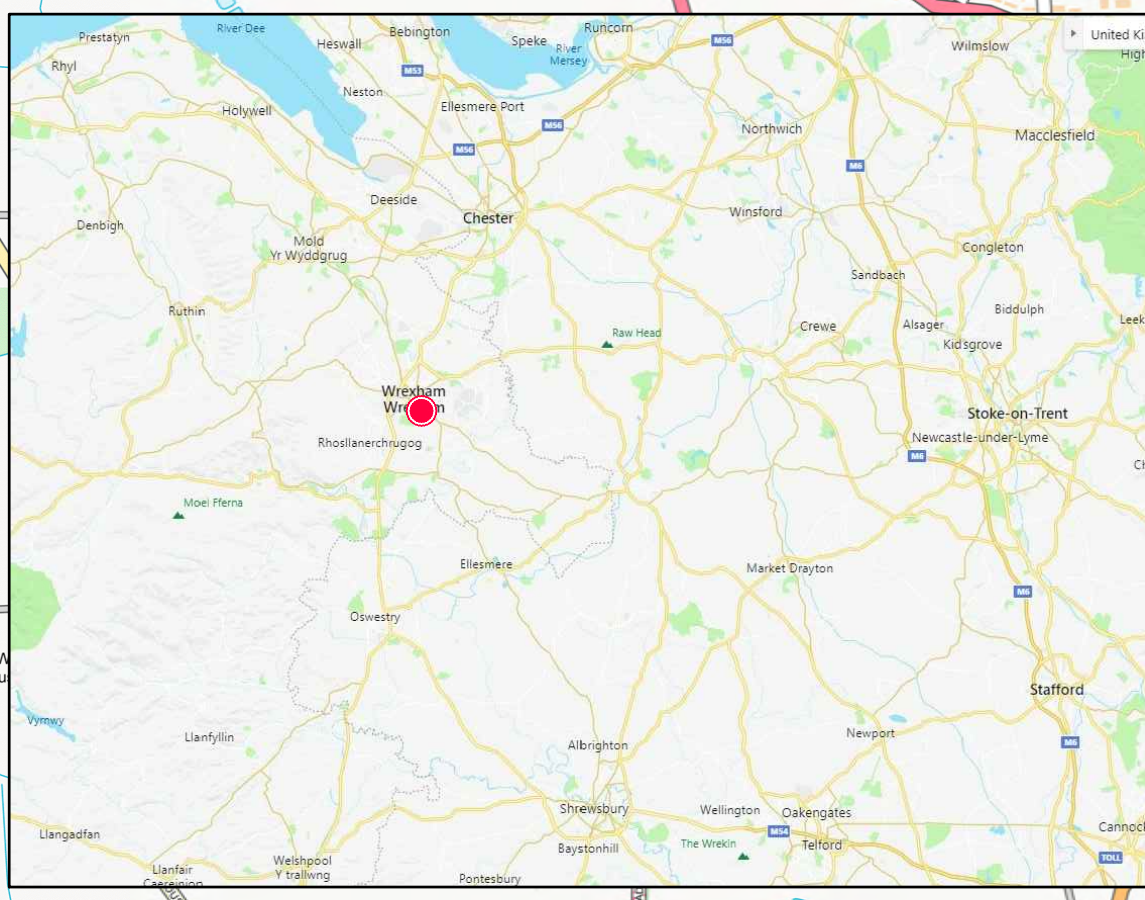
9 List of Appendices, Images and Tables

Appendix 1	Site Location Plan
Appendix 2	Existing Site Layout Plan
Appendix 3	Sewer Records
Appendix 4	Site Investigation Data
Appendix 5	Flood Maps
Appendix 6	Proposed Site Layout Plan
Appendix 7	Preliminary Drainage Strategy Plan and Calculations
Appendix 8	Drainage Maintenance Schedule
Image 1	Site Location
Image 2	Greenfield Runoff Calculation
Table 1	Pollution Hazard Indices
Table 2	Pollution Mitigation Indices

Appendix 1
Site Location Plan

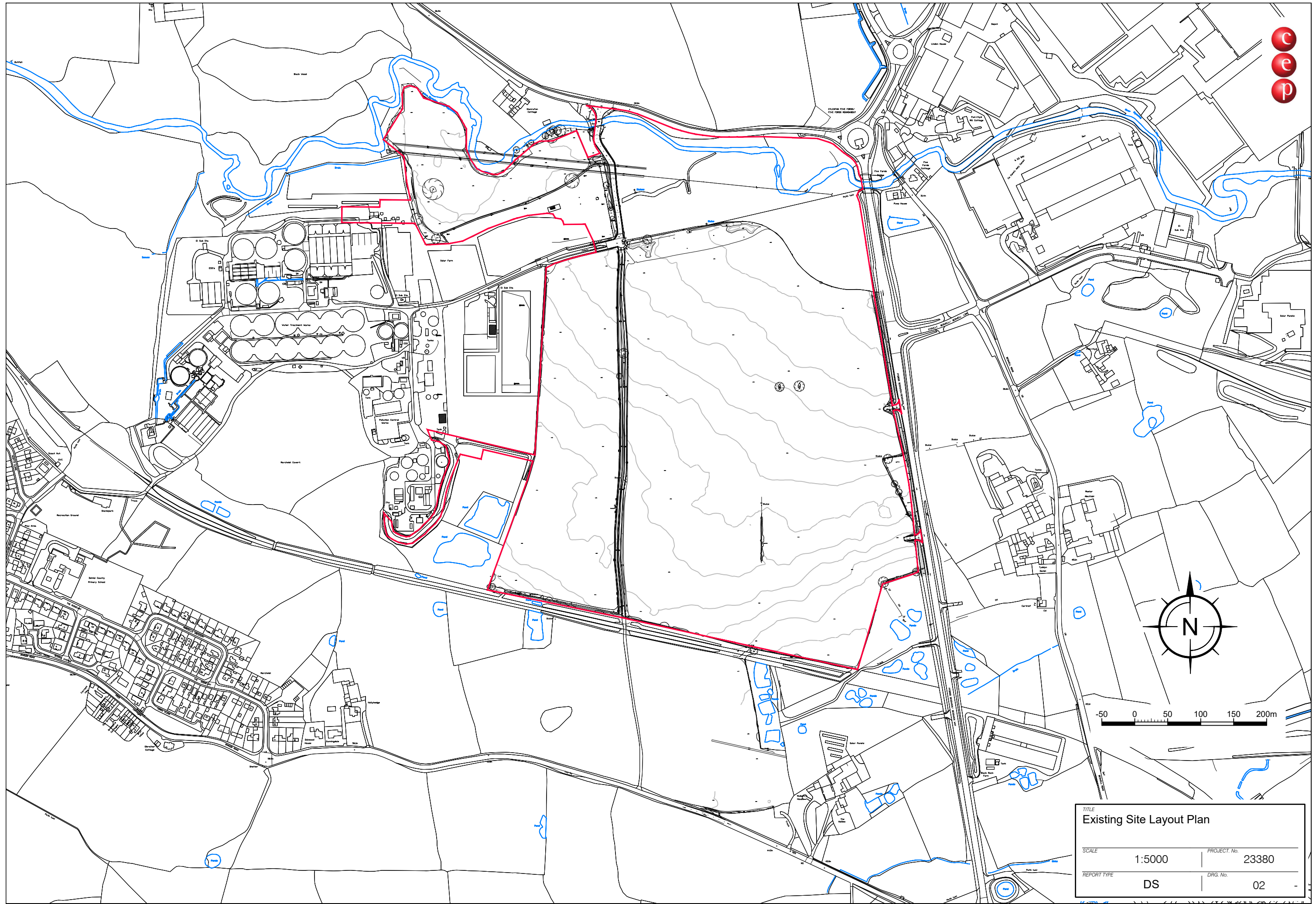


SITE LOCATION
Grid Reference
SJ 36910 47974
Grid Reference (6 figure)
SJ369479
Easting: 336910
Northing: 347974
Address (near) :
Sesswick Way, Cross Lanes, Marchwiel,
Wrexham, Wales, LL13 0SQ



TITLE	
Site Location Plan	
SCALE	1:10000
PROJECT No.	23380
REPORT TYPE	DS
DRG. No.	01

Appendix 2
Existing Site Layout Plan



TITLE			
Existing Site Layout Plan			
SCALE		PROJECT No.	
1:5000		23380	
REPORT TYPE		DRG. No.	
DS		02	

Appendix 3
Sewer Records



23380 Five Fords, Wrexham

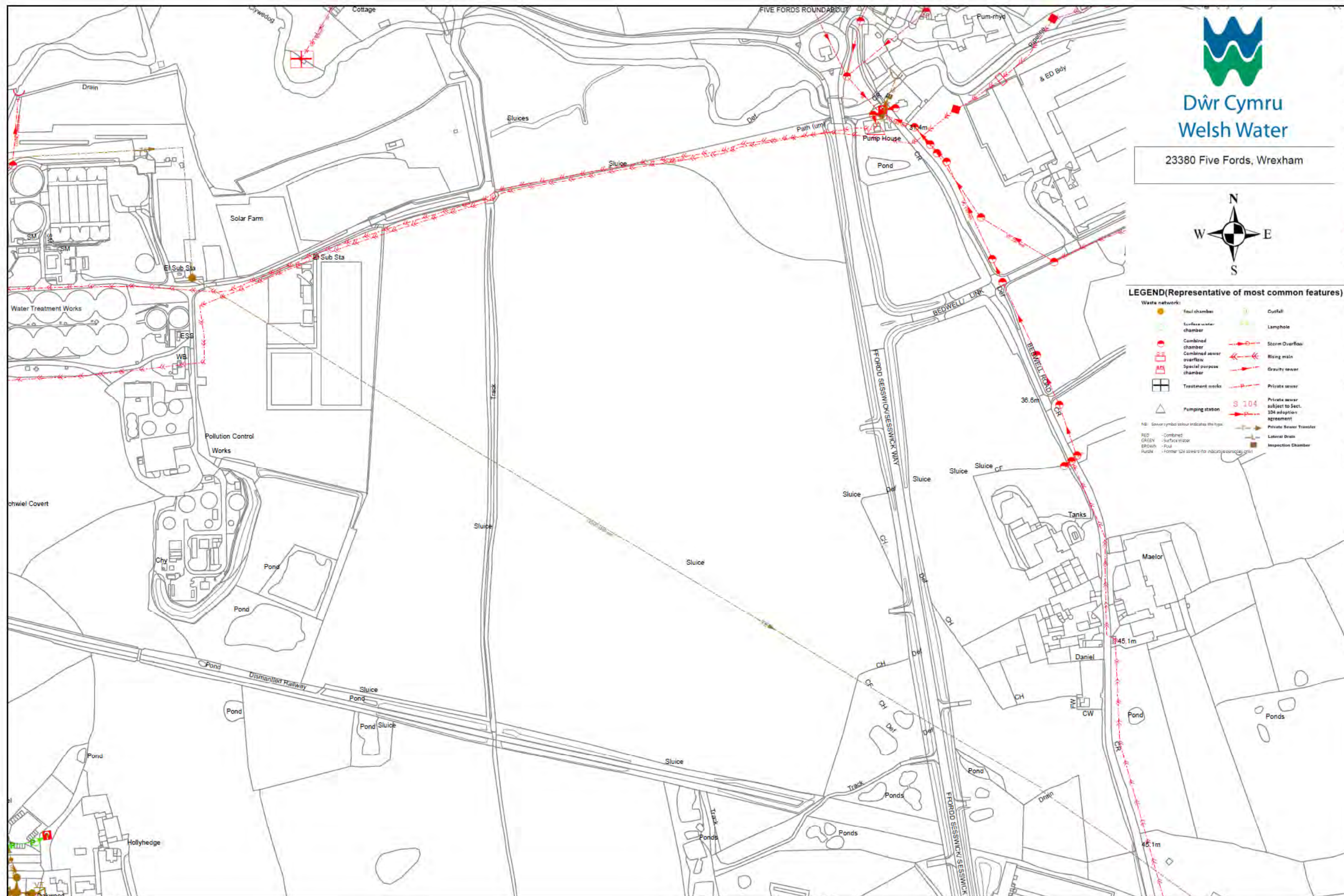


LEGEND(Representative of most common features)

Waste network:

	Fault chamber		Cutfall
	Surface water chamber		Lamphole
	Combined chamber		Storm Overflow
	Combined sewer overflow		Rising main
	Special purpose chamber		Gravity sewer
	Treatment works		Private sewer
	Pumping station		Private sewer subject to Sect. 104 adoption agreement
			Private Sewer Transfers
			Lateral Drains
			Inspection Chambers

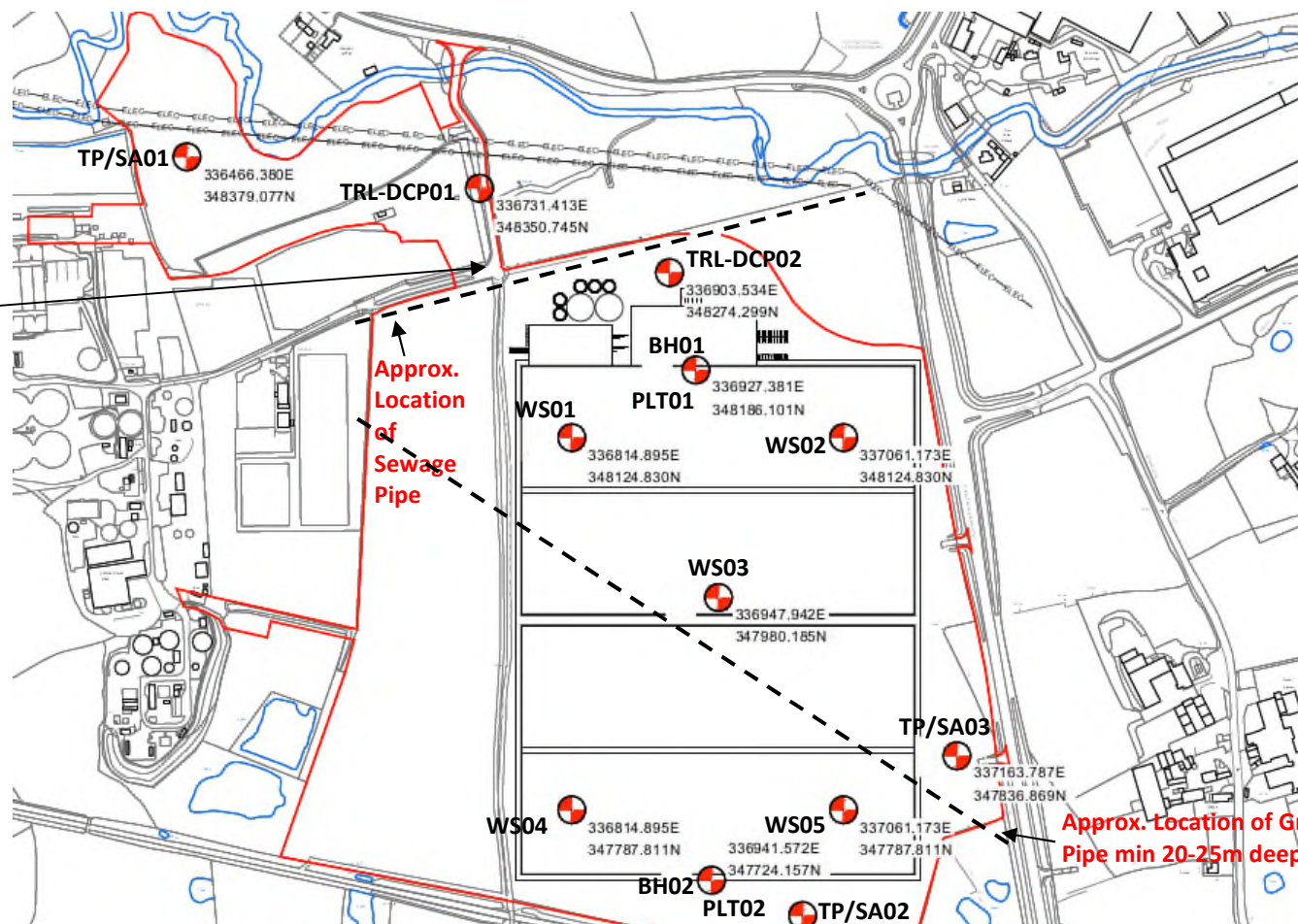
NB: Sewer symbol colour indicates the type.
 RED - Combined
 GREEN - Surface Water
 BROWN - Foul



Appendix 4
Site Investigation Data



Access
Point



Approx. Location of Gravity Fed Effluent
Pipe min 20-25m deep



GeoCon Site Investigations Ltd
Suite 2 Marple House,
39 Stockport Road,
Marple,
Stockport,
SK6 6BD.
Tel: 0844 504 3901, Fax: 0844 504 3902,
Email: info@geoconsiteinvestigations.com
Web: www.geoconsiteinvestigations.com

SITE NAME/CONTRACT

Five Fords, Wrexham

DRAWING NO.

GSI 1282/02

SCALE

N.T.S

TITLE

Exploratory Hole Location Plan

DATE

May 2019

DRAWN BY

IW



Project Five Fords, Wrexham				WINDOWLESS SAMPLE BOREHOLE No TP/SA01
Project ID GSI1282	Date 27-05-20 27-05-20	Ground Level (m)	Co-Ordinates	
Contractor				Sheet 1 of 1

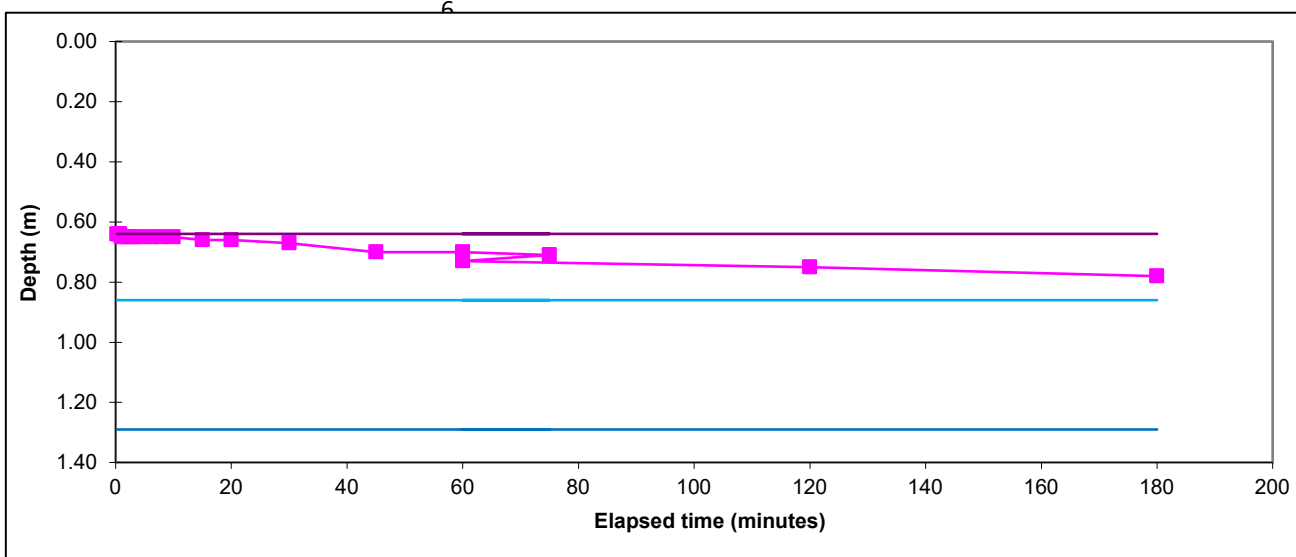
Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Depth	From	To	Hours	From	To	
											Location cleared of buried services. Trial pit dug to 1.50mbgl for soak away testing.

All dimensions in metres Scale 1:12.5	Client Civil Engineering Practise	Method / Plant Used JCB 3CX	Logged By Tom Flame
--	--------------------------------------	--------------------------------	------------------------

Geocon Site Investigations Ltd

Soakaway Test

Trial Pit No:	SA01	Test No:	1	Date:	27/05/2020
Length (m):	1.80	Datum Height:		m agl	
Width (m):	0.60	Granular infill:			
Depth (m):	1.50	Porosity of infill:		(assumed)	
Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)		
0.25	0.64	60	0.70		
0.5	0.64	75	0.71		
0.75	0.64	60	0.73		
1	0.65	120	0.75		
2	0.65	180	0.78		
3	0.65				
4	0.65				
6	0.65				
8	0.65				
10	0.65				
15	0.66				
20	0.66				
30	0.67				
45	0.70				



Start water depth for analysis (mbgl):	0.64	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	0.86	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.07		
25% effective depth (mbgl):	1.29		
Base of soakage zone (mbgl):	1.50		
Volume outflow between 75% and 25% effective depth (m ³):			
Mean surface area of outflow (m ²):			3.14
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

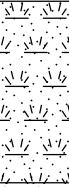
Soil infiltration rate (m/s):	Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.
-------------------------------	--

Remarks	Results processed following BRE 365 (2007). Falling head test taken within casing in rock at 4.00mbgl
---------	--

Client:		SA01
Site:		

WINDOWLESS SAMPLE BOREHOLE LOG

Project Five Fords, Wrexham				WINDOWLESS SAMPLE BOREHOLE No TP/SA02
Project ID GSI1282	Date 27-05-20 27-05-20	Ground Level (m)	Co-Ordinates	
Contractor				
				Sheet 1 of 1

SAMPLES & TESTS			STRATA					Geology	Instrument & Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						(0.30)	Brown slightly gravelly SAND with occasional rootlets. Gravel is subangular to subrounded, fine to coarse of sandstone. (TOPSOIL)	TS	
						0.30			
						(1.20)	Stiff brown mottled grey slightly sandy CLAY. (TILL)	TILLD	
						1.50			

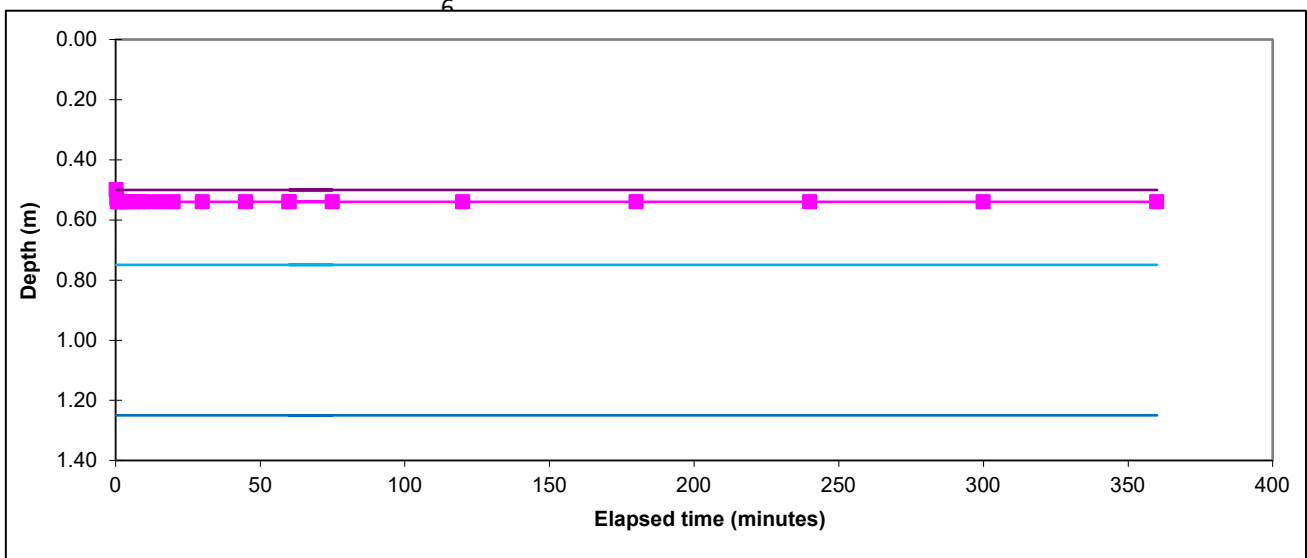
Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Depth	From	To	Hours	From	To	
											Location cleared of buried services. Trial pit dug to 1.50mbgl for soak away testing.

All dimensions in metres Scale 1:12.5	Client Civil Engineering Practise	Method / Plant Used JCB 3CX	Logged By Tom Flame
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Geocon Site Investigations Ltd

Soakaway Test

Trial Pit No:	SA02	Test No:	1	Date:	27/05/2020
Length (m):	1.60	Datum Height:		m agl	
Width (m):	0.80	Granular infill:			
Depth (m):	1.50	Porosity of infill:		(assumed)	
Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)		
0.25	0.50	60	0.54		
0.5	0.53	75	0.54		
0.75	0.54	60	0.54		
1	0.54	120	0.54		
2	0.54	180	0.54		
3	0.54	240	0.54		
4	0.54	300	0.54		
6	0.54	360	0.54		
8	0.54				
10	0.54				
15	0.54				
20	0.54				
30	0.54				
45	0.54				



Start water depth for analysis (mbgl):	0.50	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	0.75	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.00		
25% effective depth (mbgl):	1.25		
Base of soakage zone (mbgl):	1.50		
Volume outflow between 75% and 25% effective depth (m ³):			
Mean surface area of outflow (m ²):			3.68
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

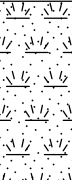
Soil infiltration rate (m/s):	Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.
-------------------------------	--

Remarks	Results processed following BRE 365 (2007). Falling head test taken within casing in rock at 4.00mbgl
---------	--

Client:		SA02
Site:		

WINDOWLESS SAMPLE BOREHOLE LOG

Project Five Fords, Wrexham				WINDOWLESS SAMPLE BOREHOLE No TP/SA03
Project ID GSI1282	Date 27-05-20 27-05-20	Ground Level (m)	Co-Ordinates	
Contractor				Sheet 1 of 1

SAMPLES & TESTS			STRATA						Geology	Instrument & Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION			
						(0.30) 0.30	Brown slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse of sandstone. (TOPSOIL)	TS		
						(0.60) 0.90	Orangish brown stiff sandy CLAY. (TILL)	TILLD		
						(0.60) 1.50	Firm grey sandy CLAY. (TILL)	TILLD		

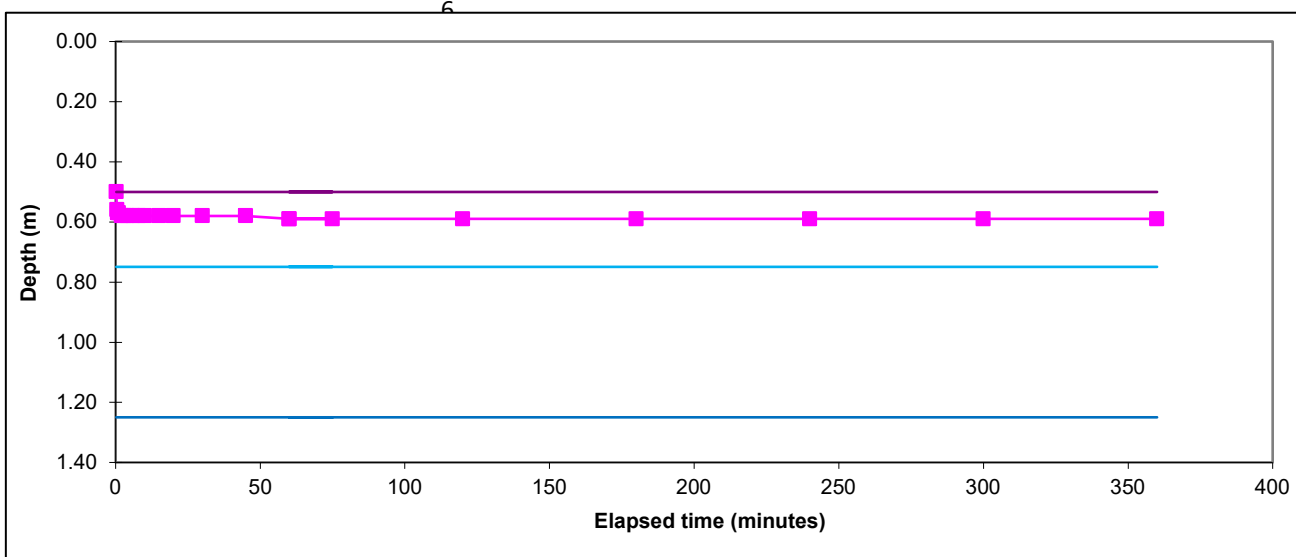
Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Depth	From	To	Hours	From	To	
											Location cleared of buried services. Trial pit dug to 1.50mbgl for soak away testing.

All dimensions in metres Scale 1:12.5	Client Civil Engineering Practise	Method / Plant Used JCB 3CX	Logged By Tom Flame
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Geocon Site Investigations Ltd

Soakaway Test

Trial Pit No:	SA03	Test No:	1	Date:	27/05/2020
Length (m):	1.70	Datum Height:		m agl	
Width (m):	0.70	Granular infill:			
Depth (m):	1.50	Porosity of infill:		(assumed)	
Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)		
0.25	0.50	60	0.59		
0.5	0.56	75	0.59		
0.75	0.57	60	0.59		
1	0.57	120	0.59		
2	0.58	180	0.59		
3	0.58	240	0.59		
4	0.58	300	0.59		
6	0.58	360	0.59		
8	0.58				
10	0.58				
15	0.58				
20	0.58				
30	0.58				
45	0.58				



Start water depth for analysis (mbgl):	0.50	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	0.75		
50% effective depth (mbgl):	1.00	Elapsed time (mins):	#N/A
25% effective depth (mbgl):	1.25		
Base of soakage zone (mbgl):	1.50		
Volume outflow between 75% and 25% effective depth (m ³):			
Mean surface area of outflow (m ²):			3.59
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

Soil infiltration rate (m/s):	Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.
-------------------------------	--

Remarks	Results processed following BRE 365 (2007). Falling head test taken within casing in rock at 4.00mbgl
---------	--

Client:		SA03
Site:		



WINDOWLESS SAMPLE BOREHOLE LOG

Project Five Fords, Wrexham				WINDOWLESS SAMPLE BOREHOLE No WS01	
Project ID GSI1282	Date 26-05-20 26-05-20	Ground Level (m)	Co-Ordinates		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			STRATA					Geology	Instrument & Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.80	D					(0.30) 0.30	Brown clayey gravelly SAND with occasional cobbles. Gravel is subangular to subrounded, fine to coarse of sandstone, mudstone and chalk. Cobbles are subrounded of sandstone.	TS	
						(0.50) 0.80	Light brown clayey gravelly SAND with occasional cobbles. Gravel is subangular to subrounded, fine to coarse of sandstone, mudstone and chalk. Cobbles are subrounded of sandstone.	TILLD	
1.20 1.20-1.65	D SPT	N12				(3.65)	Soft to firm brown CLAY. (TILL)	TILLD	
2.00 2.00-2.45	D SPT	N15							
3.00 3.00-3.45	D SPT	N13							
4.00 4.00-4.45	D SPT	N8				4.45			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	
											Location cleared of buried services. Handpit dug to 1.20mbgl. Groundwater not encountered. Borehole terminated at 4.45mbgl.
All dimensions in metres Scale 1:37.5			Client Civil Engineering Practise			Method / Plant Used Competitor Dart			Logged By Matt Styles		



WINDOWLESS SAMPLE BOREHOLE LOG

Project Five Fords, Wrexham				WINDOWLESS SAMPLE BOREHOLE No WS02
Project ID GSI1282	Date 27-05-20 27-05-20	Ground Level (m)	Co-Ordinates	
Contractor				Sheet 1 of 1

SAMPLES & TESTS			STRATA					Geology	Instrument & Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
1.20-1.65 1.20-1.65	D SPT	N17				(0.30) 0.30	Brown slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse of sandstone. (TOPSOIL)	TS	
						(1.70)	Firm brown mottled grey slightly sandy CLAY. (TILL)	TILLD	
2.00-2.45 2.00-2.45	D SPT	N15				(0.90)	Soft to firm brown slightly sandy CLAY. (TILL)	TILLD	
3.00-3.45 3.00-3.45	D SPT	N15				(2.55)	Soft to firm brown mottled grey slightly sandy CLAY. (TILL)	TILLD	
4.00-4.45 4.00-4.45	D SPT	N13				(2.55)	Soft to firm brown mottled grey slightly sandy CLAY. (TILL)	TILLD	
5.00-5.45 5.00-5.45	D SPT	N12				5.45			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	
All dimensions in metres Scale 1:37.5						Client Civil Engineering Practise			Method / Plant Used Competitor Dart		Logged By Tom Flame

Location cleared of buried services. Handpit dug to 1.20mbgl. Groundwater encountered at 4.50mbgl. Borehole terminated at 5.45mbgl at target depth.



WINDOWLESS SAMPLE BOREHOLE LOG

Project Five Fords, Wrexham				WINDOWLESS SAMPLE BOREHOLE No WS03	
Project ID GSI1282	Date 27-05-20 27-05-20	Ground Level (m)	Co-Ordinates		
Contractor				Sheet 1 of 1	

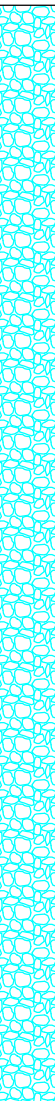
SAMPLES & TESTS			STRATA					Geology	Instrument & Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
1.20-1.65 1.20-1.65	D SPT	N19				(0.30) 0.30	Brown slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse of sandstone. (TOPSOIL)	TS	
						(2.80)	Soft brown mottled grey slightly sandy thinly laminated CLAY. (TILL)	TILLD	
2.00-2.45 2.00-2.45	D SPT	N28							
3.00-3.45 3.00-3.45	D SPT	N15				3.10	Soft to firm greyish brown CLAY. (TILL)		
4.00-4.45 4.00-4.45	D SPT	N14				(2.35)		TILLD	
5.00-5.45 5.00-5.45	D SPT	N18				5.45			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Depth	From	To	Hours	From	To	
All dimensions in metres Scale 1:37.5			Client Civil Engineering Practise			Method / Plant Used Competitor Dart					Logged By Tom Flame



WINDOWLESS SAMPLE BOREHOLE LOG

Project Five Fords, Wrexham				WINDOWLESS SAMPLE BOREHOLE No WS04	
Project ID GSI1282	Date 27-05-20 27-05-20	Ground Level (m)	Co-Ordinates		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			STRATA					Geology	Instrument & Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
1.20-1.65 1.20-1.65	D SPT	N9				(0.50) 0.50	Brown slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse of sandstone. (TOPSOIL)	TS	
						(1.30) 1.80	Loose orange clayey SAND. (TILL)	TILLD	
		(1.00) 2.80		Medium dense grey slightly clayey sandy GRAVEL. Gravel is subangular to subrounded, fine to coarse of sandstone and mudstone. (TILL)	TILLD				
		3.00		Firm grey slightly sandy CLAY. (TILL)	TILLD				
				NO RECOVERY					
3.00-3.45 3.00-3.45	D SPT	N11							
4.00-4.45	SPT	N7				(2.45)			
5.00-5.45	SPT	N10				5.45			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	

All dimensions in metres Scale 1:37.5	Client Civil Engineering Practise	Method / Plant Used Competitor Dart	Logged By Tom Flame
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WINDOWLESS SAMPLE BOREHOLE LOG

Project Five Fords, Wrexham				WINDOWLESS SAMPLE BOREHOLE No WS05	
Project ID GSI1282	Date 27-05-20 27-05-20	Ground Level (m)	Co-Ordinates		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			STRATA					Geology	Instrument & Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
1.20-1.65 1.20-1.65	D SPT	N12	↓			(0.40) 0.40	Brown slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse of sandstone. (TOPSOIL)	TS	
2.00-2.45 2.00-2.45	D SPT	N21				(1.70) 2.10	Medium dense light grey and brown slightly clayey SAND. (ALLUVIUM)	ALV	
3.00-3.45 3.00-3.45	D SPT	N10				(3.35) 5.45	Soft greyish brown slightly silty thinly laminated CLAY. (TILL)	TILLD	
4.00-4.45 4.00-4.45	D SPT	N12							
5.00-5.45 5.00-5.45	D SPT	N10							

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	

All dimensions in metres Scale 1:37.5	Client Civil Engineering Practise	Method / Plant Used Competitor Dart	Logged By Tom Flame
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Appendix 5

Flood Maps

Lle

A Geo-Portal for Wales

Cymraeg



Flood Risk Areas

Natural Resources Wales

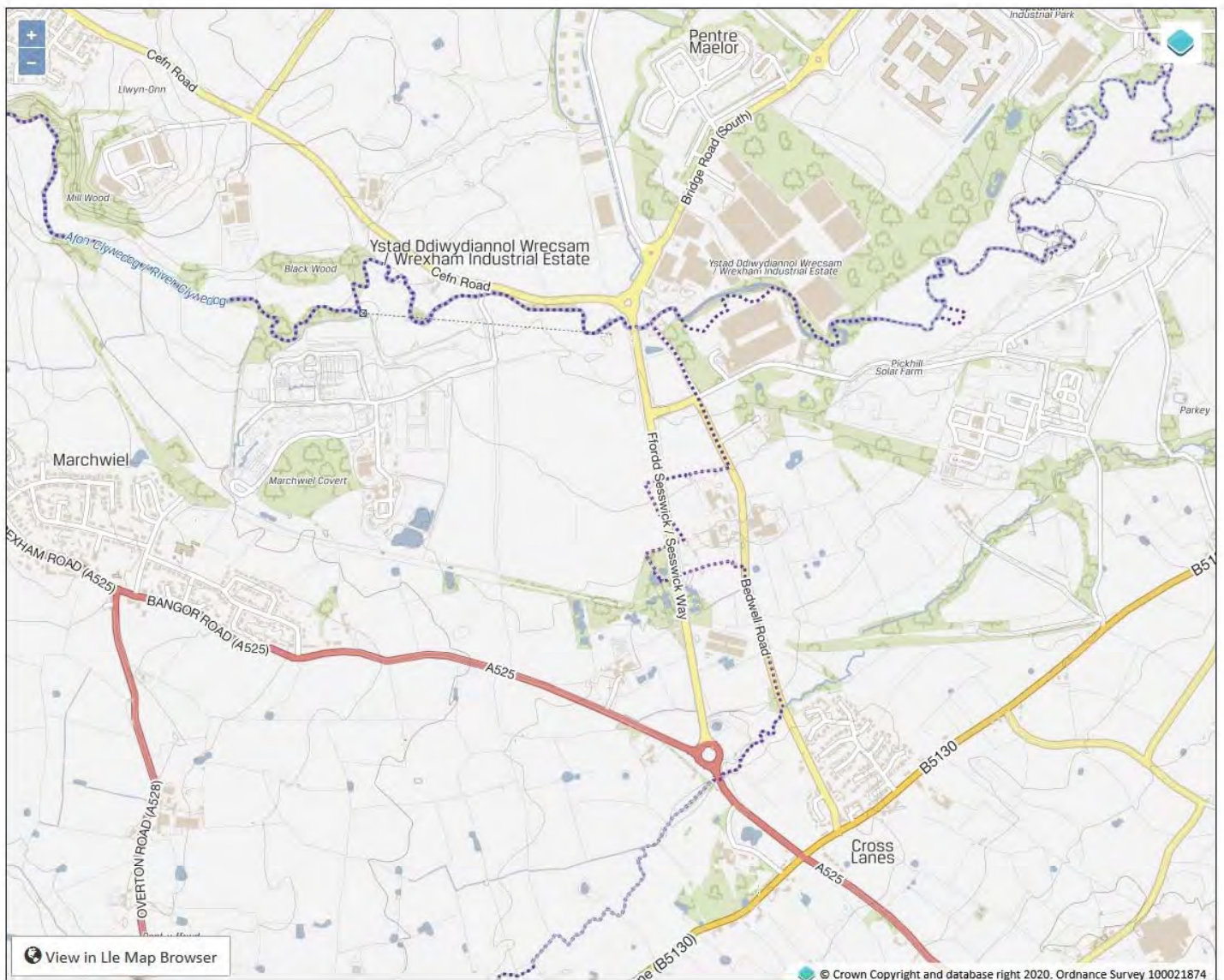
Summary

Preview

Endpoints (2)

Downloads (4)

Metadata (1)



Risk of Flooding from Rivers and Sea (RoFRS)

Natural Resources Wales

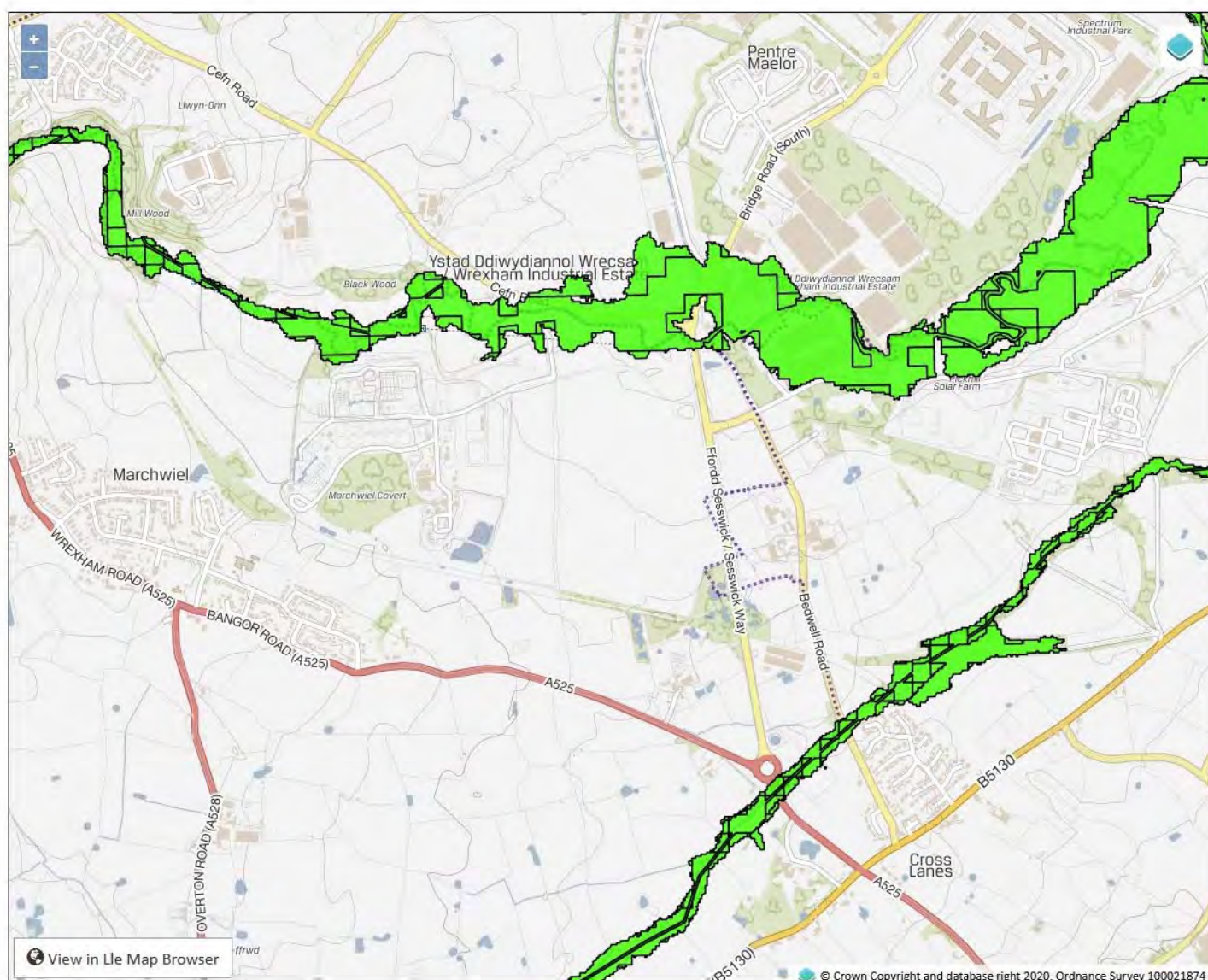
Summary

Preview

Endpoints (2)

Downloads (4)

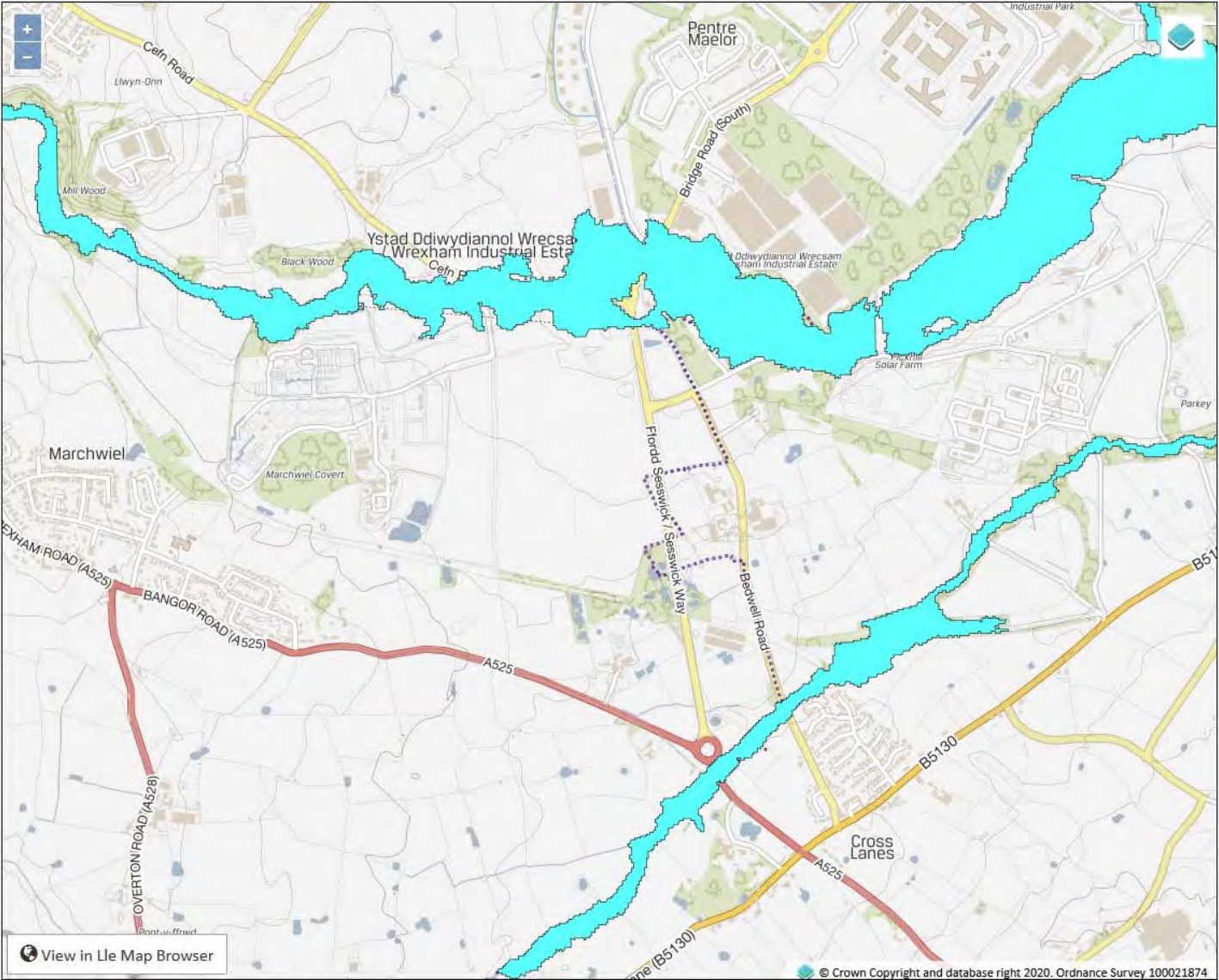
Metadata (1)



Flood Map: Flood Zone 2

Natural Resources Wales

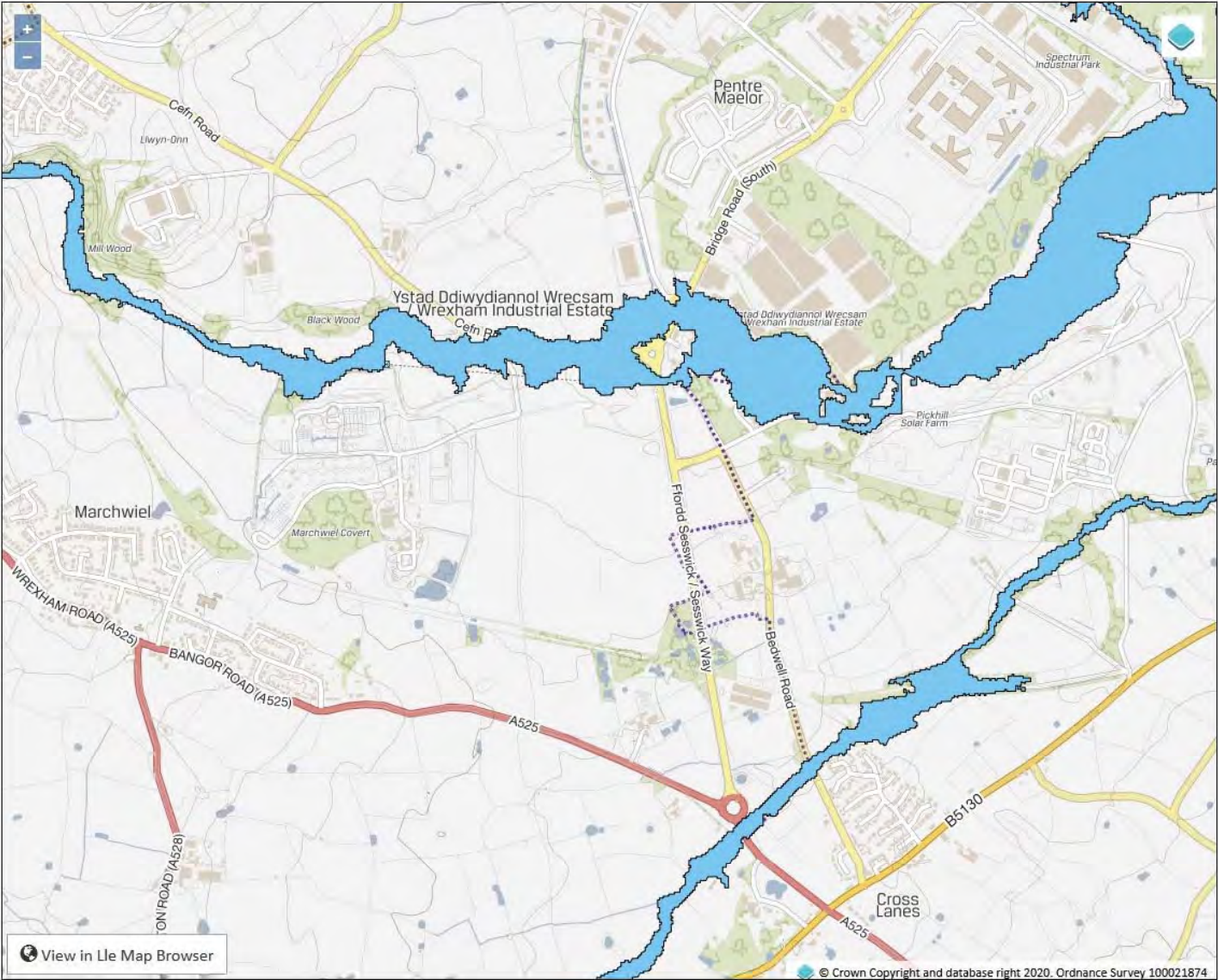
- Summary
- Preview
- Endpoints (2)
- Downloads (4)
- Metadata (1)



Flood Map: Flood Zone 3

Natural Resources Wales

- Summary
- Preview
- Endpoints (2)
- Downloads (4)
- Metadata (1)



Lle

A Geo-Portal for Wales

Cymraeg



Flood Map: Areas Benefiting from Flood Defences

Natural Resources Wales

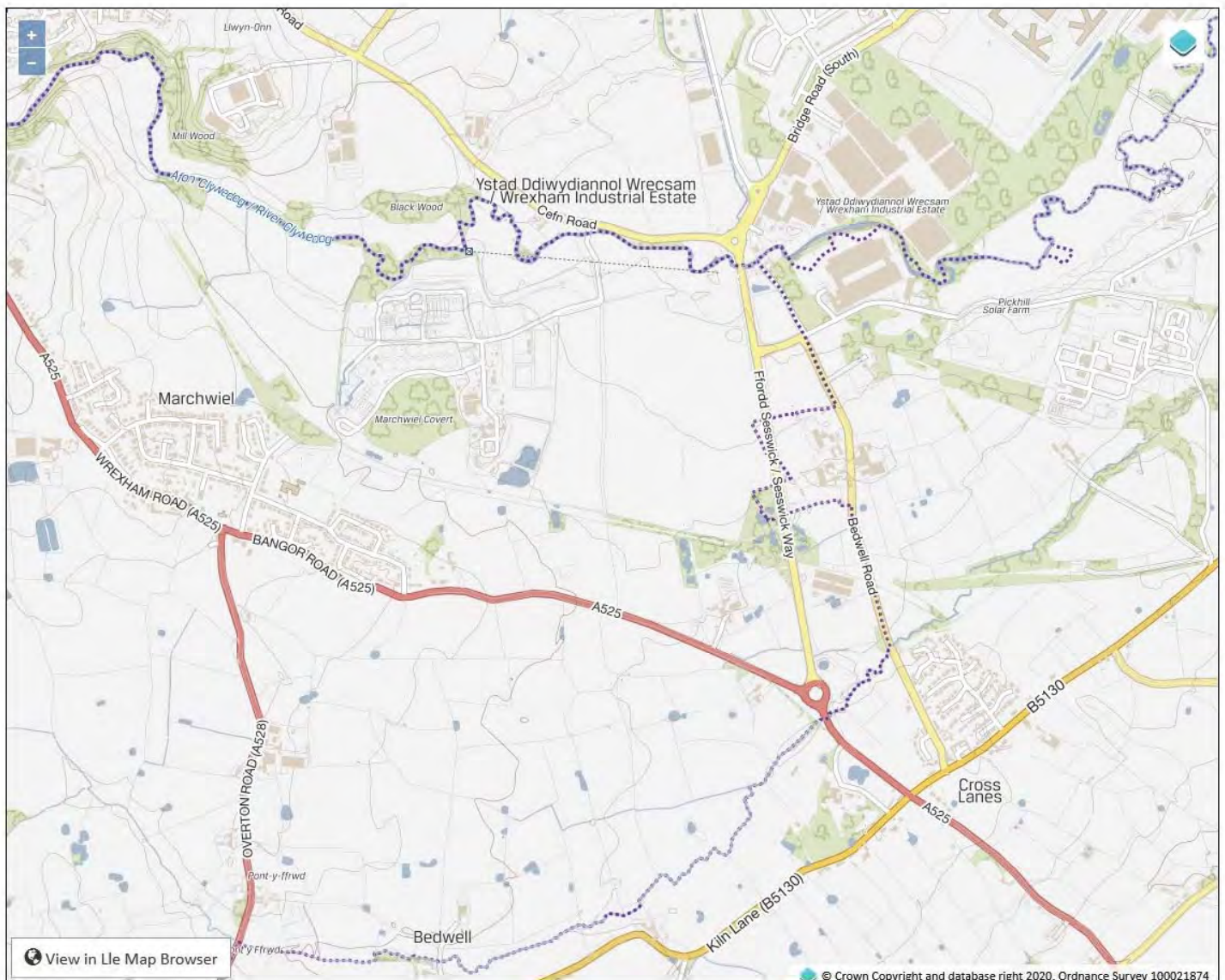
Summary

Preview

Endpoints (2)

Downloads (4)

Metadata (1)



Historic Flood Outlines

Natural Resources Wales

- Summary
- Preview
- Endpoints (2)
- Downloads (4)
- Metadata (1)

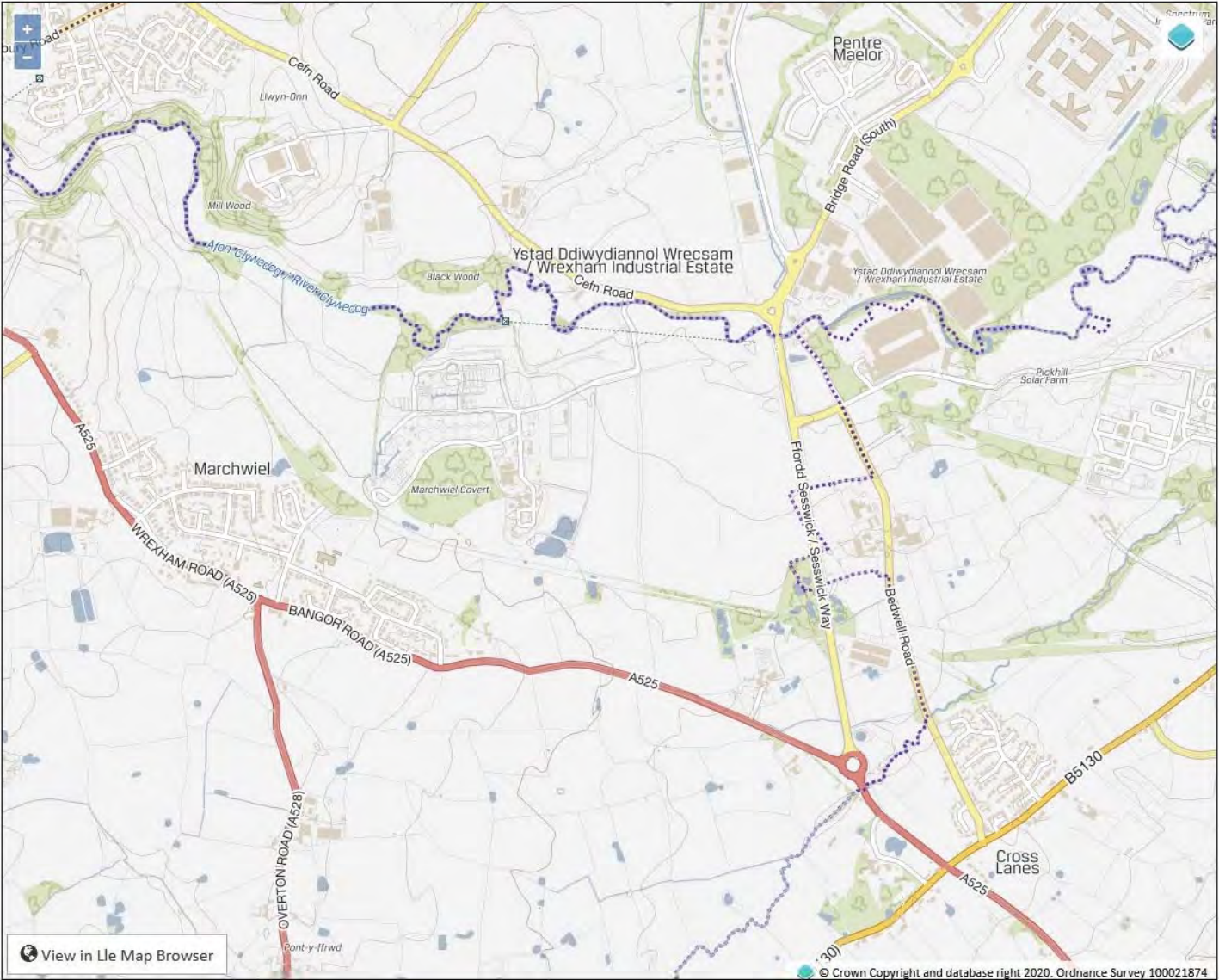


Figure 1.8 Flood Risk Assessment across Wrexham County Borough (Local Flood Risk Management Strategy 2012)

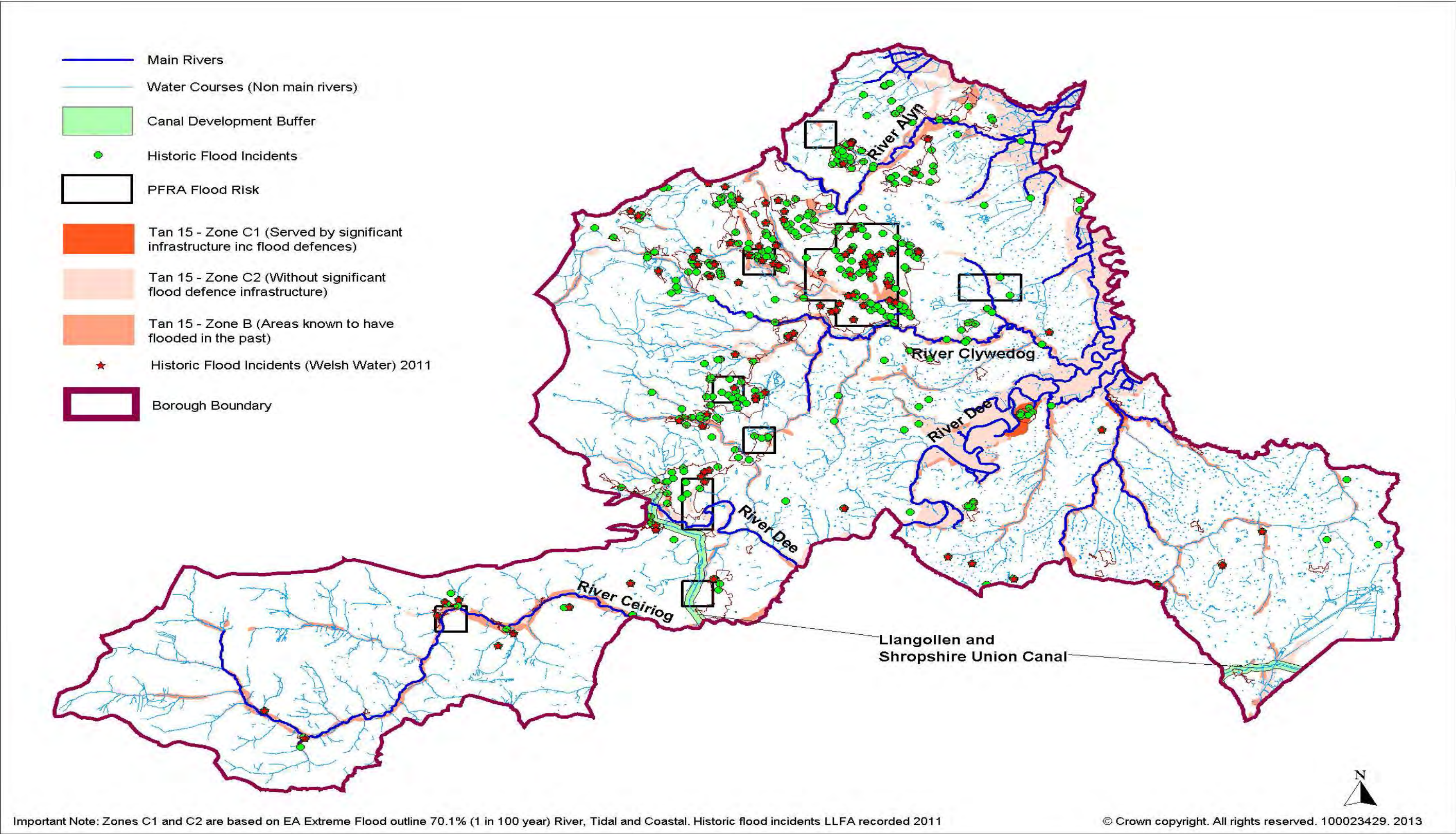
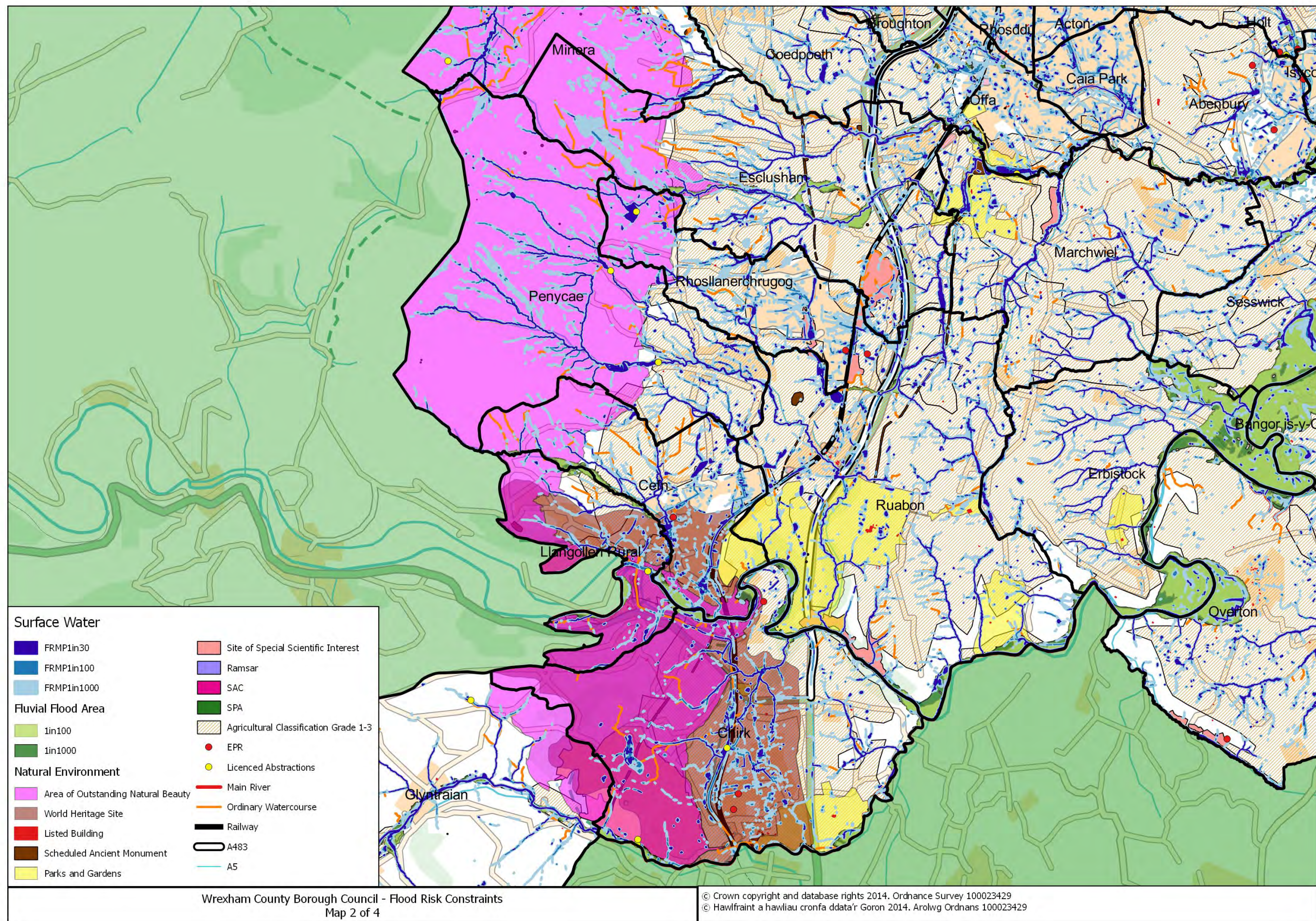


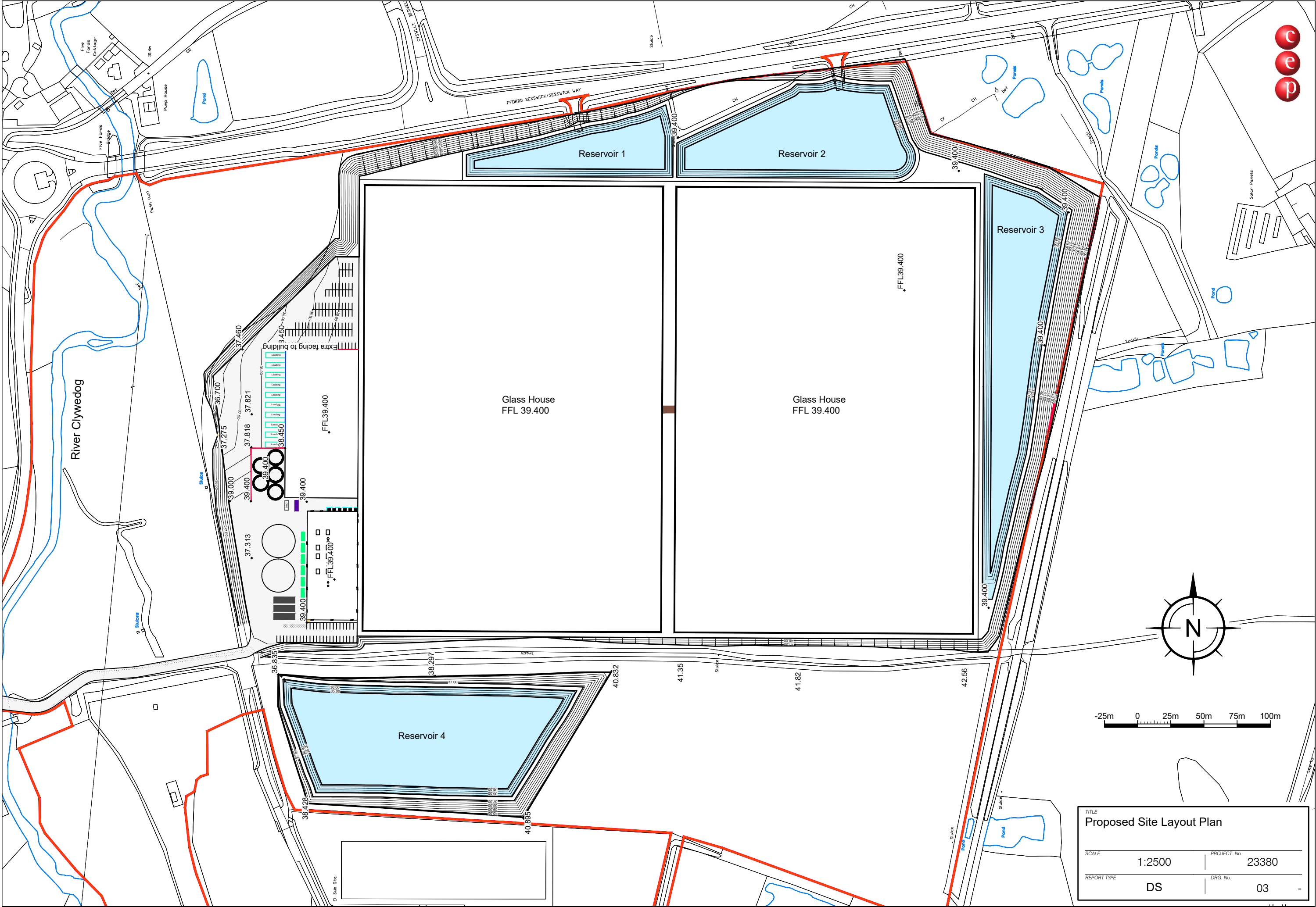
Figure 1.9 Flood Risk Areas within Wrexham County Borough

PFRA Grid Reference	B FRA 2011 Blue Squares	Community Council Area	Total number of address points		EA Flood Zone Map 2009 EA Historic Flood Outline 2009 EA 30 FMSFW and ASTSWF >			Area Flood Partners hip	Number of Historical Incidents	WW (2011) DG5 Sewerage	Groundw ater Flooding	Canals or Ponds	River Dee Catchment policy Area	River Dee Sub Area	River Dee Basin Management
Centre Point)			Addres s points	No of people (2.23)	Business Premises /Units	Critical Infrastructure (Roads, sub station, railway, hospitals or GP surgeries, schools/Nurseries, POS areas)	Type Yes or No (1 in 30, 50, 75, 100 or 200)	Yes (Year and Type)	Number	Yes, Number and Type)	<25	Yes or No (Details)	(1-6)	(1-10)	UD, MD, TD
E332470, N356490	1 Llay Industrial Estate	Llay	143	319	134	B5373	FMSFW 1 in 30 , ASTSWF >	No	43	0	<25	PONDS	¾	2/4	MD
E338470, N350470	2 Wrexham Industrial Estate East	Holt	7	16	40	WXM LINK ROAD	FLOOD Z2/3, ASTSWF>, FMSFW 1in 30	No	5	0	>75	PONDS	3	5	MD
		Abenbury	49	109	131			No	12	0	>50	PONDS	3	5	MD
		Isycoed	0	0	122			No	3	0	>75	PONDS	4	4	MD
E336500 N350400	3 Wrexham Industrial Estate West	Holt	3	7	-	WXM LINK ROAD	FLOOD Z2/3, ASTSWF >, FMSFW 1 in 30	No	0	0	>25<50	PONDS	4	4	MD
		Abenbury	6	13	-			No	0	9	>50<75	PONDS	4	4	MD
		Isycoed	102	227	-			No	0	16	>75	PONDS	4	4	MD
E334440 N352590	4 Wrexham Town Centre	Gwersyllt	40	89	147	A494, A483, Playing Fields	ASTSWF >, FMSFW 1in 30	No	27	0	>25<50	PONDS	4	4	MD
E333460 N352480	5 Wrexham Town Centre	Gresford	1	2	53	A5156, Borrass Quarry	ASTSWF >, FMSFW 1 in 30	No	22	0	>75	PONDS	4	4	MD
E334480 N351490	6 Wrexham Town Centre	Rhosddu	3401	7584		A483, University, Retail, Civic 4 schools	ASTSWF >, FMSFW 1 in 30	No	17	0	>75	PONDS			
E338550 N351440	7 Wrexham Town Centre		4399	9810	83	Acton Park	ASTSWF >, FMSFW 1 in 30	No	47	22	>75	PONDS	4	4	MD
E332500 N351600	8 Wrexham Town Centre		0	0		A5156, Chester Road, Holt Road,	ASTSWF >, FMSFW 1 in 30	No	0	0	>25<50	PONDS	4	4	MD
E334430 N350460	9 Wrexham Town Centre	Holt			-										
E334430 N350460	10 Wrexham Town Centre	Broughton	4	9	62	A483	ASTSWF >, FMSFW 1 in 30	No	31	1	>25<50	PONDS	4	4	MD
E333460 N350460	11 Wrexham Town Centre	Offa	3651	8142		A483, A541, Hospital, Technology Park, Railway, 7 schools and 1 medical centre	FLOOD Z2/3, ASTSWF >, FMSFW 1 in 30	No	11	5	>25<50	PONDS			
E332500 N350450	12 Wrexham Town Centre		3939	8784		4 schools, Queensway Sports, Whitegate Ind Estate, Dunks, CefnDre Border Retail Park, Tescos, Eagles Meadow	FLOOD Z2/3, ASTSWF >, FMSFW 1 in 30	No	43	0	>25<50	PONDS	4	4	MD
E333470 N349470	13 Wrexham Town Centre	Caia Park	0	0	212			2012							
			0	0								PONDS			
		Marchwiell			12	A525	FLOOD Z2/3, ASTSWF	No	1	1	>25<50		4	4	MD

							>, FMSFW 1 in 30								
E332910 N349590		Abenbury	48	107	6	Abenbury Road	FLOOD Z2/3, ASTSFW >, FMSFW 1 in 30	No	6		<25	PONDS	4	4	MD
E333400 N351400	14 New Broughton and Southsea		730	1628		Dismantled Railway, Roads, Solvay Banks, 1 School	ASTSFW >, FMSFW 1 in 30	No	0	0	<25	PONDS	¾	2/4	UD
		Broughton			41			No	0						
		Coedpoeth	2	4		None	ASTSFW >, FMSFW 1 in 30	No	0	0	>50>75	PONDS	¾	2/4/	UD
		Brymbo	1	2	121	None	ASTSFW >, FMSFW 1 in 30	No	1	0	>50<75	PONDS	¾	2/4	UD
E329400 N346500	15 Rhosllanerchrugog		1977	4409		Ponciau Banks 2Schools Cemetery, B5426, B5097	ASTSFW >, FMSFW 1 in 30	No	0	1	>25<50	PONDS	3	2	UD
		Rhos	0	0											
		Eclusham			-	Dismantled Railway, Solvay Banks, 1School	ASTSFW >, ASTSFW >,	No	0	0	>25<50	PONDS	3	2	UD
		Rhos	1	2	-	Aberderfyn Road		No	0	0	>25<50	PONDS	3	2	UD
E330400 N344600	16 Ruabon		1	2			ASTSFW >, FMSFW 1 in 30	No	0	0	>25<50	PONDS			
		Rhos			51	B5605		No	0	0	>25<50	PONDS	3/4/2	2/4/3	MD
		Ruabon	952	2123			ASTSFW >, FMSFW 1 in 30	No	0	0	>25<50	PONDS	3/4/2	2/4/3	MD
E328500 N342600	17 Cefn Mawr/Plas Madoc		492	1097			FLOOD Z2/3, ASTSFW >, FMSFW 1 in 30					PONDS			
		Cefn			-	B6505 (B5096)		No	0	0	>25<50	PONDS	3	½	UD
		Ruabon	459	1024	93	B5605	FLOOD Z2/3, ASTSFW >, FMSFW 1 in 30	No	0	0	>25<50	PONDS	3	1	UD
E328400 N341700	18 Cefn Mawr/Newbridge	Chirk North	459	1024		1 School, B5906, Ty Mawr CP, Railway Viaduct	FLOOD Z2/3, ASTSFW >, FMSFW 1 in 30	No	0	0		PONDS	3	1	UD
E328400 N338200	19. Chirk		41	91		Shropshire Union Canal, Railway Sports Ground, Sewerage Treatment Plant, Industrial Estate	FLOOD Z2/3, ASTSFW >, FMSFW 1 in 30					PONDS CANAL			
		Chirk South			15			No	0	0	>75	PONDS	3	1	UD
E320400 N337200	20 Glyn Ceiriog	Llansantffr aid Glyn Ceiriog	246	549	7	B5479 Disused Mine, School	FLOOD Z2/3, ASTSFW >, FMSFW 1 in 30	No	0	0	<25	PONDS	3	1	UD
		Glyntraian	4	9	8	None	ASTSFW >, FMSFW 1 in 30	No	0		<25	PONDS	3	1	UD



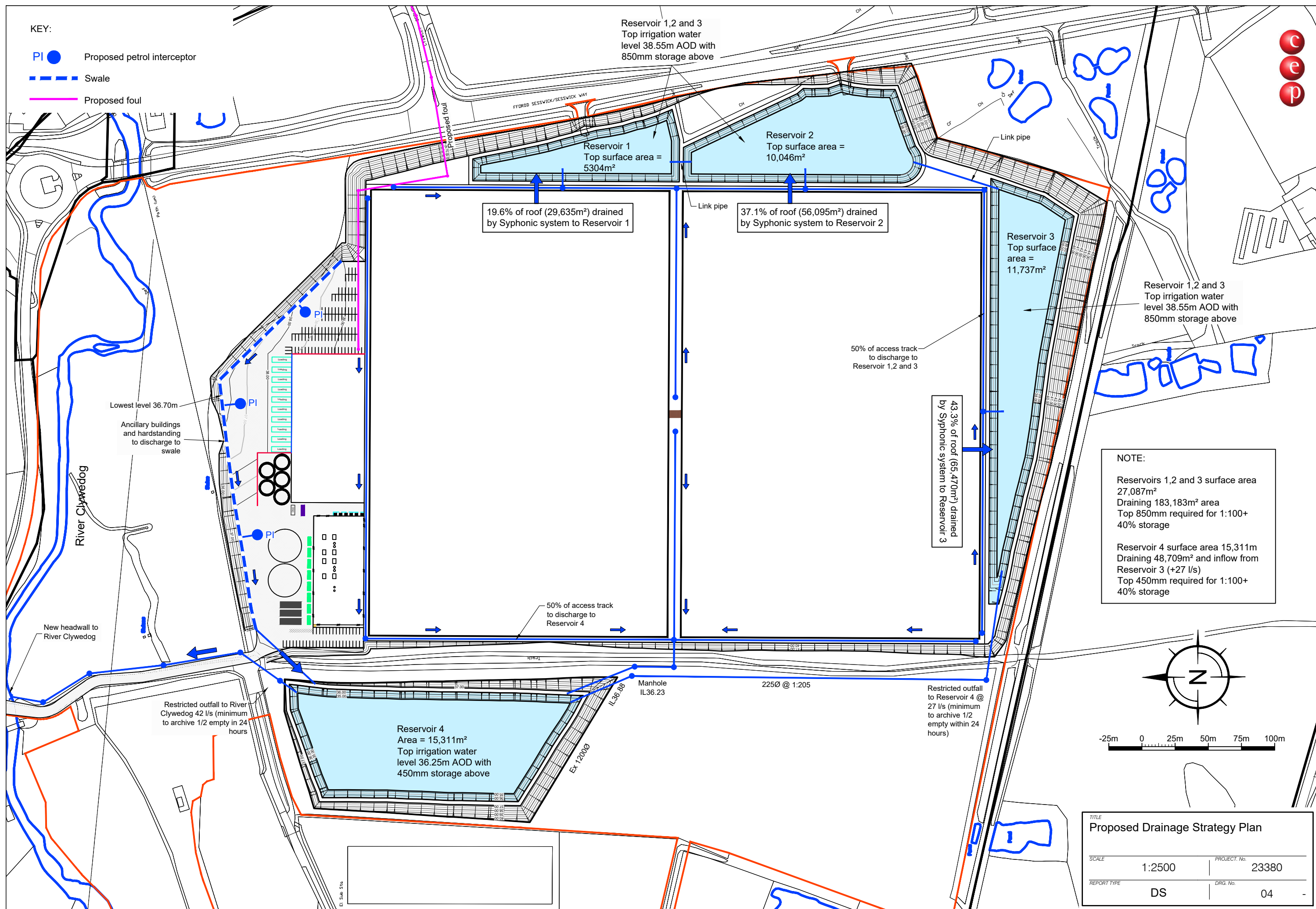
Appendix 6
Proposed Site Layout Plan



TITLE	
Proposed Site Layout Plan	
SCALE	PROJECT No.
1:2500	23380
REPORT TYPE	DRG. No.
DS	03

Appendix 7

Preliminary Drainage Strategy Plan and Calculations



The Civil Engineering Practice					Page 1
11 Tungsten Building George Street Fishersgate BN41 1RA		23380 Five Fords, Wrexham Reservoirs 1 2 and 3 Storage Preliminary Calculations			
Date 07/07/2020 File Reservoirs 1 2 and 3		Designed by SRD Checked by			
Innovyze		Source Control 2020.1			
Summary of Results for 100 year Return Period (+40%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	38.806	0.256	26.5	6604.5	O K
30 min Summer	38.892	0.342	27.0	8852.8	O K
60 min Summer	38.989	0.439	27.0	11407.9	O K
120 min Summer	39.071	0.521	27.0	13586.0	O K
180 min Summer	39.118	0.568	27.0	14841.7	Flood Risk
240 min Summer	39.152	0.602	27.0	15726.5	Flood Risk
360 min Summer	39.198	0.648	27.0	16969.6	Flood Risk
480 min Summer	39.230	0.680	27.0	17807.3	Flood Risk
600 min Summer	39.252	0.702	27.0	18410.3	Flood Risk
720 min Summer	39.269	0.719	27.0	18865.0	Flood Risk
960 min Summer	39.292	0.742	27.0	19486.0	Flood Risk
1440 min Summer	39.318	0.768	27.0	20178.7	Flood Risk
2160 min Summer	39.331	0.781	27.0	20535.3	Flood Risk
2880 min Summer	39.333	0.783	27.0	20591.8	Flood Risk
4320 min Summer	39.322	0.772	27.0	20299.6	Flood Risk
5760 min Summer	39.308	0.758	27.0	19911.4	Flood Risk
7200 min Summer	39.308	0.758	27.0	19918.5	Flood Risk
8640 min Summer	39.318	0.768	27.0	20178.8	Flood Risk
10080 min Summer	39.336	0.786	27.0	20654.7	Flood Risk
15 min Winter	38.820	0.270	26.6	6971.9	O K
30 min Winter	38.910	0.360	27.0	9345.9	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	160.734	0.0	2053.6	27	
30 min Summer	107.834	0.0	2285.2	42	
60 min Summer	69.597	0.0	4596.3	72	
120 min Summer	41.584	0.0	4526.4	132	
180 min Summer	30.383	0.0	4437.6	192	
240 min Summer	24.220	0.0	4350.4	252	
360 min Summer	17.523	0.0	4180.3	370	
480 min Summer	13.868	0.0	4040.7	490	
600 min Summer	11.535	0.0	3949.0	610	
720 min Summer	9.905	0.0	3883.4	730	
960 min Summer	7.760	0.0	3792.2	970	
1440 min Summer	5.478	0.0	3651.4	1448	
2160 min Summer	3.843	0.0	7622.5	2168	
2880 min Summer	2.987	0.0	7322.1	2884	
4320 min Summer	2.097	0.0	6762.7	4320	
5760 min Summer	1.646	0.0	14909.6	5584	
7200 min Summer	1.389	0.0	14218.8	6128	
8640 min Summer	1.225	0.0	13635.0	6912	
10080 min Summer	1.116	0.0	13238.2	7760	
15 min Winter	160.734	0.0	2140.2	27	
30 min Winter	107.834	0.0	2293.8	42	
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11 Tungsten Building George Street Fishersgate BN41 1RA		23380 Five Fords, Wrexham Reservoirs 1 2 and 3 Storage Preliminary Calculations			
Date 07/07/2020 File Reservoirs 1 2 and 3		Designed by SRD Checked by			
Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	39.013	0.463	27.0	12043.7	O K
120 min Winter	39.100	0.550	27.0	14345.4	O K
180 min Winter	39.150	0.600	27.0	15673.0	Flood Risk
240 min Winter	39.185	0.635	27.0	16609.9	Flood Risk
360 min Winter	39.234	0.684	27.0	17925.2	Flood Risk
480 min Winter	39.267	0.717	27.0	18808.5	Flood Risk
600 min Winter	39.291	0.741	27.0	19445.5	Flood Risk
720 min Winter	39.308	0.758	27.0	19926.2	Flood Risk
960 min Winter	39.333	0.783	27.0	20585.2	Flood Risk
1440 min Winter	39.360	0.810	27.0	21326.2	Flood Risk
2160 min Winter	39.375	0.825	27.0	21722.5	Flood Risk
2880 min Winter	39.378	0.828	27.0	21807.5	Flood Risk
4320 min Winter	39.369	0.819	27.0	21564.0	Flood Risk
5760 min Winter	39.357	0.807	27.0	21230.8	Flood Risk
7200 min Winter	39.355	0.805	27.0	21178.7	Flood Risk
8640 min Winter	39.360	0.810	27.0	21312.2	Flood Risk
10080 min Winter	39.377	0.827	27.0	21782.5	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	69.597	0.0	4597.5	72	
120 min Winter	41.584	0.0	4501.7	130	
180 min Winter	30.383	0.0	4396.1	190	
240 min Winter	24.220	0.0	4291.5	248	
360 min Winter	17.523	0.0	4111.9	366	
480 min Winter	13.868	0.0	4019.6	484	
600 min Winter	11.535	0.0	3970.8	604	
720 min Winter	9.905	0.0	3944.4	722	
960 min Winter	7.760	0.0	3910.4	958	
1440 min Winter	5.478	0.0	3784.7	1430	
2160 min Winter	3.843	0.0	7791.5	2128	
2880 min Winter	2.987	0.0	7570.0	2824	
4320 min Winter	2.097	0.0	7050.3	4192	
5760 min Winter	1.646	0.0	15183.4	5480	
7200 min Winter	1.389	0.0	14592.7	6768	
8640 min Winter	1.225	0.0	14137.1	7272	
10080 min Winter	1.116	0.0	13829.7	7976	
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11 Tungsten Building George Street Fishersgate BN41 1RA	23380 Five Fords, Wrexham Reservoirs 1 2 and 3 Storage Preliminary Calculations																																											
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Innovyze		Source Control 2020.1																																										
<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FEH</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> </tr> <tr> <td>FEH Rainfall Version</td> <td>2013</td> </tr> <tr> <td>Site Location</td> <td>GB 336981 347967 SJ 36981 47967</td> </tr> <tr> <td>Data Type</td> <td>Point</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> </tr> <tr> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Cv (Summer)</td> <td>0.900</td> </tr> <tr> <td>Cv (Winter)</td> <td>0.950</td> </tr> <tr> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Climate Change %</td> <td>+40</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 18.320 <table> <thead> <tr> <th>Time (mins)</th> <th>Area</th> <th>Time (mins)</th> <th>Area</th> <th>Time (mins)</th> <th>Area</th> </tr> <tr> <th>From:</th> <th>To:</th> <th>From:</th> <th>To:</th> <th>From:</th> <th>To:</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>4 6.110</td> <td>4</td> <td>8 6.110</td> <td>8</td> <td>12 6.100</td> </tr> </tbody> </table>			Rainfall Model	FEH	Return Period (years)	100	FEH Rainfall Version	2013	Site Location	GB 336981 347967 SJ 36981 47967	Data Type	Point	Summer Storms	Yes	Winter Storms	Yes	Cv (Summer)	0.900	Cv (Winter)	0.950	Shortest Storm (mins)	15	Longest Storm (mins)	10080	Climate Change %	+40	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	From:	To:	From:	To:	From:	To:	0	4 6.110	4	8 6.110	8	12 6.100
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11 Tungsten Building George Street Fishersgate BN41 1RA	23380 Five Fords, Wrexham Reservoirs 1 2 and 3 Storage Preliminary Calculations	
Date 07/07/2020	Designed by SRD	
File Reservoirs 1 2 and 3	Checked by	
Innovyze		Source Control 2020.1

Model Details

Storage is Online Cover Level (m) 39.400

Tank or Pond Structure

Invert Level (m) 38.550

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	25620.0	0.851	0.0	2.800	0.0	4.200	0.0
0.200	25961.6	1.600	0.0	3.000	0.0	4.400	0.0
0.400	26305.4	1.800	0.0	3.200	0.0	4.600	0.0
0.600	26651.5	2.000	0.0	3.300	0.0	4.800	0.0
0.700	26825.4	2.200	0.0	3.400	0.0	5.000	0.0
0.800	26999.9	2.400	0.0	3.800	0.0		
0.850	27087.3	2.600	0.0	4.000	0.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0228-2700-0850-2700
Design Head (m)	0.850
Design Flow (l/s)	27.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	228
Invert Level (m)	38.550
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.850	27.0	Kick-Flo®	0.653	23.8
Flush-Flo™	0.353	27.0	Mean Flow over Head Range	-	21.9

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	7.6	1.200	31.8	3.000	49.5	7.000	74.7
0.200	22.8	1.400	34.3	3.500	53.4	7.500	77.3
0.300	26.8	1.600	36.6	4.000	56.9	8.000	79.7
0.400	26.9	1.800	38.7	4.500	60.3	8.500	82.1
0.500	26.3	2.000	40.7	5.000	63.4	9.000	84.0
0.600	25.1	2.200	42.6	5.500	66.4	9.500	86.3
0.800	26.2	2.400	44.5	6.000	69.3		
1.000	29.2	2.600	46.2	6.500	72.1		

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Colebrook White Equation / Darcy Weisbach Formula for Circular Pipes under Full Bore Conditions

23380 **Five Fords, Wrexham**
Reservoir 3 to 4 Conveyance Link Pipe

$$V = -2\sqrt{(2gDS)} \log \left[\frac{k_s}{3.7D} + \frac{2.51v}{D\sqrt{2gDS}} \right]$$

Where:

g= gravitational acceleration	9.81 m/s ²	
v = kinematic velocity of fluid	1.139E-06 m ² /s	(1.139E-6 for water at 15 Celsius)
k _s = roughness value	0.6 mm	(Storm Sewer 0.6mm Foul Sewer 1.5)
D= pipe diameter	225 mm	
S= hydraulic gradient	1: 205.0	

V= 0.91 m/s

Q= 0.04 m³/s 36.1 l/s

31 l/s Required

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11 Tungsten Building George Street Fishersgate BN41 1RA		23380 Five Fords, Wrexham Reservoir 4 Storage Preliminary Calculations			
Date 07/07/2020 File Reservoir 4 Storage.SRCX		Designed by SRD Checked by			
Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	36.419	0.169	22.3	2512.4	Flood Risk
30 min Summer	36.431	0.181	24.9	2689.2	Flood Risk
60 min Summer	36.454	0.204	29.9	3028.0	Flood Risk
120 min Summer	36.494	0.244	38.2	3625.3	Flood Risk
180 min Summer	36.517	0.267	40.8	3977.0	Flood Risk
240 min Summer	36.534	0.284	41.2	4232.7	Flood Risk
360 min Summer	36.559	0.309	41.6	4605.6	Flood Risk
480 min Summer	36.576	0.326	41.8	4870.0	Flood Risk
600 min Summer	36.589	0.339	41.9	5070.7	Flood Risk
720 min Summer	36.600	0.350	41.9	5229.8	Flood Risk
960 min Summer	36.615	0.365	42.0	5465.0	Flood Risk
1440 min Summer	36.635	0.385	42.0	5759.9	Flood Risk
2160 min Summer	36.647	0.397	42.0	5954.1	Flood Risk
2880 min Summer	36.654	0.404	42.0	6052.1	Flood Risk
4320 min Summer	36.660	0.410	42.0	6139.2	Flood Risk
5760 min Summer	36.660	0.410	42.0	6141.4	Flood Risk
7200 min Summer	36.660	0.410	42.0	6143.9	Flood Risk
8640 min Summer	36.660	0.410	42.0	6147.1	Flood Risk
10080 min Summer	36.661	0.411	42.0	6167.2	Flood Risk
15 min Winter	36.421	0.171	22.7	2541.5	Flood Risk
30 min Winter	36.434	0.184	25.5	2726.1	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	160.734	0.0	1534.4	1440	
30 min Summer	107.834	0.0	1943.7	1440	
60 min Summer	69.597	0.0	4787.0	72	
120 min Summer	41.584	0.0	5311.3	132	
180 min Summer	30.383	0.0	5610.6	190	
240 min Summer	24.220	0.0	5812.6	250	
360 min Summer	17.523	0.0	6068.3	370	
480 min Summer	13.868	0.0	6203.9	488	
600 min Summer	11.535	0.0	6263.0	608	
720 min Summer	9.905	0.0	6267.8	728	
960 min Summer	7.760	0.0	6158.9	966	
1440 min Summer	5.478	0.0	5791.0	1444	
2160 min Summer	3.843	0.0	12036.3	2144	
2880 min Summer	2.987	0.0	11902.8	2424	
4320 min Summer	2.097	0.0	11234.2	3120	
5760 min Summer	1.646	0.0	21558.5	3920	
7200 min Summer	1.389	0.0	21874.0	4752	
8640 min Summer	1.225	0.0	22161.9	5544	
10080 min Summer	1.116	0.0	22371.8	6368	
15 min Winter	160.734	0.0	1600.6	1440	
30 min Winter	107.834	0.0	2034.5	1440	
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11 Tungsten Building George Street Fishersgate BN41 1RA		23380 Five Fords, Wrexham Reservoir 4 Storage Preliminary Calculations			
Date 07/07/2020 File Reservoir 4 Storage.SRCX		Designed by SRD Checked by			
Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	36.465	0.215	32.3	3188.5	Flood Risk
120 min Winter	36.506	0.256	40.5	3814.8	Flood Risk
180 min Winter	36.531	0.281	41.1	4186.7	Flood Risk
240 min Winter	36.549	0.299	41.5	4456.4	Flood Risk
360 min Winter	36.575	0.325	41.8	4846.8	Flood Risk
480 min Winter	36.593	0.343	41.9	5121.3	Flood Risk
600 min Winter	36.606	0.356	42.0	5328.5	Flood Risk
720 min Winter	36.617	0.367	42.0	5491.9	Flood Risk
960 min Winter	36.633	0.383	42.0	5731.6	Flood Risk
1440 min Winter	36.652	0.402	42.0	6031.2	Flood Risk
2160 min Winter	36.666	0.416	42.0	6232.9	Flood Risk
2880 min Winter	36.670	0.420	42.0	6296.9	Flood Risk
4320 min Winter	36.670	0.420	42.0	6294.4	Flood Risk
5760 min Winter	36.665	0.415	42.0	6223.9	Flood Risk
7200 min Winter	36.661	0.411	42.0	6158.8	Flood Risk
8640 min Winter	36.657	0.407	42.0	6095.6	Flood Risk
10080 min Winter	36.654	0.404	42.0	6054.8	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	69.597	0.0	4938.5	72	
120 min Winter	41.584	0.0	5490.3	130	
180 min Winter	30.383	0.0	5799.2	188	
240 min Winter	24.220	0.0	6002.7	246	
360 min Winter	17.523	0.0	6250.4	364	
480 min Winter	13.868	0.0	6366.8	482	
600 min Winter	11.535	0.0	6400.2	598	
720 min Winter	9.905	0.0	6375.4	716	
960 min Winter	7.760	0.0	6218.2	948	
1440 min Winter	5.478	0.0	5852.8	1408	
2160 min Winter	3.843	0.0	12263.9	2080	
2880 min Winter	2.987	0.0	12064.1	2708	
4320 min Winter	2.097	0.0	11376.9	3332	
5760 min Winter	1.646	0.0	21924.7	4216	
7200 min Winter	1.389	0.0	22250.1	5120	
8640 min Winter	1.225	0.0	22540.1	5976	
10080 min Winter	1.116	0.0	22758.3	6864	
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Date 07/07/2020 File Reservoir 4 Storage.SRCX	Designed by SRD Checked by	
Innovyze Source Control 2020.1		

Model Details

Storage is Online Cover Level (m) 36.700

Tank or Pond Structure

Invert Level (m) 36.250

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	14724.0	0.700	0.0	1.400	0.0	2.100	0.0
0.100	14853.3	0.800	0.0	1.500	0.0	2.200	0.0
0.200	14983.2	0.900	0.0	1.600	0.0	2.300	0.0
0.300	15113.7	1.000	0.0	1.700	0.0	2.400	0.0
0.400	15244.7	1.100	0.0	1.800	0.0	2.500	0.0
0.450	15310.4	1.200	0.0	1.900	0.0		
0.451	0.0	1.300	0.0	2.000	0.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0282-4200-0450-4200
Design Head (m)	0.450
Design Flow (l/s)	42.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	282
Invert Level (m)	36.250
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.450	42.0	Kick-Flo®	0.435	41.3
Flush-Flo™	0.361	42.0	Mean Flow over Head Range	-	27.1

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	8.8	1.200	67.4	3.000	105.3	7.000	158.5
0.200	29.1	1.400	72.6	3.500	113.5	7.500	164.2
0.300	41.5	1.600	77.5	4.000	121.2	8.000	169.7
0.400	41.8	1.800	82.1	4.500	128.3	8.500	175.0
0.500	44.2	2.000	86.4	5.000	133.4	9.000	180.1
0.600	48.2	2.200	90.5	5.500	140.1	9.500	185.1
0.800	55.4	2.400	94.4	6.000	146.5		
1.000	61.7	2.600	98.2	6.500	152.6		

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Appendix 8
Drainage Maintenance Schedule

Drainage Maintenance Schedule



The Civil Engineering Practice
11 Tungsten Building
George Street
Fishersgate
Sussex
BN41 1RA
01273 424424
reception@civil.co.uk
www.civil.co.uk

Project	Glasshouse Development at Five Fords, Wrexham, Wales
Project Number	23380

By Steve Doughty

Date 5 June 2020

1 Schedule of Maintenance

- 1.1 Once appointed the Contractor will prepare a site specific method statement for the control of silt and other pollutants during construction. CIRIA Report C532, Control of water pollution from construction sites, provides further guidance on this.
- 1.2 The Contractor will maintain the proposed drainage system during construction and until the handing over of the site.
- 1.3 Upon completion management of the onsite drainage infrastructure will be passed on to the Site Operator.
- 1.4 The following maintenance schedule details the typical tasks to be undertaken at different intervals.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Litter and debris removal – catch pits	Monthly
	Visual inspection of onsite reservoirs	Monthly
	Manage other vegetation and remove nuisance plants – aesthetics	Monthly or as required
	Remove sediment and debris from silt trap chambers, channel drains and inlet chambers	6 monthly
	Visual inspection of permeable paving for defects and settlement	Annually
	Sweeping / brushing of permeable paving	Every 2 years
	Surface and foul water pipework – jetting / rodding	Every 2 years or as required
	Remove silt and debris from oil interceptors where provided	When alarm indicates
Corrective Maintenance	Remove debris / blockages to silt traps / channel drains	As required
	Repairs to access chambers / manhole covers	As required
	Replace any broken permeable blocks / surface, remedial works to any depressions or rutting	As required
	Inspect inlet, outlet from downpipe and gullies for blockages, standing water and clear	As required

Indicative Schedule of Maintenance for the Proposed Drainage System



Inspection / Action Required	Gullies, Channels and Gutters	Catchpits	Oil Interceptors	Permeable Surface	Surface Water Pipework
After leaf fall in Autumn	✓	✓			
6 Months	✓	✓		✓	
1 Year				✓	
2 Years					✓
When alarm indicates			✓		

Drainage System Maintenance Summary