TerraConsult

23rd March 2018
Report No. 3484/R07-1

PROPOSED ARROWBIO PLANT, FLINTSHIRE ENTERPRISE ZONE 4, NORTH WALES

Flood Consequence Assessment and Conceptual Surface & Foul Water Management Plan

Carried out for: LOGIK WTE

Lead Consultant: Pegasus Planning Group Ltd

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DOCUMENT INFORMATION AND CONTROL SHEET

Document Status and Approval Schedule

Report No.	Title
3484-R07-1	**PROPOSED ARROWBIO PLANT, FLINTSHIRE ENTERPRISE ZONE 4, NORTH WALES Flood Consequence Assessment and Conceptual Surface & Foul Water Management Plan**

Issue History

Issue	Status	Date		Signature	Date
1	**Draft**	23/03/2018	**Prepared By** Bruce Wickham	[redacted]	**23/03/2018**
			Checked By Deepak Kharat	[redacted]	**23/03/2018**
		23/03/2018	**Approved By** Chris Eccles	[redacted]	**23/03/2018**

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PROPOSED ARROWBIO PLANT
FLINTSHIRE ENTERPRISE ZONE 4
NORTH WALES

FLOOD CONSEQUENCE ASSESSMENT AND CONCEPTUAL SURFACE & FOUL WATER MANAGEMENT PLAN

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PROPOSED ARROW BIO PLANT, FLINTSHIRE ENTERPRISE ZONE 4, NORTH WALES

FLOOD CONSEQUENCE ASSESSMENT AND CONCEPTUAL SURFACE AND FOUL WATER MANAGEMENT PLAN

1. INTRODUCTION

1.1 On behalf of Logik WTE Ltd (the client) the lead planning consultant Pegasus Planning Group Ltd has instructed TerraConsult Ltd to prepare this Flood Consequence Assessment (FCA) and conceptual Surface & Foul Water Management Plan (S&FWMP) for the proposed development of an ArrowBio Gas Plant on the land off Weighbridge Road, Deeside, Flintshire, North Wales.

2. PROJECT AND SITE DESCRIPTION

2.1 The project is the development of a municipal solid waste treatment BioPlant on the land off Weighbridge Road, Deeside, Flintshire, North Wales (the site). The project is aligned with several objectives of the Flintshire Local Development Plan, namely the promotion sustainable economic development and range of employment opportunities.

2.2 The proposed site of the development is depicted by the red boundary in the Paddock Johnson Partnership Drawing No. 17069-110-C. The site will require minimal profiling for the establishment of hardstand surfaces such as internal access roads, carparks, pavements, buildings and above-ground tanks. The finished development will also include small areas of grassed surfaces and some new trees will be planted as proposed in the final Landscape Strategy.

2.3 The site will cover an approximate area of 5.57 ha in the industrialised area of Deeside, in the county of Flintshire, North Wales. The site is approximately 1.3 km north-east of the River Dee and 10.2 km north-west of Chester City Centre. The nearest postcode of the site is CH5 2LF and it has a national grid reference coordinates of SJ311711. Access to the site is off the Weighbridge Road which connects to the A548 motorway located approximately 0.9 km north of the site boundary. Figure 1 depicts the site boundary and its location relative to the surrounding land uses.

2.4 Industrial activities surrounding the site include a sub-station, Flintshire Bridge Site C Convertor Station, UPM Shotton, Toyota Motor Manufacturing UK, Great Bear Distribution and Tata Steel UK Ltd. The open area adjacent to the northern boundary of the site is currently under development for the Deeside Energy from Waste (EFW) facility. Several open waterbodies and vegetated areas are present around the site.

2.5 An investigation was conducted by TerraConsult in November 2017 to identify the potential drainage and flooding concerns and existing drainage infrastructure on the site. The photographic record of this site investigation has been provided as Appendix 1 to this report.

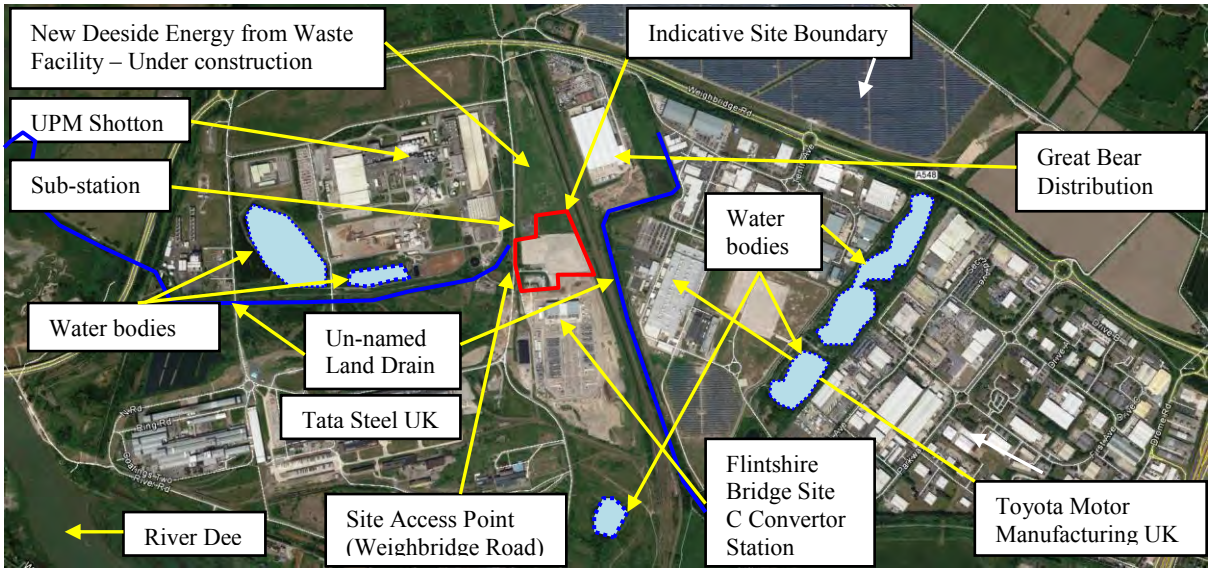

Figure 1 – Site Location and Surrounding Land Use (Base Map Source: Google Earth)

3. ASSESSMENT OBJECTIVES

3.1 The proposed development of the site constitutes a revised landform that may potentially increase the current flood risk and can impact the associated drainage infrastructure through increasing the site's surface impermeability. Furthermore, the proposed development will include a foul water drainage system for the off-site disposal of domestic and industrial treated effluent. This report has therefore been developed to assess the potential flood risk to the site and to provide a conceptual surface and foul water drainage design to ensure the safe and optimal function of the development whilst minimising the potential impacts on the surrounding area.

3.2 Flood Risk Assessment policy outlined in Welsh Planning Policy 9th Edition, the Technical Advice Note (TAN) 15 – Development and Flood Risk (2004) and policies of Natural Resources Wales, advise that the site requires an FCA for the following reasons:

- To ensure any new developments are sustainable in the long term and do not create a legacy of problems for future generations. This will include the identification of the flood risk for a potential development, and steer it to a location at little or no risk from river, tidal or coastal flooding or from run off arising from development(s) in any location, if the initial development site is located in an unacceptable high flood risk zone; and

- The results of the FCA will be used to inform the final design of a development and to demonstrate that all flood risks have been identified and appropriately mitigated for. This is vital to ensure that the development will be safe for people to live in or use during its proposed lifetime.

3.3 As a result of the above, the site therefore requires a site-specific FCA and associated drainage strategy, to appropriately identify the level of flood risk to the property and minimise and mitigate the potential flood risk within the site and any effect to offsite receptors. Furthermore a suitable

conceptual foul water drainage strategy for the off-site discharge of the domestic and treated industrial trade effluent will be outlined in this report, that are aligned with the local council and drainage utility.

3.4 This report is divided into two sections. The first will comprise of the FCA, identifying and describing the current sources of flood risk for the site and the extent of any mitigation measures potentially required to remediate flood risk and how they can be successfully managed (i.e. through a conceptual surface water drainage strategy). The second section of this report will incorporate the findings from the FCA and outline the conceptual surface and foul water drainage strategy required for the development.

3.5 The objective of this FCA is to ensure that the proposed development is suitable for its location and does not adversely impact, or increase flooding, or present risk to life and livelihood by virtue of its delivery. This will be done with reference to currently established and defined flood risk areas and extreme coastal flood levels, and provide recommendation around potential mitigation measures, if required. In accordance with TAN 15, the key objectives of any flood consequence assessment should be to provide further appreciation of:

- The consequences of flooding on the development;
- The consequences (i.e. the overall impacts) of the development on flood risk elsewhere within the catchment, for a range of potential flooding scenarios up to that flood having a probability of 0.1%; and;
- To establish whether appropriate mitigation measures can be incorporated within the design of the development, to ensure that development minimises risk to life, damage to property and disruption to people living and working on the site or elsewhere in the floodplain.

3.6 The objectives of the conceptual S&FWMP includes the development of a conceptual drainage strategy to safely and appropriately convey the surface water and foul water flows derived from the site to the respective appropriate off-site points at discharge flow rates acceptable by the local council and drainage utility. The drainage strategy will take into account areas potentially identified with a high flood risk (i.e. outcome of the FCA) to ensure that the drainage is compatible with the flood risk for the identified area.

4. LEGISLATION AND GUIDANCE

4.1 This FCA and S&FWMP has been developed in reference to the following documents and legislative guidelines:

- CIRIA C753 The SUDS Manual (2015);
- Sewers for Adoption 7th Edition (2012);
- Flintshire Preliminary Flood Risk Management Assessment (2011);
- BS 8533 2011 Assessing & Managing Flood Risk in Development Code of Practice (2011);
- BS EN 752 2008 Drain and Sewer Systems Outside Buildings;
- BS EN 858-1:2002 Separator Systems for Light Liquids Part 1;
- BS EN 858-2:2002 Separator Systems for Light Liquids Part 2;

- Pollution Prevention Guidelines – Use and design of oil separators in surface water drainage systems: PPG3 (April 2006);
- British Water Code of Practice – Flows and Loads, Sizing Criteria, Treatment Capacity for Sewage Treatment Systems;
- The Welsh Ministers standards for new gravity foul sewers and lateral drains – October 2012;
- Guidance on the mandatory adoption of sewers and lateral drains and on the Welsh Ministers' Standards for gravity foul sewers and lateral drains – July 2012;
- The Building regulations 2010: Drainage and Waste Disposal (2015)
- Planning Policy Wales (Ed 9, November 2016);
- Planning Policy Wales - Technical Advice Note (TAN) 15;
- Flood Risk Regulations (2009); and
- Flood and Water Management Act (2010).

5. PREVIOUS STUDIES

5.1 Previous studies consulted in relation to the proposed development of this site include the following:

- TerraConsult Ltd Report No 3484/R06-1: Phase 1 Site Investigation Report,
- JBA Consulting Tidal Dee Flood Mapping Update Report 2015 update.

5.2 The TerraConsult report provides the basis for environmental and geological assessment of the proposed development site; it is advised to refer to this report for information on the site's environmental and geological characteristics. The JBA report will describes the extreme flood water levels for the river Dees Tidal system; this report will be referred to in the flood consequence section of this report.

6. SITE BACKGROUND

TOPOGRAPHY

6.1 A recent (October 2017) topographical survey for the site area, as provided by the Pegasus Group revealed that the area within the application boundary has two distinct surface levels, *viz.* an upper and lower level. The upper level covers a majority of the site (approximately 92 % of the total surface area) which stretches from the north, eastern and southern boundaries up to the top of site access ramp and the embankment along the western edge of the site. The surface level with this area lies between 8.3 and 10.3 mAOD, with a subtle gently gradient of 1:137 declining from the north towards the south of the site. The lower level account for approximately 8 % of the site area, and is confined to the embankment along the western edge of the site boundary and site access ramp. The surface level within this area lies between 8.3 and 5.2 mAOD.

RAINFALL and HYDROLOGY

6.2 The Standard Average Annual Rainfall (SAAR) for the area around the site, as defined within the Flood Studies Report (NERC, 1975), is 695 mm with slightly higher rainfall depths experienced in the winter months. The average monthly rainfall pattern for the nearest weather station (Hawarden – approximately 7 km south of the site) as recorded by the UK Meteorological Office is presented below in Table 1, indicating an average annual rainfall depth of 726 mm.

Table 1 – Average monthly rainfall – Hawarden, Deeside

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	60.0	44.0	50.7	49.5	57.2	59.2	56.5	57.0	60.0	81.3	75.5	75.5
Days /month	12.3	10.5	11.5	10.3	9.7	9.6	9.9	10.6	9.8	13.8	14.4	13.2

6.3 Hydrologically, the common soil type for the area is classified as Type 2, which has an applicable Standard Potential Runoff (SPR) value of 0.3 (30%), as defined within the Flood Studies Report. The soil hydrological properties are synonymous with a sandy soil with a moderate to high permeability and low runoff potential.

6.4 The site is located approximately 1.3 km north-west of River Dee which falls under the Dee Estuary operational catchment. The River Dee is the primary river for the River Basin District catchment which has a number of upstream watercourses including the Shropshire Union Canal, Aldford Brook, River Ceiriog, River Eglwyseg and the River Afon Alwen. According to the Environmental Agency the hydromorphological designation for the catchment area is classified as moderately modified, with moderate to good ecological and chemical characteristics.

6.5 As indicated in Figure 1, there are several small water bodies (i.e. surface water ponds) and two un-named land drains located near the site which drain in a south-westerly direction towards the River Dee.

6.6 A review of the Condition Report (EAME Report No. 012-1142 Rev – 02) for the former Shotton CHP Power Station (i.e. the former land use of the site) indicates that the surface water from the former power station discharged into the un-named land drain located approximately 85 m away from the eastern boundary of the site. Whilst the majority of the previous site drainage was demolished during the decommissioning of the former Shotton CHP power station, evidence from the site investigation (Appendix 1) confirmed the presence of surface water drainage within and around the car parking area and the site entrance ramp. Currently, the rainfall falling on to the site area infiltrates to the underlying made ground of building rubble and soil material (hardcore). The rainfall which falls onto the car parking area and site access ramp located near the site's western boundary is conveyed through the existing surface water drainage to a culvert located opposite the site entrance along the Weighbridge Road. This condition of this drainage is unknown at the time of writing this report however the culvert crossing the Weighbridge Road is almost completely silted up.

6.7 The foul water drainage for the former power station was previously managed through three intermediary septic tanks (located in the south-eastern corner of the site) that proceeded to discharge into a Dwr Cymru Welsh Water foul water drainage pipe running under the Borderlands train line along the eastern boundary of the site.

SITE ENVIRONMENTAL CONSTRAINTS AND CONDITIONS

6.8 A review of the MAGIC website managed by Natural England revealed that there are no environmental significant areas of interest noted within the indicated site boundary (Appendix 2). A surface water nitrate vulnerability zone (from agricultural practices) has been identified near the south-eastern corner of the site, and a Welsh RAMSAR site, Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC) and Special Protected Area (SPA) 'River Dee Estuary' are located approximately 0.8 km north, 1 km west and 1.3 km south of the site, respectively.

6.9 The catchment's ecological and chemical categorisation is defined as moderate to good. Therefore requirements for mitigation at the site will look to ensure that there is no additional impact to the receiving watercourse and estuarine environment, as a result of receiving surface water flows from the proposed development.

7. FLOOD CONSEQUENCE ASSESSMENT METHODOLOGY

7.1 This FCA will utilise existing qualitative and quantitative flood risk information from Natural Resources Wales (NRW) and Flintshire County Council. Potential risk will be evaluated in accordance with the applicable hazards and associated flood consequence for the site location and surrounding areas.

7.2 Site vulnerability will be assessed in accordance with the Planning Policy Wales Technical Advisory Note 15 (TAN 15) guidance, so as to ensure there is minimal risk from flooding to the proposed development and that the development will not increase flooding potential elsewhere. This FCA will also look to accurately identify any further flood mitigation measures, if necessary.

7.3 In accordance with TAN 15, the site levels should be checked so as to confirm that the site sits above the maximum flood levels associated with the extreme 0.1% or 1 in 1000 year Annual Recurrence Interval (ARI) flood event. Should this be the case, no further flood risk need be considered provided it meets the acceptability criteria of not increasing flooding elsewhere.

7.4 The FCA should therefore seek to address the following:

- The potential consequences of flooding on the development;
- The potential consequences of the development on flood risk elsewhere within the catchment for a range of potential flooding scenarios, up to 0.1% or 1 in 1000 year return period flood event; and
- Identify the extent of any mitigation measures potentially required to remediate flood risk and how they can be successfully managed.

7.5 The key steps associated with the development of this FCA and S&FWMP will include the following process:

- Identify the sources of floodwater (if any);
- Define how floodwater enters and flows across the site (if any);
- Assess how high floodwaters will reach (if any); and;
- Define the extent of modifications required (such as raising levels) to prevent impact to the development and surrounding areas.

8. POTENTIAL FLOOD RISKS

8.1 The Development Advice Map (DAM) for wales outlines three flood zones which are used to in conjunction with TAN 15 and Planning Policy Wales to guide any new developments away from areas at risk of flooding where possible. The definition of these flood zones may be summarised as follows:

- Flood Zone A, identified by no shading on the DAM indicates the area where flooding from rivers and the sea is very unlikely, i.e. land with a less than 0.1% (1 in 1,000) chance of flooding occurring each year. This land is considered to be at little or no risk of River/Sea flooding and also takes into consideration the benefit provided by flood defences. These areas may also be classified as "Very Low" flood risk;

- Flood Zone B, identified as yellow shading on the DAM is defined as areas known to have been flooded in the past evidenced by sedimentary deposits and has an annual chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%) for river flooding, or between 1 in 1000 (0.1%) and 1 in 200 (0.5%) for sea flooding. The levels of the proposed development are required to be checked off against the outline for 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. These areas may also be classified as "Low" flood risk,

- Flood Zone C, identified by blue and green shading in the DAM, defines the extent of an extreme flood from rivers or the sea. These areas are likely to be affected by a major flood and has an annual chance of flooding of 1 in 100 (1%) or more from rivers and 1 in 200 (0.5%) or more from the sea. A further distinction is made in this flood zone, name C1 and C2. Zone C1 includes areas which are developed in the flood plain and are served by significant infrastructure, including flood defences. Zone C2 represents the same area but in the absence of flood defence structures. This area may be classified as a "Medium to High" flood risk.

8.2 Figure 2 below describes the site location in relation to the DAM flood zones. From the figure it is clear that the majority of the site is located within flood zone B (i.e. the upper level of the site) whilst a small portion of the site (i.e. lower level) lies within flood zone C1.

8.3 In accordance with TAN 15, the proposed development is classified as a Highly Vulnerable Development. As outlined in TAN 15, the requirements of the FCA for the area of the site which resides in flood zone B must demonstrate that the surface levels in this zone are greater than the flood levels used to define the adjacent extreme flood outline (i.e. greater than the 1 in 1000 year for river and 1 in 200 year for sea flood levels). The area of the site which lies within flood zone C2 is not considered acceptable for highly vulnerable developments. In this report it will be demonstrated that the highly vulnerable components of the proposed development will be limited to flood zone B, and the remainder of the site in flood zone C2 will be limited to only water compatible only infrastructure.

8.4 In accordance with Planning Policy Wales, TAN 15, and other relevant guidance, a variety of flood risks have been assessed in relation to the proposed development of the site. These are:

- River-system Flooding;
- Sea Flooding;
- Surface Water Flooding;
- Reservoir Flooding; and
- Historic Flooding Records

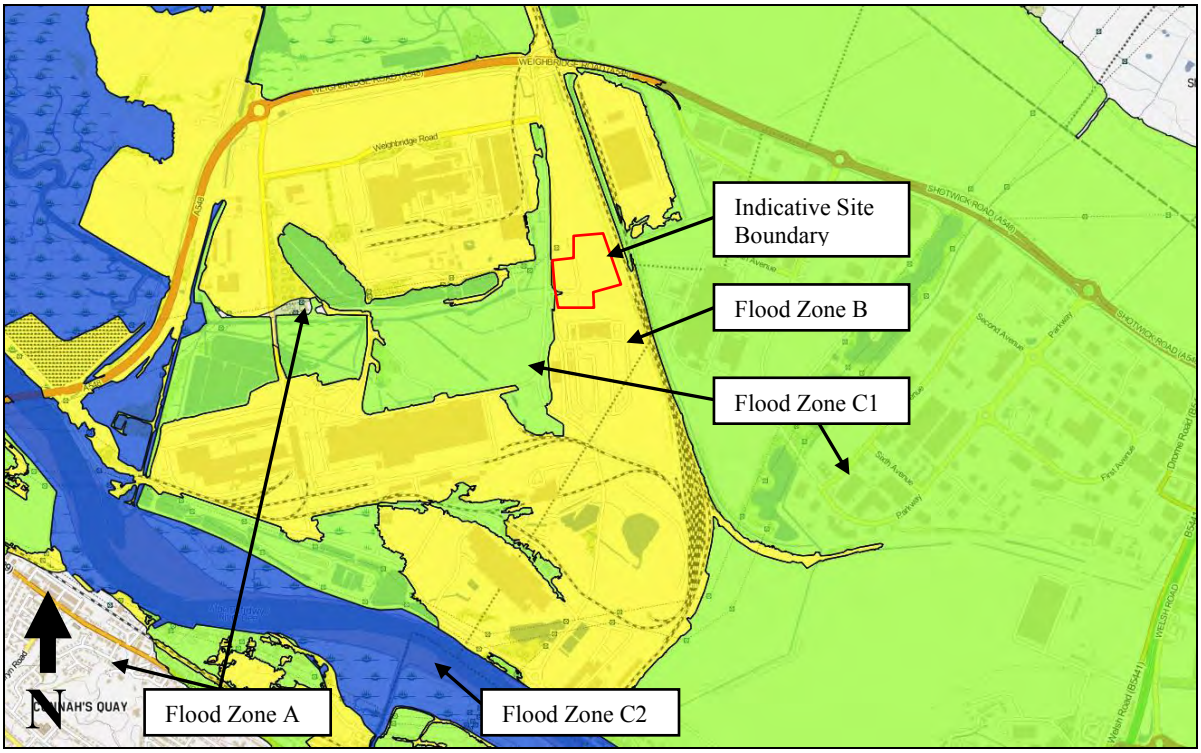

Figure 2 – Development Advice Map for Site (Source: Natural Resources Wales, 2016)

RIVER AND SEA FLOOD RISK

8.5 River flood risk is defined as the risk of flooding arising from rising water levels in rivers and watercourses to the point where the water is no longer confined to the predefined watercourse channel. The NRW Flood Map (rivers and sea) provided as Figure 3, confirms that the site lies predominantly within the non-defined river and sea flood risk zone (i.e. risk of flooding is beyond very low – less than 0.1 % in any year). However there is a high flood risk identified in the lower level of the site along the western boundary and site access ramp.

8.6 The raised surface elevations of the upper level of the site (as a result of the construction of the former CHP Shotton Power Station at the site) have placed this area of the site above the extreme river and sea flood levels. Based on the information provided in the River Dee Tidal study conducted for NRW by JBA Consulting (Appendix 3), the defended tidal water levels within the River Dee Estuary for the 1 in 1000 (0.1%) and 1 in 200 (0.5%) annual exceedance probability events with climate change, lies between 6.31mAOD near the river mouth and 7.68 mAOD 60 km upstream from the river mouth. Table 2 below provides an extract of the defended surface levels along the River Dee node points nearest to the site (i.e. between 'Flintshire Bridge' A548 and the A494 Bridge). A comparison of these extreme defended water levels to the current surveyed elevations of the upper level of the site reveals that that there is at least 0.6 m of freeboard above the highest modelled level. Furthermore 2D flood model maps produced in the report for the undefended 1 in 200 and 1 in 1000 flood extent scenarios reveals that the site is not located within the flood extent of these scenarios.

Table 2 – Surface water levels along River Dee for the 1 in 200 and 1 in 1000 Flood Events (Source - Tidal Dee Flood Mapping Update, JBA Consulting 2015)

Node Point ID	Easting	Northing	Modelled Surface Levels				Modelled Surface Levels + Climate Change					
			0.5% AEP (2011)	0.5% AEP (2015)	0.1% AEP (2011)	0.1% AEP (2015)	0.5% AEP (2065)	0.5% AEP (2090)	0.5% AEP (2115)	0.1% AEP (2065)	0.1% AEP (2090)	0.1% AEP (2115)
10104210	332277	368641	6.470	6.476	6.680	6.694	6.909	7.204	7.431	7.132	7.353	7.506
10103710	331849	368901	6.480	6.485	6.690	6.704	6.928	7.209	7.461	7.134	7.367	7.55
10103210	331422	369164	6.480	6.489	6.700	6.709	6.929	7.226	7.474	7.117	7.375	7.579
10102710	331002	369438	6.480	6.491	6.690	6.705	6.918	7.236	7.483	7.13	7.383	7.596
10102220	330583	369713	6.480	6.485	6.680	6.694	6.898	7.236	7.499	7.14	7.391	7.617
10101970	330367	369836	6490	6.500	6.700	6.714	6.904	7.234	7.513	7.142	7.397	7.637
10101720	330123	369893	6.470	6.483	6.690	6.697	6.903	7.22	7.505	7.132	7.388	7.622
10101240	329625	369943	6.490	6.496	6.700	6.713	6.907	7.214	7.516	7.109	7.384	7.658
10100740	329192	370149	6.490	6.502	6.710	6.721	6.901	7.222	**7.520**	7.111	7.379	**7.677**
10100240	329025	370615	6.470	6.482	6.690	6.695	6.871	7.202	7.487	7.107	7.36	7.639
10100000	328871	370804	6.470	6.475	6.680	6.686	6.879	7.185	7.473	7.101	7.35	7.619

8.7 The areas immediately north and south of the site beyond the site boundary are identified with a very low risk of flooding from river and sea (i.e. less than 0.1 % in any year); similarly for the area to the east of the site. The train line running along the eastern boundary of the site acts an artificial barrier to inhibit the ingression of river and sea flood water onto the site along the eastern edge of the site boundary. Furthermore there is a 3 m high earth bund running between the train line and the eastern boundary of the site (Appendix 1). The area to the west of the site is largely identified with a medium to high river and sea flood risk, which includes roads and storm water drainage infrastructure, several small watercourses and small water bodies and low-lying vegetated areas. However, as indicated on the DAM the areas adjacent to the west and east of the site are recognised to benefit from flood defence structures present along the northern banks of the River Dee.

SURFACE WATER FLOOD RISK

8.8 Surface water flood risk is defined as the risk arising from ponded surface waters as a result of runoff from precipitation (typically rainfall) gathering at a depression (i.e. low lying area) on the surface of a low impermeable surface type. This type of flood risk is generated by rainfall and is generally difficult to model and define, as it may be subject to localised rainfall patterns and altered topography. The NRW Flood Map for Surface Water, provided as Figure 3, indicates that the majority of the site sits outside of any defined fluvial flood risk zones. There are four small isolated areas identified with a low surface water flood risk (i.e. between 0.1 % and 1 % in any year) and a medium surface water flood risk (between 1% and 3.3% in any year) for a small isolated area in the south-eastern corner of the site. These small areas of surface water flood risk represent the site layout and surface levels of the previous Shotton Power Station and are not representative of the current site conditions or the levels to be proposed for the ArrowBio Plant development.

RESERVOIR FLOOD RISK

8.9 While there are several open surface water bodies and a reservoir located within a 1.5 km radius of the proposed development, the site sits above the surrounding area and does not appear to lie in the flow path of the nearby water bodies should the structure fail or overtop. A review and investigation of NRW flood mapping for reservoirs indicates that the site is not subjected to this form of flood risk (Figure 3). Similarly, the areas immediately adjacent to the site do not lie within a reservoir flood risk zone.

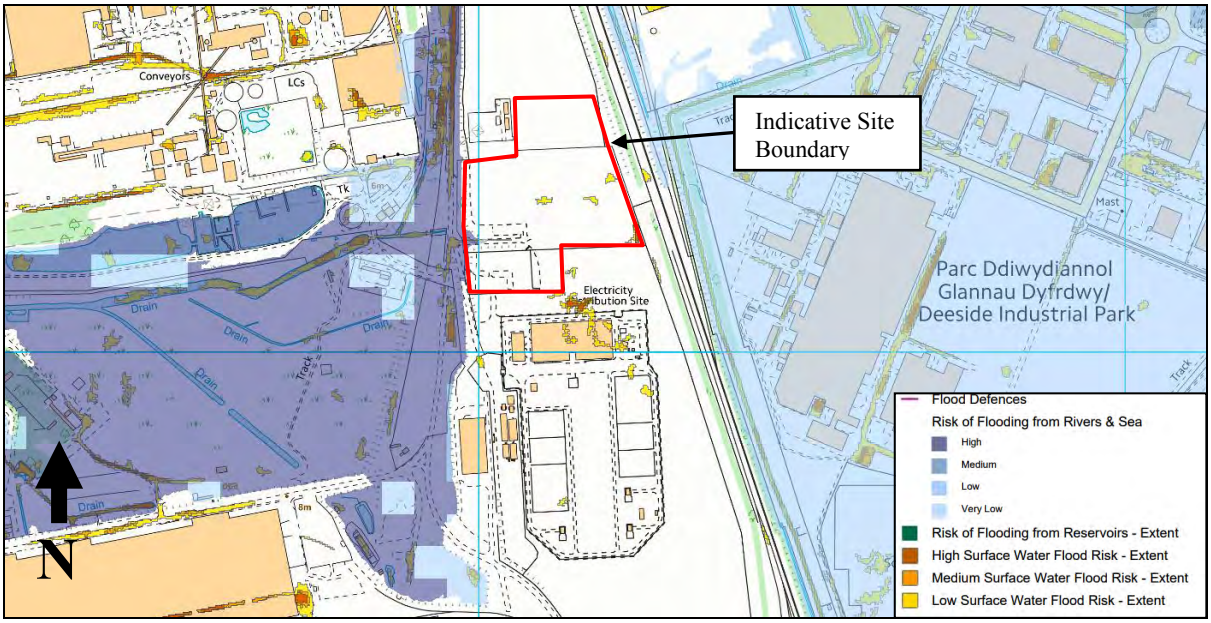

Figure 3 – Flood Risk from Rivers and Seas, Surface Water and Reservoirs (Source: Natural Resources Wales, 2016)

GROUNDWATER FLOOD RISK

8.10 Ground water levels below the site area are low with an anticipated depth of 5 m or more (TerraConsult Ltd Report No 3484 R06 Issue 1: Phase 1 Site Investigation Report). Assuming that the finished surface levels of the proposed development will be at or higher than the current surface levels of the site, the potential flood risk associated with groundwater flooding may be considered as negligible and unlikely to impact the site operations.

HISTORIC FLOOD RISK

8.11 A review of the Flintshire Preliminary Flood Risk Assessment Report (2011) and the Flintshire Local Flood Risk Management Strategy (2013) revealed no recorded events of flooding within the site.

9. SUMMARY OF FLOOD RISKS

9.1 A review of the available flood risk information has concluded that the majority of the site area (i.e. upper level) is associated with a very low to negligible flood risk, and that there is no apparent connection to the aforementioned sources of flooding within the site. However a small portion of the site along the western boundary (i.e. lower level) has been identified with a medium-to-high river and sea flood risk, and medium surface water flood risk at an isolated area at the site entrance.

9.2 In the potential event of river and sea flooding in this area of the site, flood waters will access the site from the west along Weighbridge road, but are unlikely to proceed further into the site (i.e. it should not proceed further than the top of the site access ramp). Similarly, the egress of flood water will proceed westwards, down the site access ramp and away from the site and along Weighbridge road.

9.3 A summary of the applicable flood risks and areas of further investigation and potential control required has been provided in Table 3.

Table 3 – Existing Flood Risk Summary

Type of Flood	Assessed Risk	Control Measures
River and Sea	Based on the NRW long term flood risk maps the majority of the site lies within a very low flood risk (less than 0.1 % in any year). The exception is a lower level area of the site area along the western boundary and site access ramp. Based on the River Dee Tidal Study, the upper level of the site resides at least 0.6 m above the 1 in 1000 AEP event + climate change. Furthermore, the site is not located within the 1 in 1000 AEP + climate change undefended scenario. Low and high flood risk areas adjacent to the eastern and western boundary of the site.	The highly vulnerable sections of the development (i.e. the buildings, biological plant area, storage areas for hazardous and waste materials, internal roads and carpark) will be confined to the upper level area of the site which sits within the very low flood risk zone (i.e. above the 1 in 1000 AEP tidal event level). The lower level area of the site located along the western boundary will largely remain its current condition as an undeveloped vegetated surface with flood compatible drainage (i.e. a grass ditches, pipes, a culvert and manholes). Acceptable consequences for nature of use. The occupiers must be made aware of the flood risk through this FCA. No increase in flooding elsewhere (e.g. from surface waters) through an appropriate surface water management plan outlined in this report.
Surface Water	Site sits outside areas of high surface water flood risk. Risk of flooding less than 0.1 % in any year. Low to medium flood risk areas adjacent to the western and southern boundary of the site.	On site mitigation measures to provide sustainable drainage systems and attenuation features on site through the proposed surface water management plan outlined in this report. This will be done so as to minimise potential for impact to local surface water drainage systems, road network and surrounding land-use.
Reservoir	Outside of maximum extent	None required
Groundwater	Very Low	None required
Historic	None recorded on site	None required

10. VULNERABILITY OF PEOPLE, PROPERTY AND ADDITIONAL MITIGATION MEASURES

10.1 In accordance with the TAN 15 Development Category classification, it is regarded as 'Highly Vulnerable'. However, the proposed development's assessed flood risk can be considered low to negligible; consequently the potential hazard or vulnerability to the people within the site can be considered low to negligible, provided that they are familiar with this FCA and associated Flood Evacuation Route plan (Appendix 4).

10.2 Furthermore, the development will ensure that potential risks associated with increased surface water runoff to the external receiving environment will be managed effectively and will not increase the potential for flooding within the proposed development or on properties adjacent to the site. This will be assessed and provided for through the conceptual surface water management plan outlined in this report.

10.3 Infrastructure and systems of the development that is vulnerable to flood damage (including offices) should not be built in the lower level area along the western boundary of the site that has been identified with a high flood risk. Instead only water compatible infrastructure (i.e. roads, pipes, manholes, swales and other similar drainage systems) should be constructed in this area of the site.

10.4 The proposed surface water drainage should be designed to accommodate (i.e. no unacceptable level of surface water ponding within the site) the 1 in 100 year + 20% climate change storm events. Any storm water storage or attenuating structures should be located in area of the site that permits any overflow from the structure to proceed away from vulnerable infrastructure and people, and towards flood water compatible areas.

10.5 Under typical operational conditions, the storm water drainage for the development should limit the off-site discharge of the storm water to the Q_{bar} value for the site area, up to the 1 in 100 year storm event.

10.6 In order to minimise the potential impact on the water quality of receiving water resources adjacent to the site, the use of SuDS features such as Bio-remediation channel system, grass lined ditches and geo-cellular attenuation features should be included in the final storm water drainage. In addition, bypass separators should be sized up and included in the storm water drainage to intercept potential silt, oils and debris entrained in the runoff within the site area.

10.7 The storm water and foul water drainage systems should be designed in accordance with the Welsh Government Building Regulation (2010) and Sewers for Adoption (7th edition), to ensure the relevant design standards of the system are met and the optimal functioning of the system. This should be carried out by suitably qualified and experienced individuals.

10.8 During the construction and operational phases of the development, personnel on-site should refrain from entering the low-lying area along the western boundary of the site that has been identified with a high flood risk. This should be mandatory under prolong or high rainfall events where a flood risk warning has been issued for the area or region. In addition, personnel onsite should be made aware for the potential flood risk for the site, through the consultation of the site's FCA and flood evacuation plan.

10.9 In addition to standard health and safety procedures and practice for construction sites (i.e. induction, high visibility and protection gear, demarcation of potentially dangerous areas within the site through warning signs / lights, permit system, etc) any potentially dangerous ponded bodies of water that have developed within the site (after a significant rainfall event(s)) should be pumped off-site at a rate no more than the Qbar value for the site area; provided that the quality of the water is at an acceptable standard that would not compromise the receiving environment.

10.10 In addition, during the construction phase of the development, voids and trenches will be excavated to install the required storm water and foul water drainage, which will create potential risk hazards to personnel walking or operating machinery on-site. In order to mitigate for these potential hazards, standard health and safety procedures and practice for construction sites (i.e. induction, high visibility and protection gear, demarcation of potentially dangerous areas within the site through warning signs / lights, permit system, etc.) should be followed by the contractors and personnel present on the site. Furthermore, temporary construction screens should be placed around the site to limit the visual impact to the area adjacent to the site.

11. ASSESSMENT OF FLOODING

11.1 In accordance with Flintshire County Council and TAN 15, a justification approach is required for any new development. The aim of the justification test is to ensure that the chosen development site offers the lowest possible flood risk, based on the qualitative assessment of potential flood risk (Table 4). That is, the 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. The Planning Authority should only approve a development where it can be demonstrated that the proposal doesn't increase the overall risk of flooding in the area and is adequately protected from flooding itself. Keeping in mind that the majority of the site (upper level area) resides in flood zone B and lies above the extreme tidal flood levels of the River Dee, this area of the site does not require justification. However the lower level of the site is recognised to reside on flood zone C1, but will have minor development with only water compatible infrastructure (i.e. vegetated land cover, open grassed ditches, pipes, culverts and manholes for storm water drainage). Furthermore, the only site access is provided from the Weighbridge road which is necessary for the functioning of the development, and cannot be changed.

Table 4 – Qualitative Justification Test for Proposed Development

Step	Qualitative Flood Risk Assessment Criteria	Y or N	Further Assessment Required?
1	Is the site in an area of low risk of flooding?	Y	N
2	Is there an alternative potential site in the area that is of low risk of flooding?	N	N
3	Is the site in an area of medium risk of flooding?	N	N
4	Is there an alternative site in Flood zone 2	N	N
5	Does the site lie in the Functional Floodplain (zone 3b)?	N	N
6	Will the proposed development type be acceptable in the Flood Zone?	Y	N
7	Are there other potential allocation sites in the same Flood Risk Zone?	N	N
8	Is the proposed development likely to be safe and appropriate?	Y	N

11.2 The FCA for proposed ArrowBio plant has identified the potential sources of flood risk for the site and has shown the proposed development is not subjected to an unacceptable risk of flooding. The majority of the site's current surface levels sit at least 0.6 m above the 1 in 1000 + climate change level for the section of River Dee near the site; the small area of the site identified to be at risk of flooding will remain in its current state as water compatible infrastructure. Furthermore, through the justification test (above) the proposed development is situated in the optimal location in respect to the surrounding area and the corresponding flood risk. Consequently the Site location is deemed as appropriate from a Flood Consequence Assessment perspective.

12. SURFACE WATER DESIGN CRITERIA

12.1 In order to effectively manage the surface water within the proposed development to minimise the risk to life, damage to property and disruption to people on the site or adjacent to it, requires an effective surface water management plan to control the surface water within the site and discharge it off-site at an appropriate location at an acceptable flow rate. Relevant legislation, conditions, policies and guidance listed in section 4 of this report outline requirements of an effective and acceptable SWMP for a new development; these are summarised in this section of the report.

IMPACTS OF CLIMATE CHANGE AND OFF-SITE SURFACE WATER FLOWS

12.2 Flood Consequence Assessment allowance outlined in Welsh government flood management policy (http://gov.wales/docs/desh/publications/160831guidance-for-flood-consequence-assessments-climate-change-allowances-en.pdf) recommends that the central estimate/ change factor for the 2080's scenario should be used to assess the surface water management plan for a new development. In this case the climate change factor of 20 % for the 2080's is prescribed for the River Dee Basin. So as to accurately represent the future risk associated with climate change impacts, which may compound flood risk on the site and surrounding areas, an allowance of 20% on top of the peak rainfall events has been provided in the estimation surface water flows generated from site.

12.3 TAN15 and the Flintshire County Council guidance recommends that surface water generated from the proposed development should, as far as is practicable, be managed in a sustainable manner to mimic the site's pre-development flow conditions (i.e. the Greenfield flow rate). Surface water drainage design should therefore seek to ensure that volumes and peak flow rates of surface water leaving the development are no greater than those prior to development, through reducing surface water run-off where possible. The Greenfield flow rates for the site area have been derived using the ICP SUDS method prescribed in the MicroDrainage software (Appendix 5).

12.4 On this basis the proposed surface water drainage strategy will be designed to retain any flooding arising from the 1 in 100 year + 20% Climate Change rainfall event to the site planning boundary while accommodating the Greenfield Q_{bar} value of 27.5 l/s ensure no increased flood risk to downstream receptors.

TECHNICAL GUIDELINES AND RECOMMENDATIONS

12.5 Whilst the proposed SWMP presented in this report is presented at a conceptual level rather than at a detailed design stage, the surface water drainage strategy has been designed in accordance with several fundamental technical guidance requirements outlined in the Sewers for Adoption 7th Edition (2012), CIRIA C753 The SUDS Manual (2007), British Standards 752 and 858, The Building Regulations (2010) and The Welsh Ministers' Standards for gravity foul sewers and lateral drains. These include the following:

- As far as practicable, sewers and lateral drains should be laid in highways (in this case the internal site access roads) or open space where they are reasonably accessible and visible;
- The external face of any new sewer or lateral drain should be at least 1.2 m away from any building or structure or at a distance equivalent to the depth of the sewer below the foundation – whichever is greater;
- The minimum depth of cover to the crown of the gravity pipe without protection should be as follows:
  - 0.35 m for domestic gardens and pathways without any possibility of vehicular access;
  - 0.5 m for domestic driveways, parking areas and yards with height restrictions to prevent entry of GHV weight in excess of 7.5 tonnes;
  - 0.9 m for agricultural land, public open space, domestic driveways, parking areas and yards for GHV weight in excess of 7.5 tonnes; and
  - 1.2 m other highways and parking areas with unrestricted access to vehicles with a GHV weight in excess of 7.5 tonnes.

12.6 Technical guidance provided within CIRIA C753 (The SuDS Manual) recommends minimising the potential impact on the water quality of the receiving environment. Consequently, the proposed surface water drainage strategy will include a series of bypass oil separators to collect potential oil and silt entrained in the surface runoff from the site. These will be sized in accordance with Pollution Prevention Guidelines 3 (PPG3), in the absence of a new Guidance for Pollution Prevention (GPP) guideline specific to oil separators for drainage systems.

12.7 Similarly, Pollution Prevention Guidelines 26 (corresponding GPP guideline is yet to be made available), states that areas / buildings designated to store potentially polluting liquids require secondary containment to accommodate a capacity of at least 25% of the total volume of the containers being stored, or 110% of the largest container, whichever is the greatest. This includes the maintenance depot / fuel and oil store building planned for the site.

13. SURFACE WATER DESIGN CONCEPT

13.1 The surface water design has been developed using MicroDrainage software tool. It takes into consideration applicable Sustainable Drainage Systems or SuDS design criteria as recommended by the Flintshire County Council and TAN 15. This conceptual design has also taken into account surrounding surface water bodies, hydrogeological impacts and localised infrastructure / environmental constraints. Furthermore, surface water from the site will be drained under gravity through an appropriately sized and designed drainage network, which will then outfall into the proposed surface water control features assessed within this report. The drainage network will aim to incorporate sustainable drainage system controls (where practical) in accordance with recognised best practise guidance and legislation.

13.2 The proposed site layout and surface water drainage is depicted in TerraConsult Drawing 3484/01/001. The proposed surface water drainage strategy has been designed to accommodate the surface water flows for the completed development.

13.3 As indicated in TerraConsult Drawing 3484/1/001, there will be three main drainage lines; Pipe Numbers (PN's) 1.000 – 1.011, 9.000 – 9.007 and 15.000 – 15.002. Branch lines will connect to the main drainage lines at manholes / junction boxes. Four subsurface geo-cellular storage tanks have been incorporated into the drainage design to provide the necessary attenuation for the site, and two bypass oil and silt separators have been prescribed at the end of two main drainage lines to minimise the amount of silt and entrained oil from entering the subsurface attenuation tanks and subsequently leaving the site. The site is considered to be at little risk of infrequent light contamination and potential for small spills; as such, bypass separators have been prescribed for the site's surface water drainage strategy. The treated trade effluent from the plant's operations will be managed through the BioPlant's internal waste water treatment process and discharged off-site through the foul water drainage network proposed in this report. This report does not cover the management of effluent within the Bio Plant's internal processes, and is limited to the site's surface and foul water drainage management only.

13.4 In addition to the bypass separators, two grassed ditches have been included near the end of the proposed surface water drainage network, to provide additional treatment to the surface water leaving the development.

13.5 Flow control devices including two Hydro-Brakes and four non-return valves have been included in the design to optimise the balance between attenuation volume of the subsurface geo-cellular tanks

and the Greenfield Q_{bar} discharge flow rate. It is proposed that the surface water drainage system for the site will tie-in to the existing Weighbridge Road culvert at site main entrance, located at the western boundary of the site.

13.6 It is also proposed that to appropriately accommodate the construction process for the proposed development site, the final surface water management controls are constructed as a priority. This will thereby allow a temporary control regime of internally drained waters being discharged off site at the nominal design discharge rate (i.e. not exceeding the Greenfield Q_{bar} value for the site.

13.7 At the time of writing this report the surface levels of the finalised layout are yet to be confirmed, and therefore, at this conceptual stage of the surface water drainage design, these levels are based on the current surface levels according to the recent site topographic survey provided by the Pegasus Group.

13.8 Furthermore, additional ground investigation works has been recommended in TerraConsult Report 3484 /R06-1 Phase 1 Site Investigation report. In the absence of a clear understanding the ground conditions below the site (which may contain contaminated materials) along with the absence of infiltration data for the site, the use of infiltration SuDS systems for surface water management controls has been precluded and will not be investigated further within this report.

14. SURFACE WATER DESIGN ASSUMPTIONS AND INPUTS

14.1 It is proposed that the site impermeability factors contributing runoff to surface water drainage will be defined by its applicable end-use (i.e. land use surface type) and the total area of the site. This will be assessed in accordance with prescribed land use impermeability factors and corresponding Impermeability Factor's indicated in Table 5.

Table 5 – Land Use Impermeability Factors (adapted from CIRIA C753 Table 26.14)

Land Use Surface type		Impermeability Factor
Roofs	Industrial	1.0
Hardstand	Site Internal Access Roads	0.8
	Pavements	0.8
	Carpark	0.8
	Biological Plant Area	1.0
Open Areas	Grassed Areas	0.1
	Hardcore (Crushed loosed packed rubble)	0.1

14.2 The site impermeability has been calculated with regards to the finished land use surface type conditions as defined in Table 5 of this report, and the proposed layout plan for the development is depicted in TerraConsult Drawing No. 3484/1/001. Here the site area was divided into 22 Drainage Areas (DAs) to represent the area that will be drained through the proposed drainage network. For each drainage area the land use surface type area and corresponding weighted impermeability were calculated. The drainage area and corresponding impermeability percentage value were used in the model to produce the runoff values from the relevant drainage areas. Note due to round-off formatting in Table 6, some of the small areas representing a specific land surface type may be indicted as 0.00 ha, but they still have an actual surface area. As summarised in Table 6 below, the average site impermeability is approximately 78%.

Table 6 – Contributing Surface Water Drainage Areas

Total Site Area – 5.57 ha	A – Vegetation and Hardcore Impermeability Factor of 0.1		B - Car Park/ Hard Standing Impermeability Factor of 0.8		C - Roads Impermeability Factor of 0.8		D – Roofs and Biological Plant Area Impermeability Factor of 1.0		E - Sub Total Area (ha)	Drainage Area Impermeability (%) =[[(A× 0.1) + (B× 0.8) + (C× 0.8) + (D× 1.0)] / E] ×100
	Area (ha) - A	%	Area (ha) - B	%	Area (ha) - C	%	Area (ha) - D	%		
Drainage Area 1:	0.00	0.00	0.00	0.00	0.00	0.00	0.33	100	0.33	100
Drainage Area 2:	0.00	0.00	0.00	2.34	0.09	51.0	0.08	46.56	0.18	89
Drainage Area 3:	0.00	0.00	0.00	0.00	0.00	0.00	0.24	100	0.24	100
Drainage Area 4:	0.00	0.00	0.00	0.00	0.00	0.00	0.31	100	0.31	100
Drainage Area 5:	0.00	1.50	0.00	0.00	0.11	65.5	0.06	32.99	0.17	86
Drainage Area 6:	0.00	5.32	0.00	9.74	0.03	84.9	0.00	0.00	0.03	76
Drainage Area 7:	0.00	0.00	0.44	100	0.00	0.00	0.00	0.00	0.44	80
Drainage Area 8:	0.00	0.00	0.01	7.99	0.07	92.0	0.00	0.00	0.08	80
Drainage Area 9:	0.00	0.00	0.25	100	0.00	0.00	0.00	0.00	0.25	80
Drainage Area 10:	0.00	0.00	0.27	100	0.00	0.00	0.00	0.00	0.27	80
Drainage Area 11:	0.01	13.7	0.03	45.7	0.02	40.5	0.00	0.00	0.06	70
Drainage Area 12:	0.02	12.4	0.08	49.1	0.06	38.4	0.00	0.00	0.16	71
Drainage Area 13:	0.09	36.3	0.04	16.7	0.11	43.3	0.01	3.64	0.25	55
Drainage Area 14:	0.00	0.00	0.00	0.00	0.00	0.00	0.54	100	0.54	100
Drainage Area 15:	0.01	5.62	0.00	0.00	0.12	71.0	0.04	23.37	0.17	81
Drainage Area 16:	0.00	0.00	0.00	0.00	0.00	0.00	0.41	100	0.41	100
Drainage Area 17:	0.01	4.23	0.04	25.1	0.07	45.4	0.04	25.16	0.16	82
Drainage Area 18:	0.00	0.00	0.00	0.00	0.00	0.00	0.53	1000	0.53	100
Drainage Area 19:	0.01	3.15	0.01	5.57	0.11	60.5	0.06	30.74	0.18	84
Drainage Area 20:	0.18	36.8	0.02	4.49	0.28	57.9	0.00	0.69	0.48	54
Drainage Area 21:	0.10	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.10	10
Drainage Area 22:	0.16	65.5	0.00	0.00	0.08	34.5	0.00	0.00	0.25	34
Sub Total Area (ha):	0.58	N/A	1.19	N/A	1.16	N/A	2.64	N/A	5.57	N/A
Average Impermeability (%)										78

14.3 As indicated on TerraConsult drawing 3484/1/001, the undeveloped area on the west of the proposed buildings and ancillary equipment is taken as impermeable area and the larger area around the bin parking area is taken as car park surface. Considering so will ensure that the resultant drainage strategy is robust enough to cater to the future developments that may be proposed on the application site at later stage. In the proposed drainage strategy, pipes 5.000, 6.000 and 11.000 and their corresponding upstream manholes and Geo-cellular Attenuation Tank 4, are designed to receive the potential runoff from the indicated future development area, and may be constructed at a later stage when developing the areas of the site.

14.4 Flow analysis for the design was conducted for the 1, 30 and 100 year return period storms with climate change accounted for by increasing runoff by 20% in accordance with the Welsh Planning Policy Wales Guidance and TAN 15.

14.5 Rainfall input was generated using the Flood Estimation Handbook (FEH) function within the MicroDrainage. The main catchment parameters for input as part of this design criteria are as follows:

- Return period = 100 year,
- Version = 2013,
- Site Location = GB 331126 371270 SJ 331126 71270
- Data type = Point,
- Maximum Time of Concentration = 30 min,
- Global Time of Entry = 5 min,
- Percentage of Site Impermeability = User Defined (see Table 6);
- Maximum Rainfall Intensity = 50 mm/hr;
- Volumetric Run-off Coefficient = 0.84 (summer) and 0.75 (winter) - Default;
- Climate Change = 20%;

14.6 In addition to the input parameters listed above, design inputs for the proposed subsurface attenuation tanks, Hydro-Brakes and non-return valves are as summarised in Table 7 below.

Table 7 – Surface Water Attenuation Tanks and Flow Control Inputs

Attenuation Tank	Down Stream Pipe Number	Surface Area (m^2)	Cover Level (mAOD)	Invert Level (mAOD)	Depth of Tank (mAOD)	Porosity (Void: Ratio)	Structure Storage (m^3)
Geo-cellular Tank 1	1.002	215	10.00	7.50	1.20	0.94	256
Geo-cellular Tank 2	10.001	364	9.00	7.30	0.40	0.94	160
Geo-cellular Tank 3	9.004	120	9.00	7.30	0.40	0.94	53
Geo-cellular Tank 4	11.001	273	9.00	7.30	0.40	0.94	120
Geo-cellular Tank 5	1.006	2800	9.40	6.30	1.20	0.94	3334

Flow Control Device	Down Stream Pipe Number	Design Flow (l/s)	Cover Level (mAOD)	Invert Level (mAOD)	Design Head (m)
Hydro-Brake 1	1.006	19.0	9.40	6.30	1.10
Hydro-Brake 2	1.010	27.0	5.35	4.50	0.80
Non-return Valve 1	10.001	N/A	9.00	7.30	N/A
Non-return Valve 2	11.001	N/A	9.00	7.30	N/A
Non-return Valve 3	9.007	N/A	6.49	9.30	N/A
Non-return Valve 4	15.002	N/A	5.40	4.60	N/A

14.7 In addition to Hydro-brake and Non-return valves, gate values should be installed at the outlet pipes 1.000, 3.000 and 4.000. These should be closed in the event of the spills from Biological Plant Area, to prevent potential contamination of surface water in the remainder of the drainage network.

14.8 A heavy duty geo-cellular modular cell must be used for the subsurface attenuation tanks because of its siting below the car park and internal access roads. For example, the Polystorm Xtra Modular Cell product by Polypipe Ltd (http://www.polypipe.com/) would be a suitable product, however the decision for which drainage manufacture to use remains with the client, provided that it meets the specifications outlined in this report, relevant British Standards (i.e. British Standard BS 8110, BS 7533-13: 2009) and the necessary compressive strength requirements (i.e. at least 83 tonnes/m^2).

14.9 The sizing of the two bypass oil separators was based on the methods outlined in the pollution Prevention Guidelines (PPG3) *Use and Design of Oil Separators in Surface Water Drainage Systems* (April 2006), which incorporates the design components and guidelines outlined in British Standards BS EN 858-1:2002; BS EN 858-2:2003 and the CIRIA SuDS manual. The bypass separators are designed to intercept all flows from the area served, which are generated by rainfall rates of up to 6.5 mm/hour. The calculations for bypass separators are summarised in Table 8 below:

Table 8 – Bypass Separator Sizing Calculations

Bypass Separator	Downstream Pipe Number	Peak Flow Rate (l/s)	Inlet Pipe Diameter (mm)	Drainage Area (m^2)	Nominal Size (NSB) = 0.0018 × Area (m^2)	Oil Capacity (NSB × 15) (Litres)	Silt Capacity (NSB × 100) (Litres)
1	1.005	479	600	23509	42	635	4232
2	9.007	465	525	28733	52	776	5172

14.10 The bypass separator products (i.e. NSBE050) from Kingspan Klargester (https://www.kingspan.com/gb/en-gb) should be suitable for proposed surface water drainage.

14.11 Gully channel type and design have not been prescribed in this report at this stage of the surface water drainage design. This can be addressed under the future detailed drainage design stage of the development. The gully channels should meet the specifications outlined in the relevant detailed drainage design and BS EN 1433:2002. It is recommended that Bio-remediation channel system (which is lined) should be used to collect the runoff from the site area and channel it to the proposed surface water drainage strategy. There are several manufactures for these types of products, of which, the D-Rainclean Bio Remediation Channel product from Stormwater Management Ltd (http://www.storm-water.co.uk/source-control) should be suitable for the proposed surface water drainage strategy. The decision for which drainage manufacture to use remains with the client, provided that it meets the specifications outlined in this report, relevant British Standards.

15. SITE SURFACE WATER MANAGEMENT CONSTRAINTS

15.1 The main constraints relevant to the design of an acceptable conceptual surface water drainage strategy are as follows:

- High percentage of site impermeability (78%) with limited open space available for surface drainage features (i.e. ponds and swales);
- Relatively flat surface topography of the site (approx. 1:137); and

- Incorporation of recommended minimum cover depth for the pipe and subsurface attenuation tanks, to accommodate HGV vehicles on the site; and
- Meeting the Greenfield Q_{bar} flow requirement.

16. SURFACE WATER MANAGEMENT DESIGN SUMMARY

16.1 The results of the modelling exercise for the propose drainage design indicates that the surface water flows for the events up to and including the 1 in 100 year critical rainfall event can be successfully managed on-site with no flooding for rainfall simulations up to and including the 1 in 100 year + 20% allowance for climate change events.

16.2 Furthermore, all surface water runoff can be successfully discharged below the maximum permissible discharge rate of 27.5 l/s (Greenfield Q_{bar}), for all rainfall events up to and including the 1 in 100 year + 20% for climate change allowance.

It is anticipated that HGV vehicles will be the largest contribution of traffic within the site. Consequently, all the pipes, manholes and subsurface attenuation structures should be reinforced to maintain structural integrity. The grass ditches are located in the most downstream part of the drainage network (i.e. PN's 1.009 and 15.002) and are subjected to a maximum flow velocity between 0.4 m/s and 0.5 m/s, which are below the CIRIA C753 SUDS Manual recommended value of 2.0 m/s. However, it is recommended that the inlets and outlets of these grassed ditches be constructed with an erosion control lining such as turf reinforcement matting (i.e. 700-750 Type 3 Coir fibre matting), along with a precast concrete head and tail wall to minimise potential erosion action at this location of the drainage network.

16.3 A summary of the proposed surface water drainage network and performance is shown in Table 9 below. Appendix 6 contains the model output for the proposed surface water drainage design.

Table 9 – Summary of Surface Water Management Network and Controls

Storage Feature	Total Design Vol. Inc. manhole and Pipe(m^3)	Max. Vol. (m^3)	Upstream Manhole Cover Level (mAOD)	Max Water Level (mAOD)
Attenuation Tank 1	263	259	10.0	8.9
Attenuation Tank 2	164	163	9.0	8.3
Attenuation Tank 3	56	56	8.9	8.2
Attenuation Tank 4	123	121	9.0	8.4
Attenuation Tank 5	3343	2765	9.4	7.3

Section Type	Sections	Total Length (m)	Manning's n Value	Diam. /Ditch Base Width (mm)	Ditch Height (mm)	Diam. / Ditch Top Width (mm)	Cover Depth (m)
Pipe	1.000–1.007; 1.009; 9.000–9.007; 15.000–15.002	772.9	0.015	300-600	N/A	N/A	0.0 – 3.03
Culvert	1.010	12.0	0.015	1000	500	1000	0.45 – 0.55

Grassed Ditches	1.008; 15.002	112.0	0.027	100; 1000	300; 500	700; 2000	0.00 – 0.10

Maximum permissible discharge into existing surface water drainage ditch (Greenfield Qbar)	27.5 l/s
Maximum discharge from surface water drainage (PN 1.011)	26.8 l/s

16.4 As per the Welsh FCA policy, a Flood Evacuation Plan for the proposed development has been provided as Appendix 4 in this report. In the unlikely event that the site is subjected to flooding, occupants of the site should follows the evacuation route and make their way to the emergency assembly point located on the in the south western corner of the raised area within the ownership boundary – further details are outlined in the Flood Evacuation Plan.

17. FOUL WATER DESIGN CRITERIA

17.1 In order to control the foul water within the site and discharge it off-site at an appropriate location at an acceptable flow rate, to minimise the risk to life, damage to property and disruption to people on the site or adjacent to it, requires an effective foul water management plan. Relevant legislation, conditions, policies and guidance outlined under section 4 of this report outline requirements of an effective and acceptable foul water drainage plan for a new development, which are summarised below.

TECHNICAL GUIDELINES AND RECOMMENDATIONS

17.2 In addition to the technical guidelines and recommendations outlined for the surface water drainage (outlined in Sewers for Adoption 7th Edition, The Building Regulations (2010), and The Welsh Ministers' Standards for gravity foul sewers and lateral drains) additional design criterion should be adhered to for the conceptual design of the foul water drainage component of the proposed development. This includes the following:

- Pipes should be free from defects or other features that might cause blockage or otherwise impede the design flow;
- The layout for the drainage system should be kept simple. Changes in direction and gradient should be minimised. Connections of drains should be made obliquely or in the direction of flow.
- Pipes should be laid in straight lines where practicable but may be laid to slight curves if these can still be cleared of blockages. Any bends should be limited to positions in or close to inspection chambers or manholes.
- Gravity drains and sewers should have adequate gradient to maintain self-cleansing conditions. To provide a self-cleansing regime within gravity foul sewers, the minimum flow velocity should be 0.75 m/s at one-third design flow. Where this requirement cannot be met, then this criterion would be considered to be satisfied if:
  - A 150 mm nominal internal diameter gravity sewer is laid to a gradient not flatter than 1:150 where there are at least ten dwelling units connected; or,
  - A sewer or lateral drain with a nominal internal diameter of 100 mm, or lateral drain serving ten or less properties is laid to a gradient not flatter than 1:80, where there is at least one WC connected and 1:40 if there is no WC connected properties.
- The roughness value (ks) for foul gravity sewer design should be 1.5 mm

- Access points to the sewers should be sited with due regard to the public utility services. An access point should be built:
  - At every change of alignment, gradient or pipe material;
  - At the head of all sewers;
  - At every junction of two or more public sewers;
  - Where there is a change in the size of the sewer;
- Manholes should be provided as the mean of access to a pipe where:
  - The depth from the surface to the crown of the pipe is greater than 3m;
  - There are two or more upstream pipes serving more than 10 properties; or
  - The distance between manholes would otherwise be greater than 150m (i.e. no part of the pipe should be more than 75 m from the adjacent manhole).
- Where access to a pipe is provided through an inspection chamber, no part of the pipe should be more than 22.5m from the adjacent inspection chamber.
- Foul water drains and sewer systems should be sealed and water tight to minimise the ingress of surface and ground water.

18. FOUL WATER DESIGN CONCEPT

18.1 As in the case for the surface water drainage design, the foul water drainage has been developed using MicroDrainage software tool. This conceptual design has also taken into account surrounding surface water bodies, hydrogeological impacts and localised infrastructure / environmental constraints.

18.2 The foul water from the site will be drained under gravity through an appropriately sized and designed foul water conveyance network, which will then discharge into a public foul water sewerage line (Dwr Cymru Welsh Water) as described within this report (Appendix 7).

18.3 The proposed site layout and foul water drainage is depicted in TerraConsult Drawing 3484/1/001. The proposed foul water drainage strategy has been designed to accommodate the foul water flows for the proposed development under consideration.

18.4 As indicated in TerraConsult Drawing 3484/1/001, there will be 1 main drainage line; Pipe Number (PN) 1.000 – 1.004. A branch line (2.000) will connect approximately half-way along the main branch line, before the connection to the public foul water sewerage. The mainline will be expected to convey the treated trade effluent from the daily operation from the Biological Plant Area. An Inspection chamber with a Gate vale and flow meter must be connected to the foul water line (i.e. outlet of PN 1.002) before it joins with the domestic flow component. A second Gate value should be installed at the outlet of the foul water network, before it connects to DCWW sewer, in the unlikely event (for whatever unforeseen reason) the foul water flows leaving the site need be restricted or prevent incoming flows from DCWW sewer.

18.5 At the time of writing this report the surface levels of the finalised layout are yet to be confirmed, and therefore, at this conceptual stage of the foul water drainage design, these levels are based on the current surface levels according to the recent site topographic survey provided by the Pegasus Group.

19. FOUL WATER DESIGN ASSUMPTIONS AND INPUTS

19.1 The anticipated maximum peak flow for the site is derived from two components of the proposed development – (1) Treated trade effluent and (2) Domestic wastewater including grey water.

19.2 The management of the internal wastewater flows involved in the day to day process of the plant (i.e. the production of Bio gas and the maintenance floor washing within the buildings) will remain in a closed loop system within the development and is beyond the scope of this report. However, the client has provided an estimated daily volume of 400 m^3 of treated trade effluent that will need to be discharged from the plant. This equates to approximate flow rate of 4.6 l/s.

19.3 The domestic foul water component is based on the anticipated number of occupants that will be present on the site during typical day-to-day operations. The client has instructed that there will be approximately 40 employees on the site during typical daily operations of the plant. An additional 40 individuals have been added to this number to account for visitors and future expansion at the site. Based on the British Water Code of Practice – Flows and Loads - 4, the typical daily flows for fulltime staff in an industrial setting is 90 litres per person (0.001 l/s/person). A peak flow factor of 6 was applied to the flow value to provide a peak flow rate for the domestic waste water component for the development.

19.4 The calculation for the total foul water peak flow rate from the development was calculated as follows:

- Treated trade effluent maximum flow rate 400 m^3/day= 4.6 l/s.
- Domestic foul water = 0.001 l/s × 80 × 6 = 0.5 l/s
- Total foul water flow rate = 5.1 l/s

19.5 Should an additional toilet or shower facility be required on the site at a location that is relatively far away from the proposed foul water drainage network (i.e. at the site entrance), it would be impractical and inefficient to convey the small volume of foul water towards the foul water drainage at the other end of the site. In this case, it is recommended that a standard off-the-shelf manufactured package treatment plant system be adopted at this location, if required.

19.6 A pre-planning enquiry has been sent to the local public sewerage utility provider Dwr Cymru Welsh Water (DCWW) to confirm whether the public sewerage adjacent to the eastern boundary of the site can accommodate the anticipated foul water flows from the development. DCWW have confirmed that their network can accommodate the domestic component of the foul water at a connection point along the eastern boundary of the site (Appendix 7). The trade effluent component will need Consent to Discharge into the DCWW network. Provided that the trade effluent quality meets the necessary standards DCWW have indicated that their network can accommodate a 5 l/s flow rate.

19.7 At the time of writing this report, DCWW do not have the cover level and invert levels of manhole connection point for the proposed development on their records. It is recommended that a sewerage survey is carried out to ascertain these levels and confirm the outfall invert level of the proposed foul water drainage network.

20. SITE FOUL WATER MANAGEMENT CONSTRAINTS

20.1 The main constraints relating to the foul water drainage are as follows:

- Limited area of open space to route the foul water drainage;
- Limited (i.e. single drainage line) public foul water drainage to connect to; and
- Relatively flat topography of the site – it is difficult to achieve the necessary gradient and flow velocity under gravity whilst still meeting the invert level at the connection point to the public foul sewage line.

21. FOUL WATER MANAGEMENT DESIGN SUMMARY

21.1 The foul water drainage network will be laid along the eastern boundary of the site; the exception is PN 2.000. HGV vehicles will contribute to the majority of the traffic within the site. Consequently, all the pipes, manholes and subsurface structures (i.e. inspection chamber) should be reinforced to maintain structural integrity.

21.2 The results of the proposed foul water drainage network indicate that maximum flow velocities within the network range between 0.6 m/s and 0.8 m/s. Whilst the flow velocities may not be consistently high within the foul water network (i.e. 0.75 m/s at 1/3 the design flow velocity), the pipes have been prescribed a relatively steep gradient (i.e. 1:80 and 1:35) well below the minimum gradient of 1:150. Furthermore, the pipes have been sized up to accommodate additional flow or volumes (i.e. the maximum flow / capacity ratio is less than 0.27) from the site should the need arise at a later stage of the development. However, the increased flow rate leaving the site will need to be approved then by the local drainage utility DCWW.

21.3 A summary of the proposed foul water drainage network and performance is shown in Table 10 below. Appendix 8 contains the model output for the proposed foul water drainage design.

Table 10 – Summary of Foul Water Management Network

Section Type	Sections	Total Length (m)	Pipe Routines (mm)	Diameter (mm)	Slope (1:X)	Flow (l/s)	Maximum Flow Velocity (m/s)	Cover Depth (m)
Pipe	1.000 – 1.004; 2.000	210	1.5	150 - 225	35 - 80	0.5 – 5.1	0.6 – 0.8	0.5 – 1.36

22. OPERATION AND MAINTENANCE REQUIREMENTS

22.1 The surface water management system (including the foul water component) shall be inspected regularly (minimum 12 months between inspections) and after periods of heavy rain. The inspection must be carried out and recorded by a suitability qualified/experienced person. In particular the following shall be recorded:

- The condition of the grassed ditch linings, head and tail walls. This should include identification of any excessive erosion at the inlet and outlet of the grassed ditches;
- Any siltation within the drainage network, including flow control devices, manholes and the inlets and outlets of the attenuation structures;
- The structural condition of the attenuation structures, manholes, inspection chamber and pipe network;
- Remove any unwanted debris and accumulated material within the drainage network;
- Any repairs or maintenance required to the system shall be undertaken as soon as is reasonably practical, by a suitably qualified and experienced contractor;
- Operational maintenance regimes as recommended through CIRIA C 753 – SUDS Manual are provided in Table 11. This should also include regular cleaning and removal of any

debris scattered on the internal roads, carpark and other hardstand surfaces within the development.

- Additional operation and maintenance requirements may be required for the flow control devices, geo-cellular attenuation units, that Bio-remediation channel systems and bypass separators, as prescribed by the relevant manufacturer for the produces used in the proposed surface water drainage.
- Furthermore, DCWW may require flow records of and analyses of the trade effluent leaving the site – details of this will be subjected to the conditions outlined in the Consent to Discharge.

Table 11 – CIRIA C753 SUDS Manual Recommended Maintenance and Monitoring Regime

Schedule	Activities	Recommended Frequency
Regular Maintenance	Remove litter and debris	Monthly
	Remove Nuisance Plants and Unwanted Debris	As required
	Inspect inlets, outlets, banksides, structures and pipework etc for evidence of blockage or physical damage	Monthly
	Inspect for poor water quality	Monthly
	Remove any accumulated sediment at pipework outfalls and inlets to basin and tanks	As required
Occasional Maintenance	Reseed areas for poor vegetation growth	As required
	Remove accumulated sediment from base, sides or pre-treatment areas	As required or biannually (whichever is less)
	Removed any unwanted debris and accumulated material within the pipe network, manholes / junctions and storage tanks	As required or biannually (whichever is less)
Remedial Actions	Repair erosion and vegetation areas damaged in high flows	As required
	Re-align any erosion controls or rip-rap placements	As required
	Repair any internal wall erosion and wash-outs on inlets and exceedance outlets	As required
	Repair any damage to pipe network , manholes / junctions and attenuation tanks	As required
Monitoring	Inspect banksides, structure and any pipework for damage	Monthly
	Inspect Inlets, outlets and exceedance paths for any siltation and record interval since last cleaned	Biannually

22.2 In addition to the above, in order to minimise / prevent potential hazards on the site, Individuals on-site should report any identified potential risks to the drainage (i.e. sagging road surfaces or potholes above the drainage infrastructure, or evidence of overflowing/ overtopping at manholes / junction boxes) to relevant management personnel of the site. This should be reported as soon as practically possible and addressed promptly to avoid potential risk.

23. FCA AND S&FWMP CONCLUSIONS

23.1 The majority of the proposed development is not considered to be at risk of flooding from river, coastal, surface water, groundwater or reservoir breaching. Whilst a small portion of the site (i.e. along the western boundary and site entrance) may be subjected to a tidal flood risk, this area of the site will largely remain undeveloped and will comprise of water compatible infrastructure (i.e. pipes, manholes, a culvert and grassed ditches), and is unlikely to be severely affected/damaged from

potential flooding. Furthermore it is recommended that the finished surface levels of the development do not sit below the current surface levels of the site, as this should provide at least 0.6 m of freeboard for the site (excluding the lower level area located along the western boundary of the site) above the 1 in 1000 year event + climate change Tidal level.

23.2 The proposed ArrowBio plant is categorised as 'Highly Vulnerable' development, but it is located in a suitable and acceptable flood risk zone based on the Development Advice Map by Natural Resources Wales.

23.3 The proposed surface water drainage strategy has shown to successfully convey and attenuate the anticipated runoff from the site for all rainfall events up to and including the 1 in 100 + 20 % climate change, whilst still meeting the necessary Greenfield Q_{bar} discharge rate of 27.5 l/s for the site, thus ensuring no increase in the flood risk to people and property within and adjacent to the site.

23.4 Similarly, the proposed foul water drainage design has shown to adequately convey the anticipated foul water flows and volumes generated from the site to the intended connection point on the public foul water sewerage utility DCWW. The local water and sewer utility has confirmed that they can accept the domestic foul water component from the site, and that they have capacity to accommodate the 5 l/s flow rate from trade effluent – however this is subject to the outcome of the Consent to Discharge.

23.5 It is recommended that cover levels, invert levels, conditions and dimensions of the drainage infrastructure at the discharge points for the surface and foul water drainage be confirmed through a site sewer survey prior to commencement of construction works at the site.

23.6 Visual amenity, safety requirements and consideration of the landform should be taken into account when developing the final detailed design of surface water system as part of the site's development masterplan.

23.7 In conclusion, the proposed development will not be at risk of flooding nor or will it increase the flood risk to surrounding properties, provided that the proposed surface water drainage strategy and recommendations included in this report are adopted. The proposed conceptual surface and foul water drainage plan outlined in this report has shown to adequately manage the drainage within the site to an acceptable level of risk; however the final drainage plan and method of treating the foul water for the site must be agreed upon before building can commence. Should the layout of the proposed development change from that considered in this report (i.e. increased semi impervious areas or altered topographic levels, etc.) a revised SWMP should be produced to accommodate the new layout. Similarly, should the flow rates and volumes of the anticipated foul water differ to those used in this report, a revised foul water drainage component should be developed to accommodate the new flows and volumes.

DRAWINGS

Paddock Johnson Partnership

Drawing No. 17069-110-C

TerraConsult

Drawing 3484/1/001 – ArrowBio Plant, Deeside – Conceptual Surface and Foul Water Drainage

BIO AREA

Biogas Holder
Methanogenic Reactor

Digester Tanks
Boilers
Air Compressor

Balance Tank
Acidogenic Tanks

Effluent Treatment Tanks
Dewatering System and Sludge Containers
Filters
Bio Residue

Office/ Laboratory
Electric Room

Retaining Wall (600mm)

Ramp

Ramp

Weighbridge Road

Sorting Hall

Generator

Bio Filter

Main Hall

Offices,
Welfare and
Control above

Reception

Bin Area

Waste
Reception
Hall

RDF Hall

Disabled (3) and
Visitors shuttle
buggy parking

Railway

Car Parking (34)

Maintenance Depot/
Fuel and Oil Store

Vehicle
Washing

Retaining Wall
(2800mm)

Weighbridges
and Kiosk

0 10 20 30 40 50 60 70 80 90 100

N

notes:

Written dimensions to be taken in preference to scaled dimensions.

Due to the inaccuracies of scanning, scanned images should not be scaled.

- Buildings/ Enclosures
  Main building max height **20.6m,**
  Gross external footprint **5,390m²**
- External Building stairs and landings
- Building Canopies
  Area **809m²**
- External Process Plant
  Refer to Chapter 4 for max heights and diameters
- Biological Plant Area within sunken bund 600mm deep
- Access Roads
- Footpaths/ Paving
- Bin Area
- Car Parks
- Indicative Soft Landscape Areas
- Retaining Wall to indicated height
- Application Site Area **5.57 Ha**

rev	date	description	by
C	15/03/18	Minor amendments. PLANNING	PE
B	13/03/18	Biological Area and minor update.	PE
A	30/01/18	Notes/ legend updated	PE

status: **PLANNING**

client: LOGIK **WTE**

ArrowBio

project: Proposed Arrow Bio Plant
Weighbridge Road, Zone 4
Deeside Industrial Park

drawing title: **Assessment Plan**
As Proposed

drawing no: **17069-110-C**

17069-900-D.dwg

scale: 1:625 sheet: A1

date: 29/01/2018 by: PE checked: PE

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Pond

N

Pipeline

Pipeline

ETL

Drain

4.9m

El Sub Sta

DA1

DA2

DA3

DA4

DA5

DA6

DA7

DA8

DA9

DA10

DA11

DA12

DA13

DA14

DA15

DA16

DA17

DA18

DA19

DA20

DA21

DA22

Subsurface Geocellular Attenuation Tank 1
CL – 10.00 mAOD
IL – 7.50 mAOD
Porosity – 0.94
Depth – 1.2 m
Surface Area – 215m²
Structure Volume – 256m³

Subsurface Geocellular Attenuation Tank 2
CL – 9.00 mAOD
IL – 7.30 mAOD
Porosity – 0.94
Depth – 0.4 m
Surface Area – 364m²
Structure Volume – 160m³

Subsurface Geocellular Attenuation Tank 3
CL – 8.80 mAOD
IL – 7.19 mAOD
Porosity – 0.94
Depth – 0.4 m
Surface Area – 120m²
Structure Volume – 53m³

Subsurface Geocellular Attenuation Tank 4
CL – 9.00 mAOD
IL – 7.30 mAOD
Porosity – 0.94
Depth – 0.4 m
Surface Area – 273m²
Structure Volume – 120m³

Subsurface Geocellular Attenuation Tank 5
CL – 9.40 mAOD
IL – 6.30 mAOD
Porosity – 0.94
Depth – 1.2 m
Surface Area – 2800m²
Total Structure Storage – 3334m³

Bypass Separator (1)
CL – 9.40 mAOD
IL – 6.90 mAOD

Bypass Separator (2)
CL – 9.30 mAOD
IL – 6.49 mAOD
Non Return Valve

Gate Valve for pipe 4.000
CL – 10.00 mAOD
IL – 7.88 mAOD

Gate Valve for pipe 3.000
CL – 10.00 mAOD
IL – 7.88 mAOD

Gate Valve for pipe 1.000
CL – 10.00 mAOD
IL – 8.09 mAOD

Flow meter for Trade Effluent only
Gate valve for Trade Effluent only
Monitoring point for Trade Effluent – Inspection Chamber
CL – 9.10 mAOD
IL – 7.59 mAOD

Outlet
CL – 8.50 mAOD
IL – 7.04 mAOD
Max Flow – 14.9 l/s

Outlet
CL – 5.35 mAOD
IL – 4.40 mAOD
Max Flow – 26.8 l/s

Hydro-Brake
IL – 6.30 mAOD
Design Head – 1.1 m
Design Flow – 19.0 l/s

Hydro-Brake
IL – 4.50 mAOD
Design Head – 0.8 m
Design Flow – 27.0 l/s

Non Return Valve
CL – 5.40 mAOD
IL – 4.90 mAOD

Non Return Valve
CL – 9.30 mAOD
IL – 6.45 mAOD

Non Return Valve
CL – 9.00 mAOD
IL – 7.30 mAOD

Infilled, decommissioned waste water treatment tank

FB

FB

Foo

Drain

MP 13

SL

CE

5.1m

Tanks

Notes:

1. Do not scale, if in doubt contact TerraConsult Limited.
2. All dimensions are in meters unless otherwise stated.
3. This drawing is not to be reproduced in any part or form without consent of TerraConsult Limited, all copyright reserved.
4. Drawing should be read in conjunction will all other relevant reports, including TerraConsult report 3484/R07-1
5. Conceptual layout of drainage, designed in MicroDrainage. Exact layout and alignment of drainage to be confirmed from architect and design engineer in Detailed Design.
6. Topographical survey provided by Pegasus Group Limited, as undertaken by PM Surveys UK (Drawing Number PMS17130). Survey station location and co-ordiantes to be confirmed on site prior to commencement of any works on site.
7. Locations and levels of manholes, junctions and outfalls to be verified prior to commencement of works.

Key:

- Site Planning Boundary
- Drainage areas
- Surface water drainage line
- Foul water drainage line
- Cymru Welsh Water Sewerage
- Surface water manhole/junction
- Foul water manhole/junction
- Surface water / foul water valve
- Bypass Separator
- Retaining wall
- Surface water tank (Geocellular modular system)
- Vegetation surface type
- Hardcore surface type
- Pavement surface type
- Car park and road surface type
- Roof surface type
- Biological plant area - sunken 0.6m deep
- Potential expansion of development

TerraConsult

Bold Business Centre, Bold Lane, Sutton, St Helens WA9 4TX

Client

LOGIK WTE ArrowBio

Pwer Gwyrdd Ltd

Site

Proposed ArrowBio Plant, Deeside

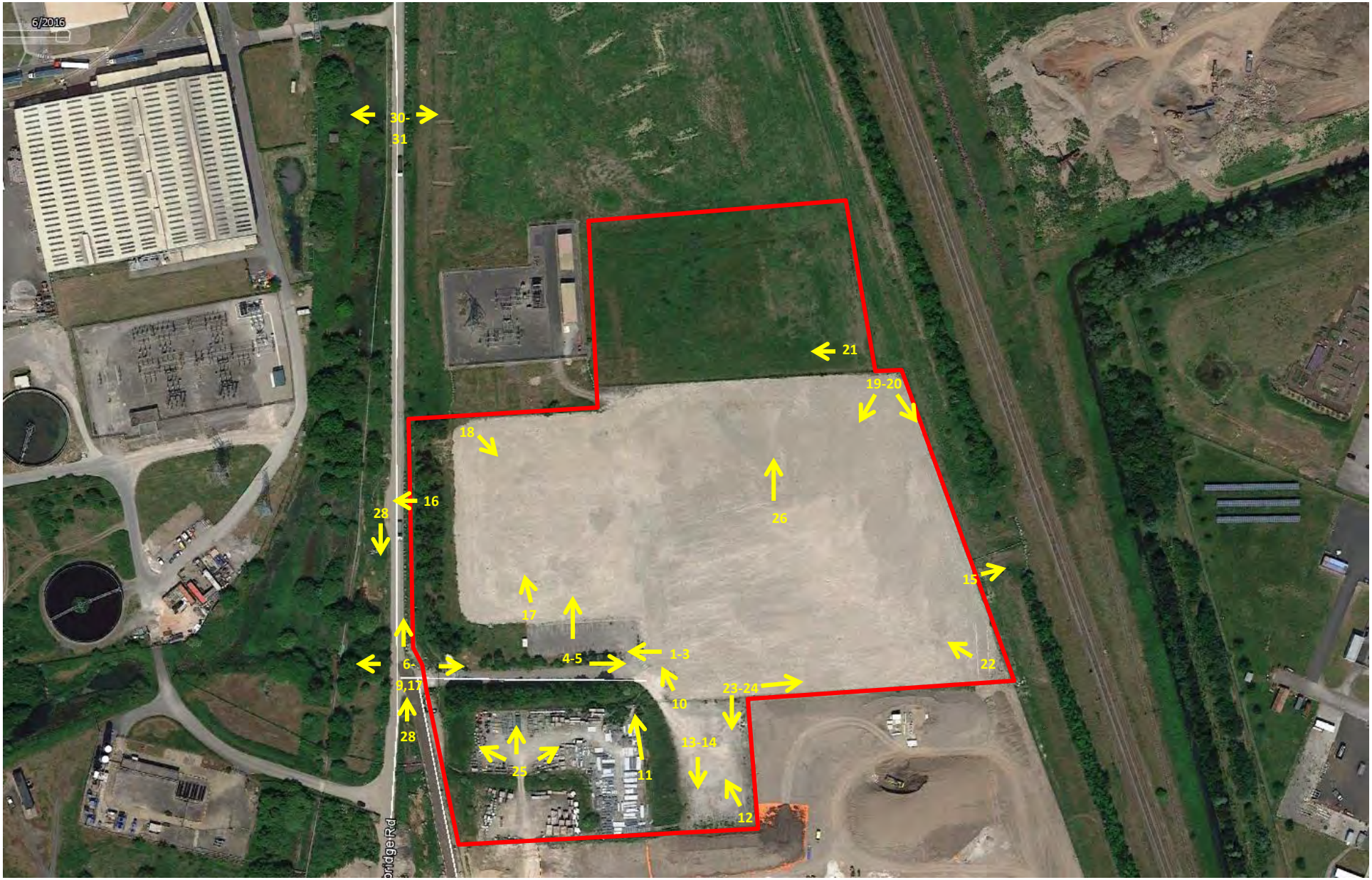
Title

Conceptual Surface and Foul Water Drainage

Scale	1:675 @ A1		
Drawing No.	3484/1/001		
Rev	Date	Description	
File	3484 - Arrow Bio Plant - SWMP-Draft-FEHv2.dwg		
Date	03/2018	Engineer	BNW
Drawn	BNW	Checked	DRAFT

Appendix 1

Photographic Record of Site Visit



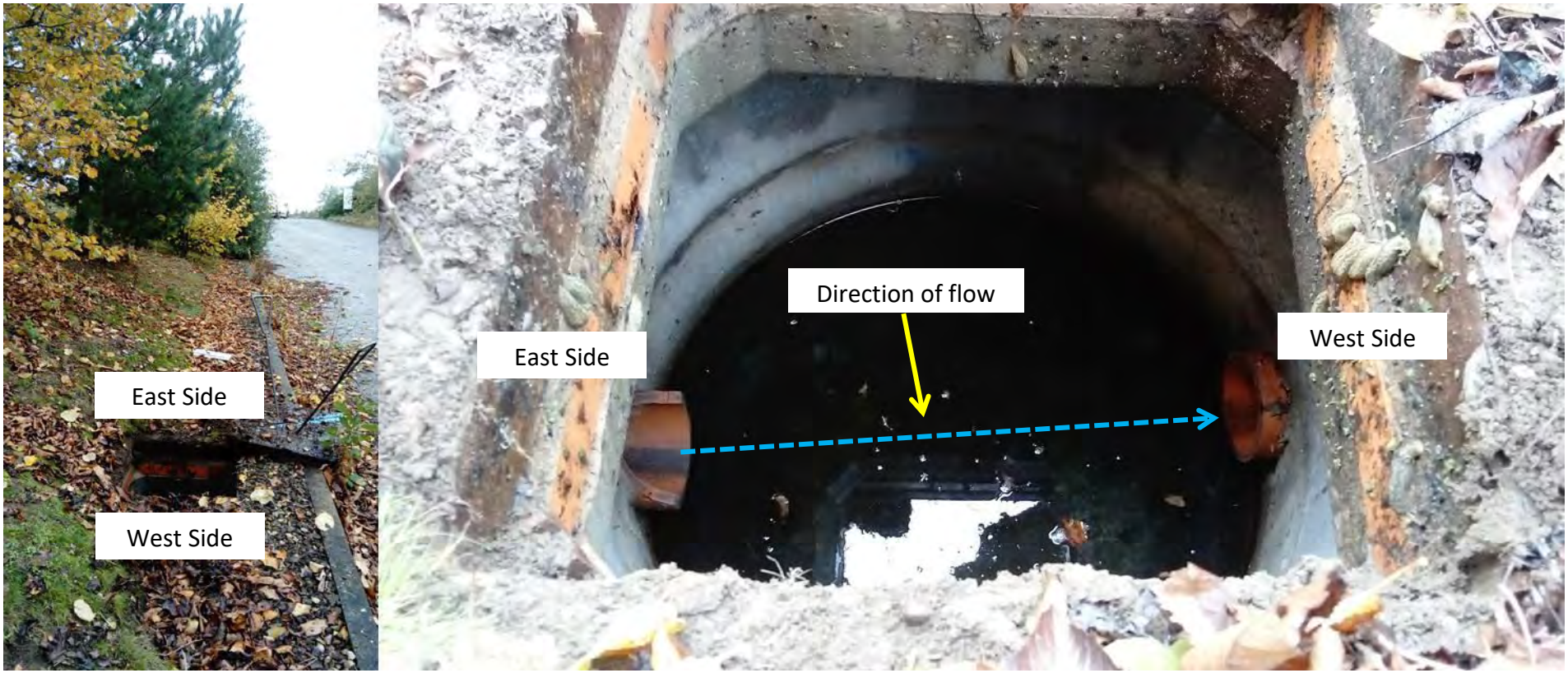
Photograph layout of Site Visit for Surface Water Drainage

Photograph 1 – Looking westwards down site access ramp and onto car park area. Surface water drainage present along site access ramp and car park.

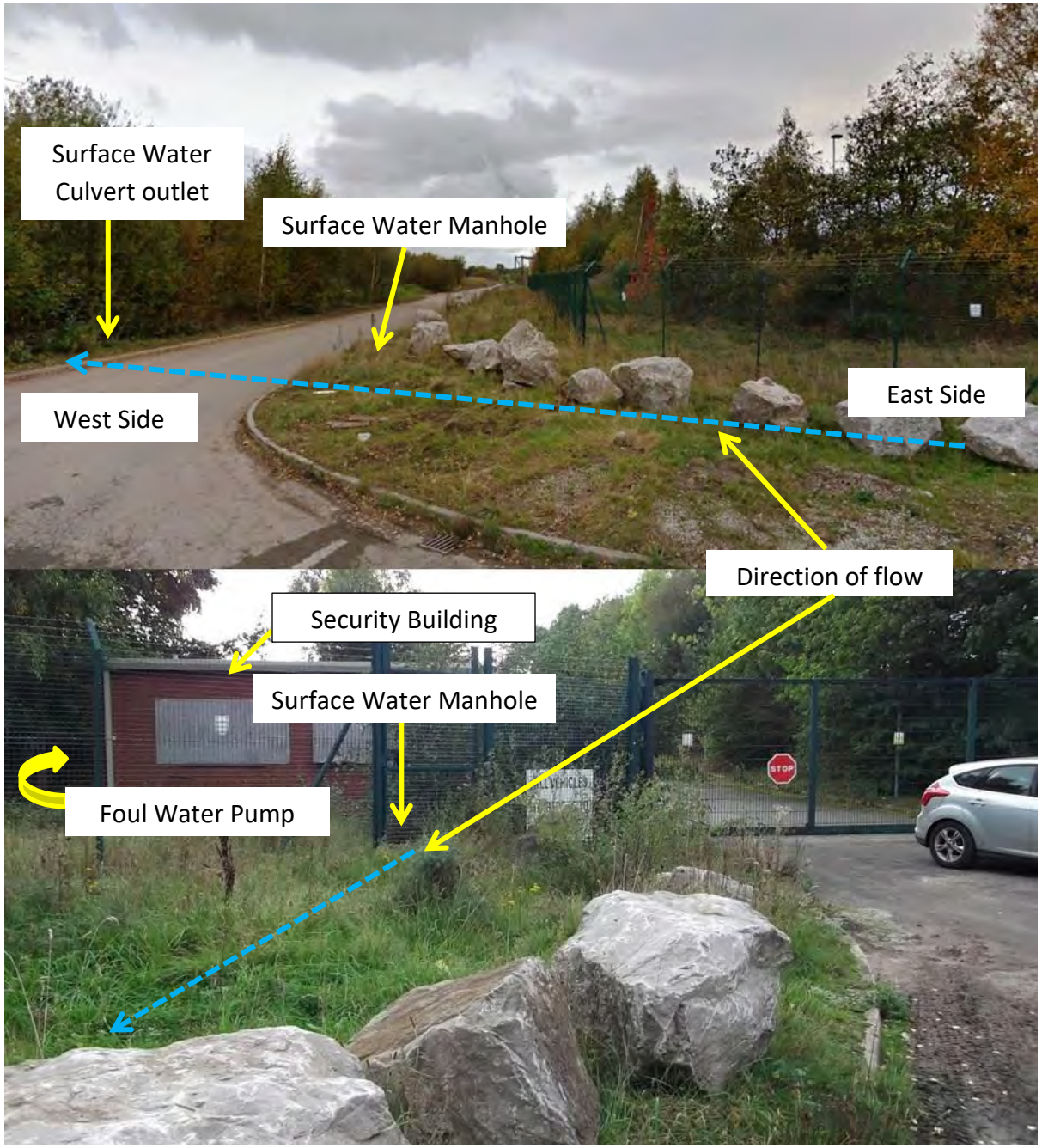
Photograph 2 – Manhole for surface water drainage at depicted in Photo 1. No outlet pipe identified, incoming pipe from the north.

Photograph 3 - Looking westwards on to car park area with surface water drainage. Lateral gully drain present along the southern edge of car park.

Photograph 4 – Surface water drainage in carpark. Lateral gully drains present along the southern edge of car park draining eastwards. Manhole receiving surface water from the north and proceeding eastwards.



Photograph 5 – Surface water drainage in adjacent to site access ramp. Manhole receiving surface water from the east and proceeding westwards towards the site entrance.



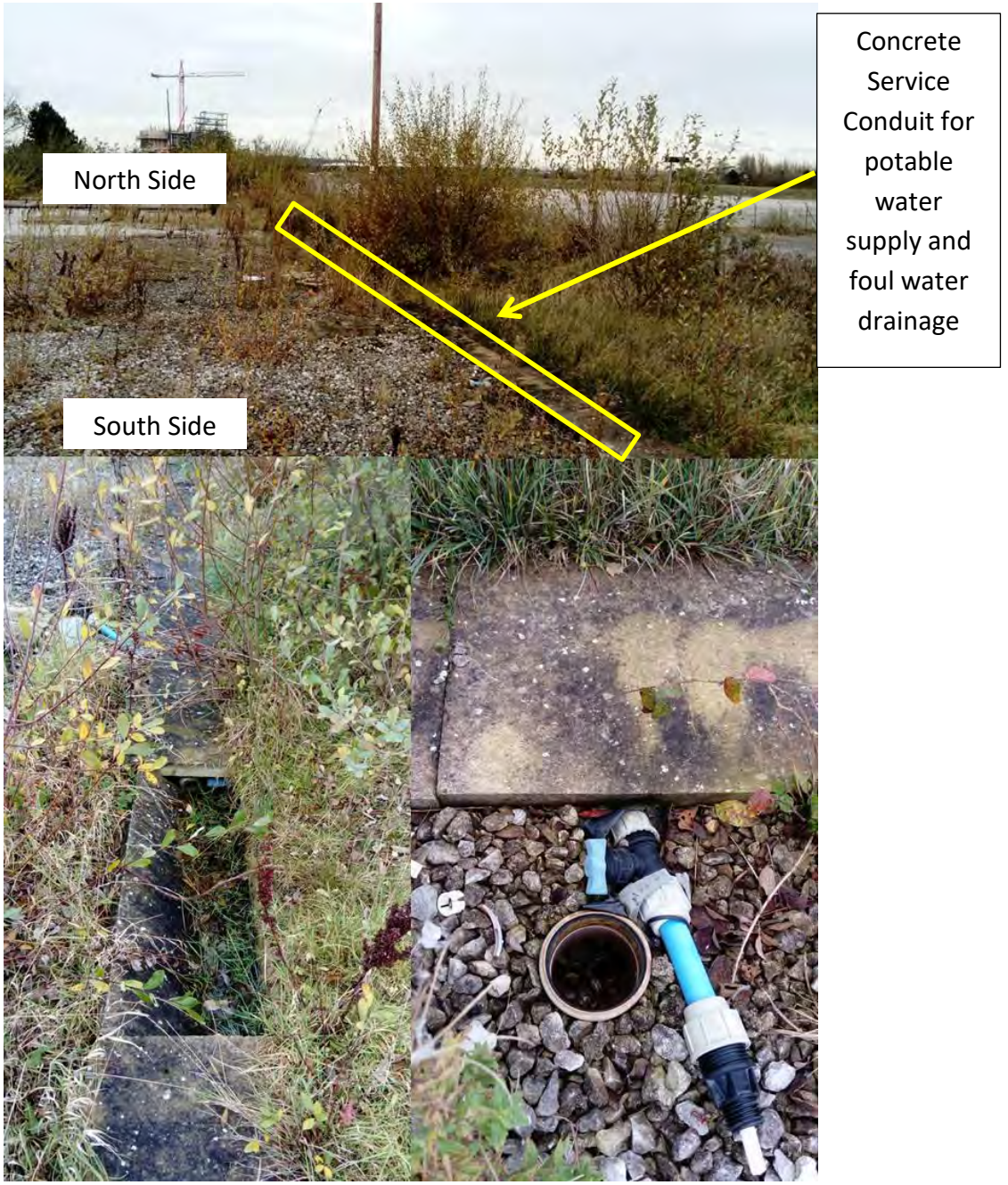
Photograph 6 – Surface water drainage at bottom of site access ramp. Surface water proceed from an easterly direction towards two manholes before entering culvert a below Weighbridge Rd. A disused Foul water pump is presently located behind (i.e. east side) of the Security building at the site entrance.

Photograph 7 – Surface water drainage and Foul water pump adjacent to site access gate. Surface water draining in a westwards direction towards the culvert at Weighbridge Rd.

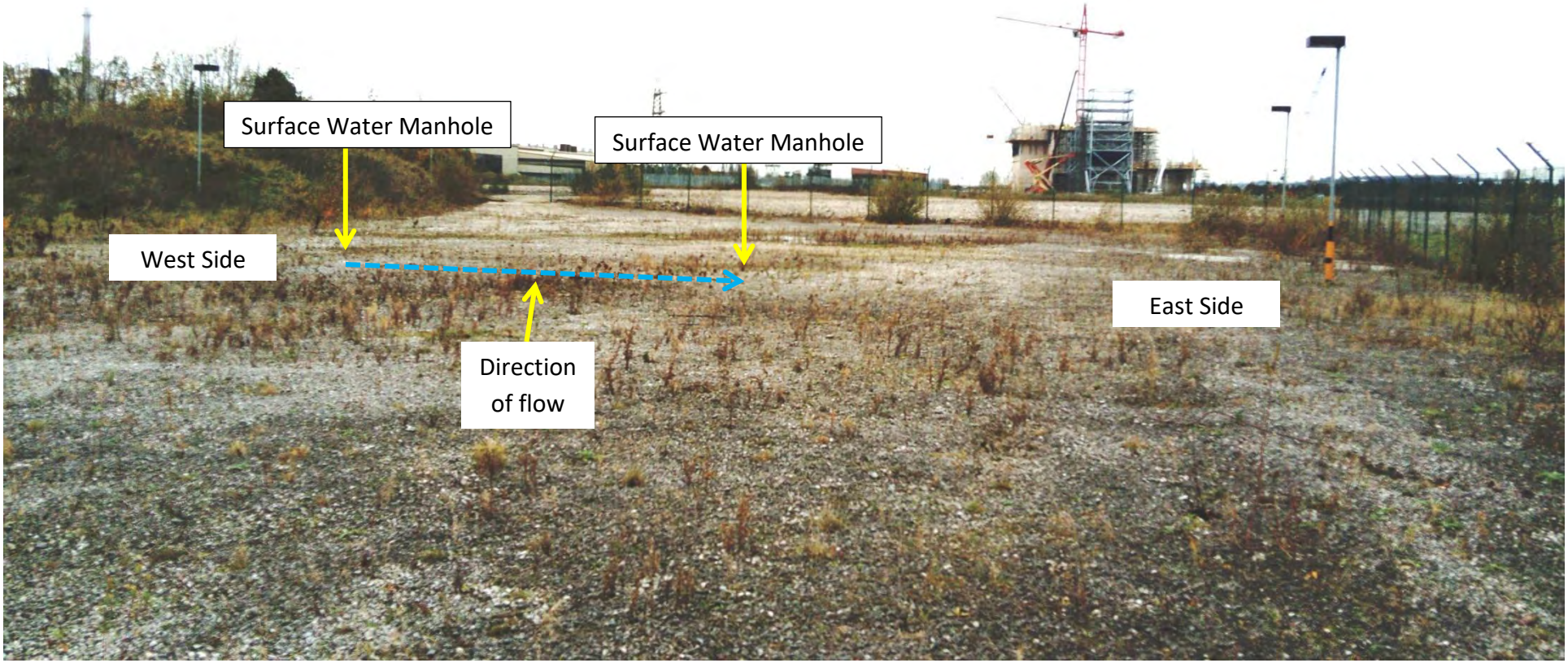
Photograph 8 – Surface water drainage adjacent to site access gate and Weighbridge Rd. Surface water draining in a westwards direction towards the culvert at Weighbridge Rd.

Photograph 9 –Blocked culvert under Weighbridge Rd, near site main access gate. Silted-up and overgrown downstream watercourse receptor.

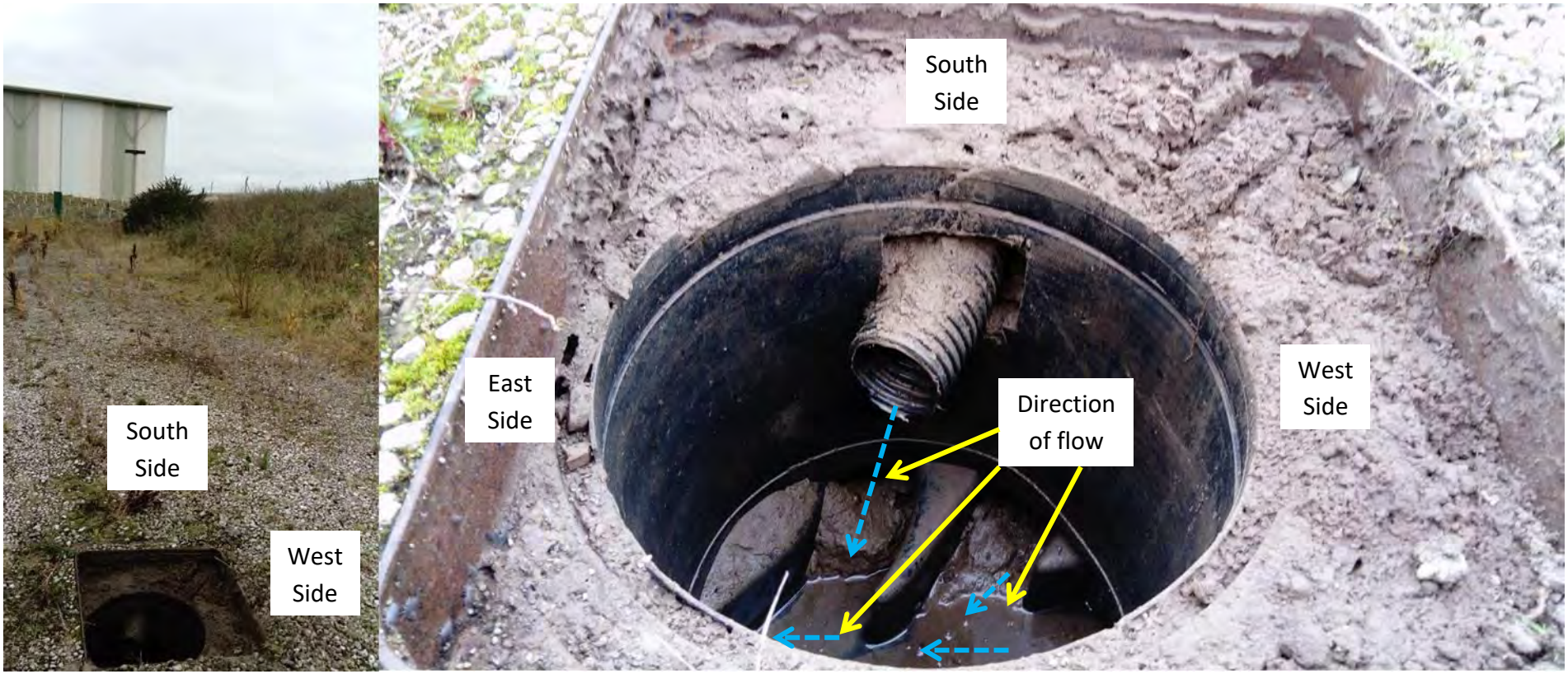
Photograph 10 –Surface water manhole located to the south side at the top of the site access ramp. Surface water inlet drains from the north and proceeds eastwards.



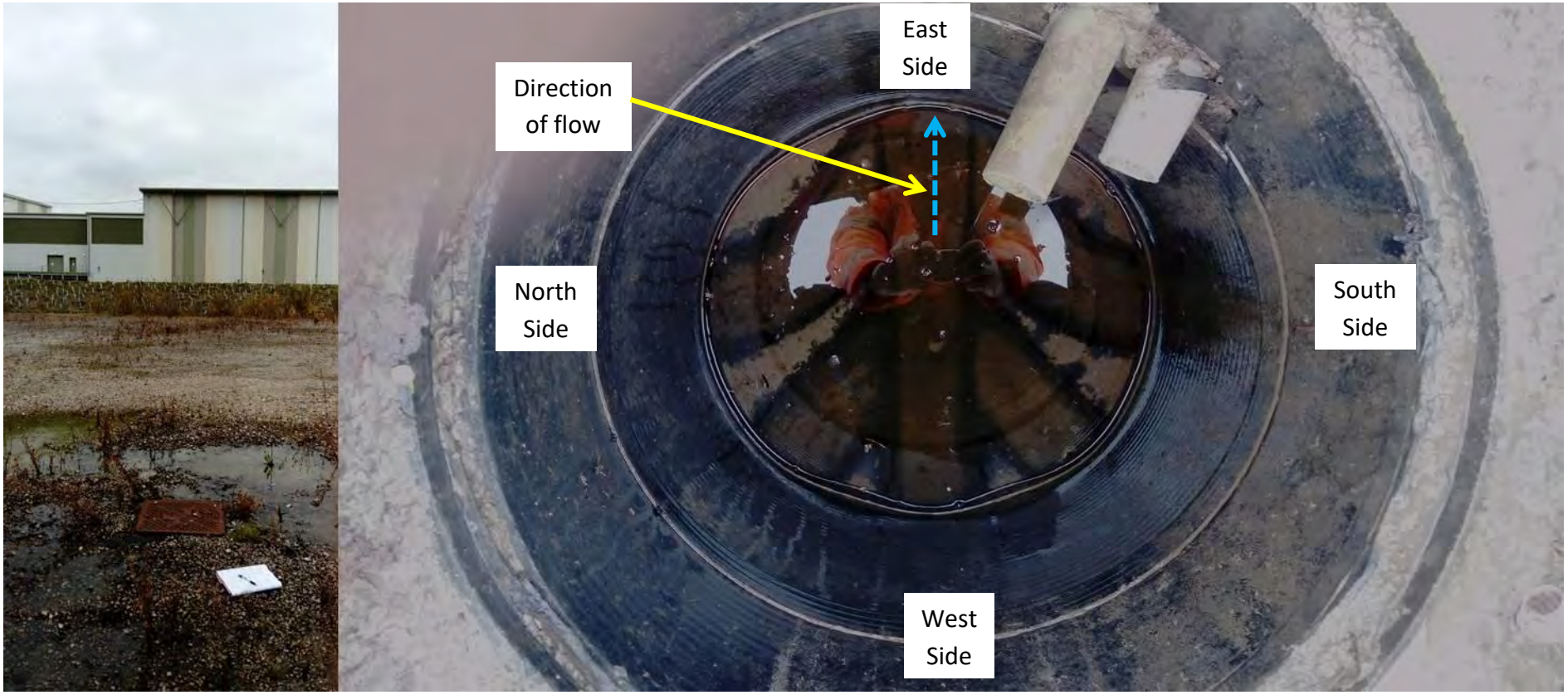
Photograph 11 – Previous potable water supply and foul water drainage in the elevated area located in the south-western corner of the site.



Photograph 12 –Surface water drainage located east of the elevated area located in the south-western corner of the site.



Photograph 13 –Surface water drainage located east of the elevated area located in the south-western corner of the site. Multiple inlets from the south, west and north side, which proceeds to outlet in an eastwards direction.



Photograph 14 –Surface water drainage located east of the elevated area located in the south-western corner of the site. Multiple inlets from the south, west and north side, which proceeds to outlet in an eastwards direction.

Photograph 15 –Foul water drainage located along the middle of the eastern boundary of the site, draining in a eastward direction towards the train rail line in the background.

Photograph 16 – Looking westwards down onto Weighbridge Road at western boundary of site. Surface water drainage or water supply in background running along eastern side of Weighbridge Road.

Photograph 17 – Looking northwards on to demolished hard-core area of Shotton Power Station. Construction of new EfW facility and operational sub-station in background.

Photograph 18 – Looking south-eastwards on to demolish Shotton Power Station at north-western corner of site.

Photograph 19 – Looking south-westwards on to the demolish hard-core area of Shotton Power Station at the eastern boundary of the site. Flintshire Bridge Site 400kv Convertor Station in background.

Photograph 20 – Looking southwards along the eastern boundary of site. Approximate 3m high earth bund flanking the eastern boundary of the site.

Photograph 21 – Looking westwards at norther-eastern corner of undeveloped area of the site. Operational sub-station in background.

Photograph 22 – Looking North-westwards on to on demolish hard-core area of Shotton Power Station at the south-eastern corner of undeveloped area of the site. Construction of new EfW facility in background.

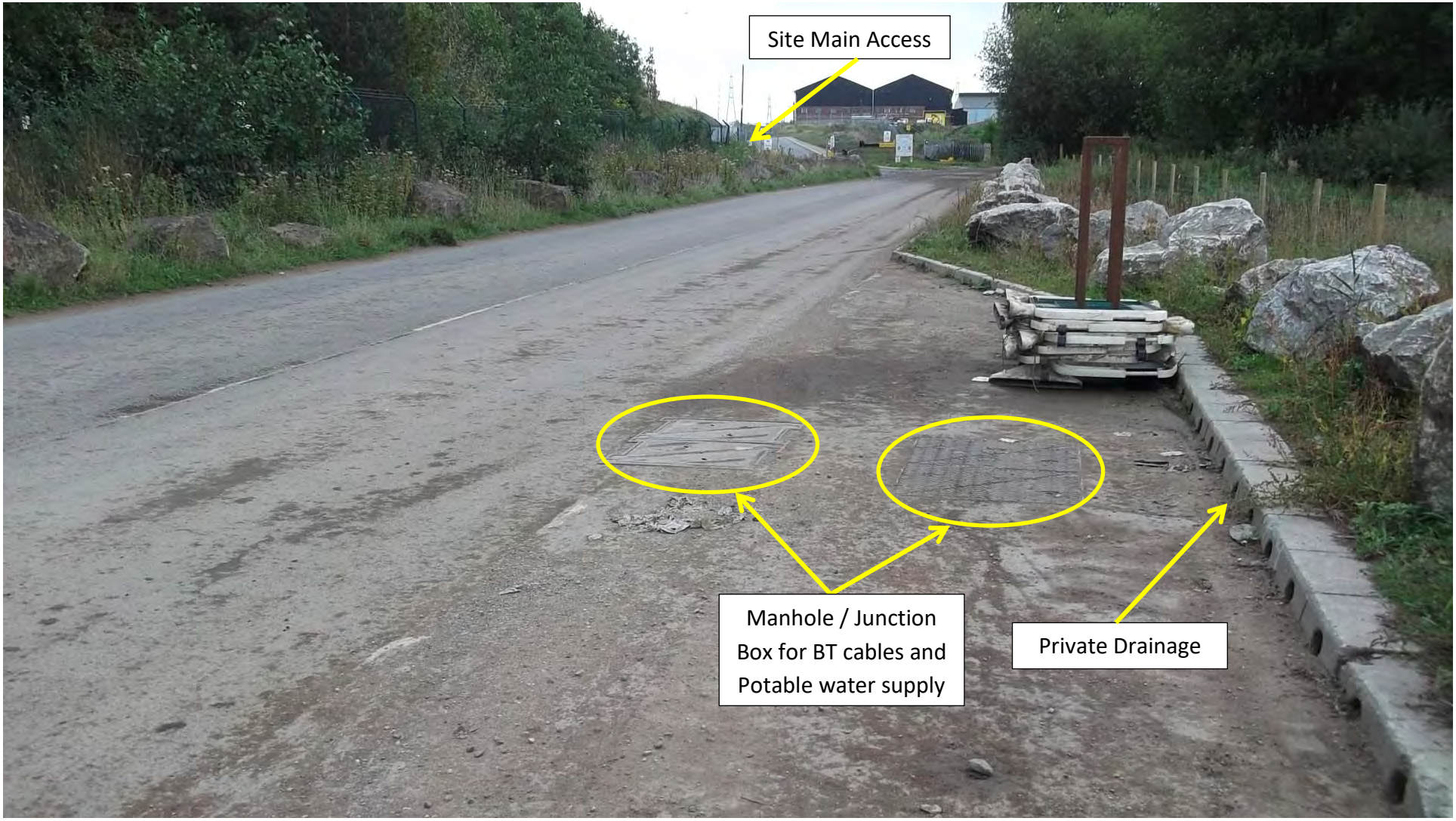
Photograph 23 – Looking eastwards along the southern boundary of the site. Approximate 3m high earth bund flanking the southern boundary of the site.

Photograph 24 – Looking southwards on to the Flintshire Bridge Site 400kV Convertor Station at the southern boundary of the site. Approximate 3m high earth bund flanking the southern boundary of the site.

Photograph 25 – Looking northwards on to the raised area of the site, located in the south-western corner of the site.

Photograph 26 – Looking northwards on to small pluvial puddles at the middle of the site. Construction of new EfW facility in background.

Photograph 27 – Looking northwards along Weighbridge Road at site entrance.



Photograph 28 – Looking southwards at bus-stop on western side of Weighbridge Road. Site main access identified in the background on the left-hand side of Weighbridge Road. Private drainage, water supply and BT cables located along the western edge of Weighbridge Rd.

Photograph 29 – Looking northwards at site main access along Weighbridge Rd. Potable water supply and BT cables located along the eastern edge of Weighbridge Rd.

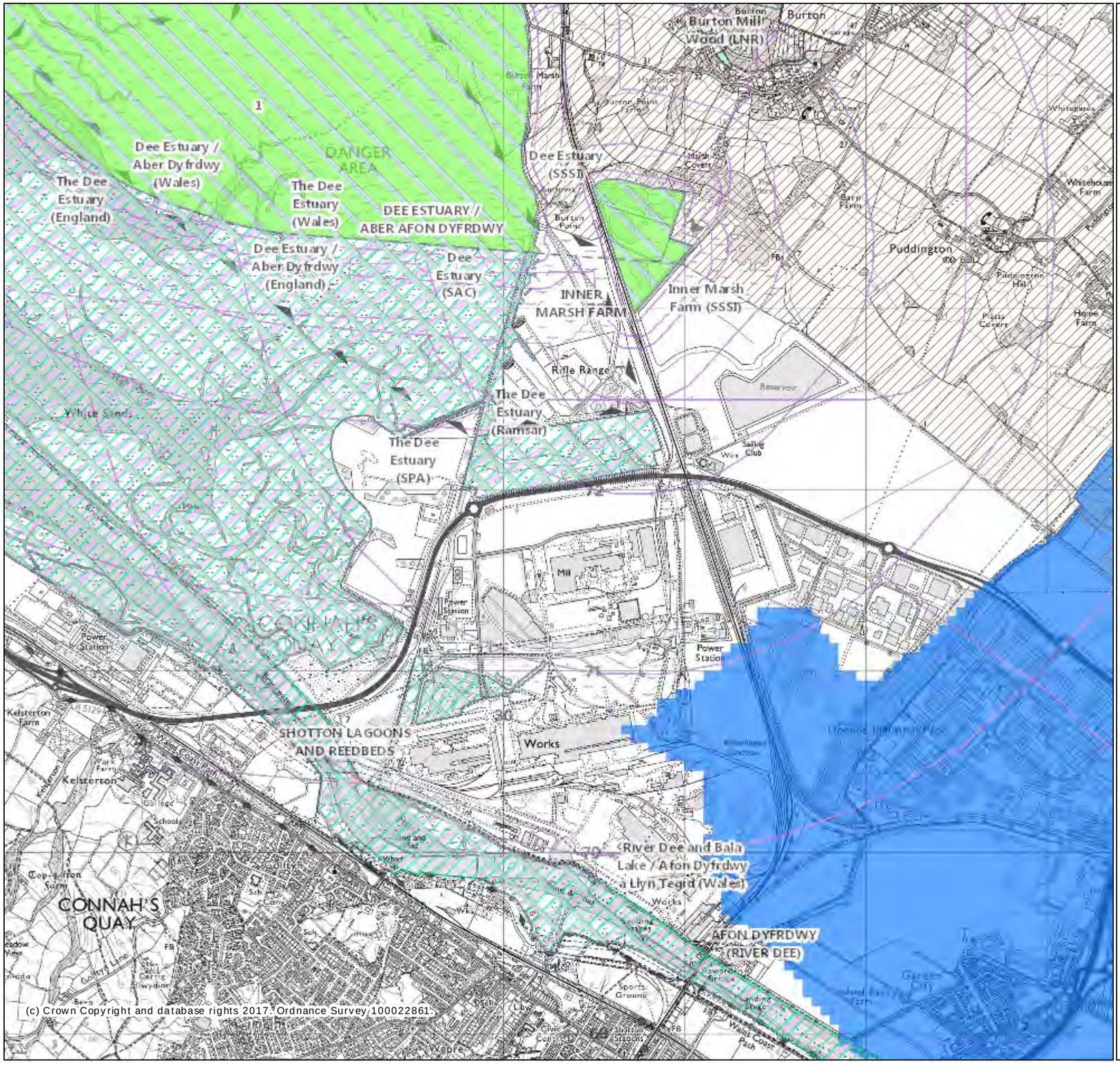
Photograph 30 –Blocked culvert inlet on the eastern side of the Weighbridge Road, north of the site.

Photograph 31 –Blocked culvert outlet on the eastern side of the Weighbridge Road, north of the site.

Appendix 2

Natural England MAGIC – Environmental Constraints

3484 - Arrow Bio Plant - Environmental Constraints



Legend

- Limestone Pavement Orders (England)
- Local Nature Reserves (England)
- Moorland Line (England)
- National Nature Reserves (England)
- National Nature Reserves (Scotland)
- National Nature Reserves (Wales)
- National Parks (England)
- Ramsar Sites (England)
- Ramsar Sites (Scotland)
- Ramsar Sites (Wales)

Sites of Special Scientific Interest Units (England)

- Favourable Condition
- Unfavourable Recovering
- Unfavourable no change
- Unfavourable Declining
- Part Destroyed
- Destroyed
- Not Assessed

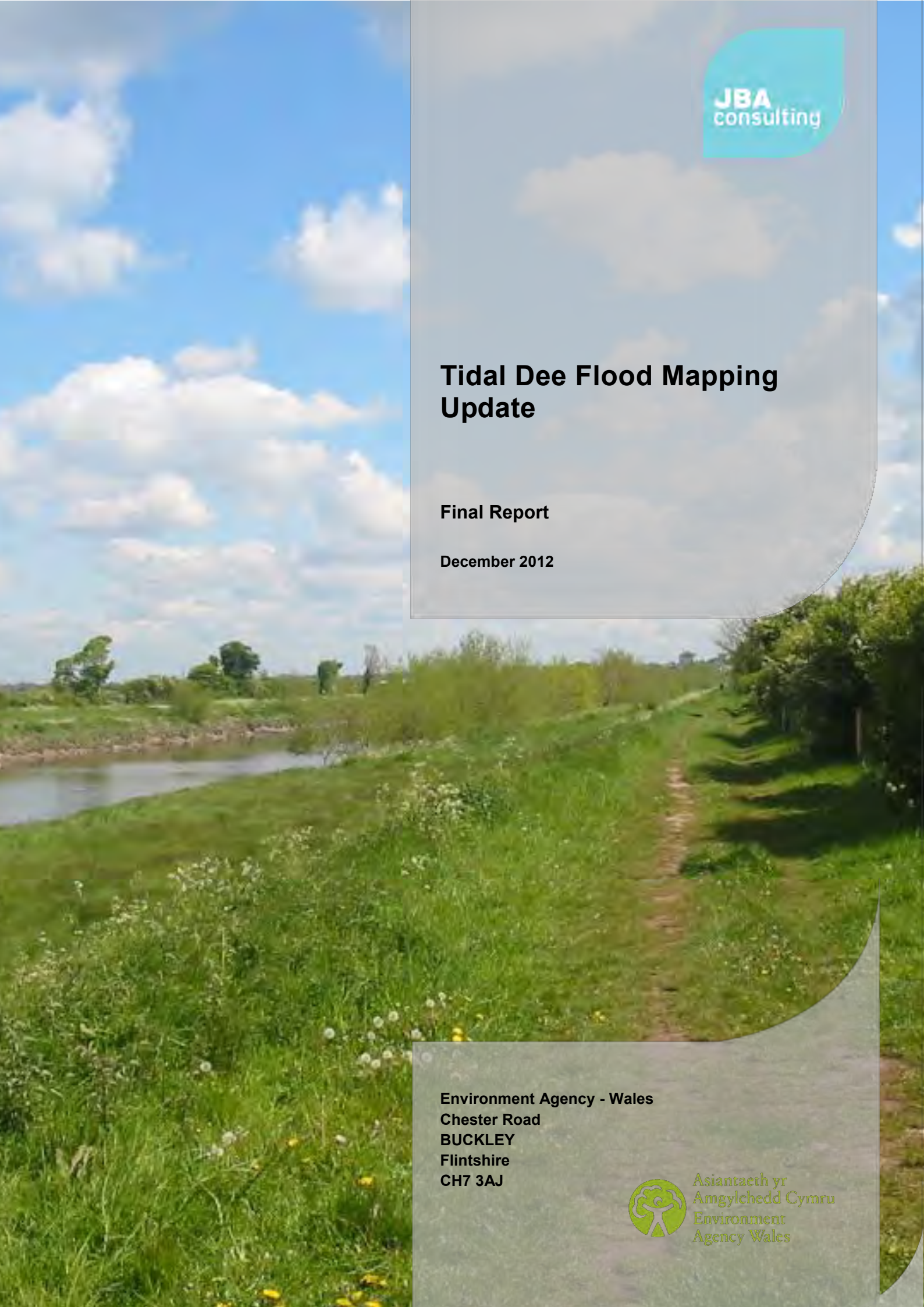
- Sites of Special Scientific Interest (England)
- SSSI Impact Risk Zones - to assess planning applications for likely impacts on SSSIs/SACs/SPAs & Ramsar sites (England)
- Sites of Special Scientific Interest (Scotland)
- Sites of Special Scientific Interest (Wales)
- Special Areas of Conservation (England)
- Special Areas of Conservation (Scotland)
- Special Areas of Conservation (Wales)
- Special Protection Areas (England)
- Special Protection Areas (Scotland)
- Special Protection Areas (Wales)

Projection = OSGB36
xmin = 325000
ymin = 369000
xmax = 335700
ymax = 374500

0 0.5 1
km

Appendix 3

River Dee Tidal Study – Select Pages Extracts



Tidal Dee Flood Mapping Update

Final Report

December 2012

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
7 December 2012 (Draft v1.0)		Richard Weston
11 December 2012 (Final v1.0)	Table in Appendix C corrected.	Vicky Farrelly

Contract

This report describes work commissioned by Richard Weston, on behalf of Environment Agency Wales, by a email dated 17 September 2012. Environment Agency Wales's representative for the contract was Richard Weston. Sam Willis and Chris Smith of JBA Consulting carried out this work.

Prepared by ..... Sam Willis BSc MSc
Analyst

Reviewed by ..... Chris Smith BSc PhD CEnv MCIWEM C.WEM MCMI
Principal Analyst

Purpose

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Executive Summary

Environment Agency Wales requested an update to the flood maps for the tidal Dee to incorporate the revised extreme sea levels as outlined in the Coastal flood boundary conditions for UK mainland and islands report (February 2011). This version of the report is an update to the October 2011 version (2011s4937 Final Report v4.1) using a MINITR value of 4 rather than 2 in the ISIS model to correct an over-prediction of water levels.

Depth and velocity maps for the undefended and defended scenarios in the inner and outer Dee estuary for the 5%, 1.33%, 0.5% and 0.1% AEP events have been produced and from these the delineation of Areas Benefitting Defences (ABDs).

Hydraulic models of the tidal Dee, the outer Dee and at Talacre were updated/developed as part of the Dee Strategy (2010) using new survey data made available for the strategy. The flood maps produced as part of this study have utilised these latest model versions and the relevant developments are documented in this report.

The updates to the flood maps indicate flood risk in the inner Dee is volume limited by the capacity of the channel passing Connah's Quay. The flood risk in this location is therefore reduced from that indicated in the existing flood maps.

The updates to the flood maps for the outer Dee and at Talacre utilise results from the Tidal Dee ISIS model and give additional information in these areas than was available previously. The models are however fairly high level using a 10m grid and some approximations in defence levels.

Representative tidal curves within the inner Dee estuary have been extracted from the model at suitable intervals for the purposes of development control.

The work undertaken in this project is broad scale modelling across an extensive area. Although some information is fairly detailed, e.g. defence crest levels survey, other information such as secondary defences and potential floodplain flow routes have been gathered via a desktop study only.

Figure 3-1: Defended Scenario Flood Extents

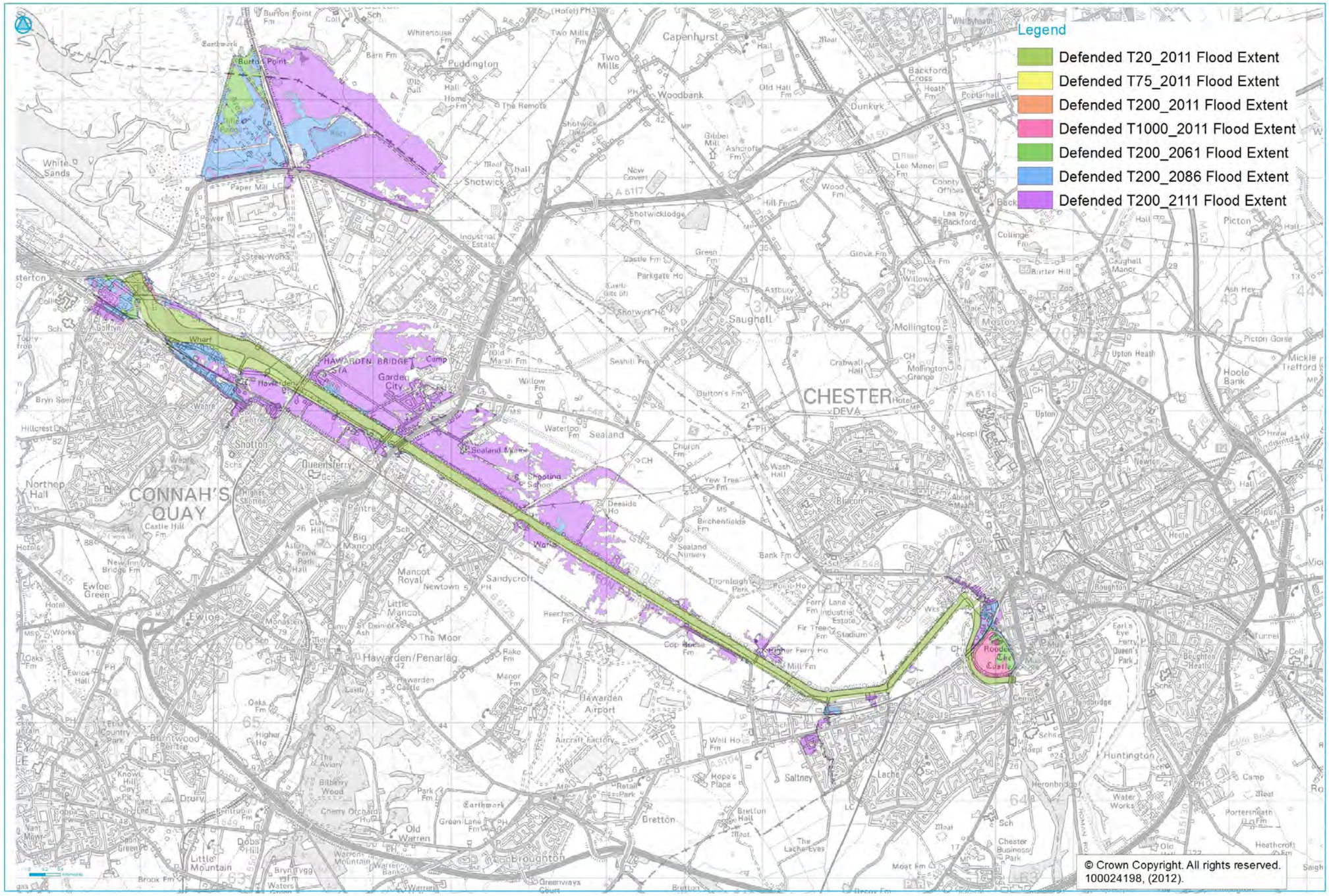
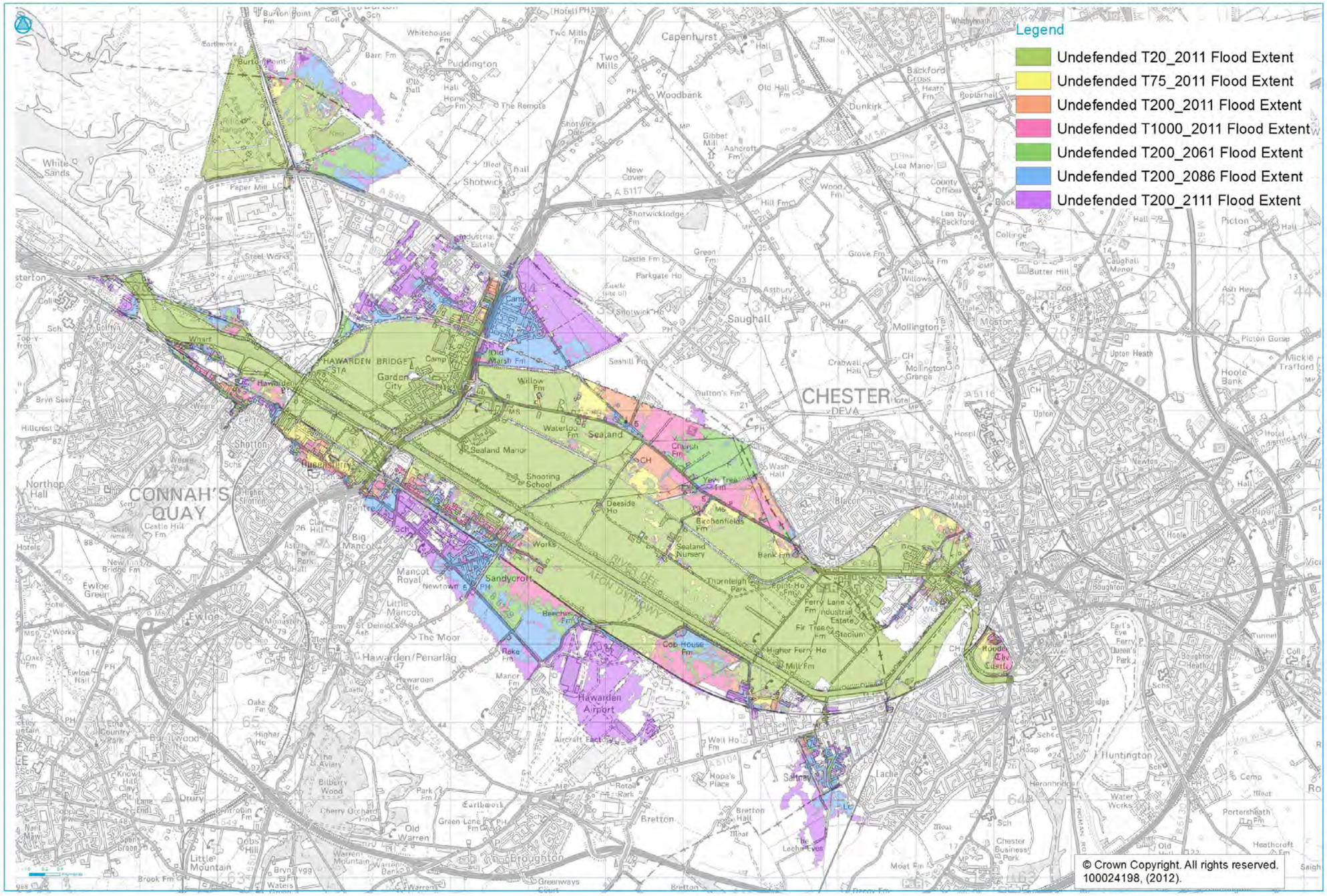


Figure 3-2: Undefended Scenario Flood Extents



D. Tabulated Tidal Dee Peak Level 1D Model Results

Peak levels at each node in the 1D model have been extracted for the defended model scenarios. These results are tabulated below and are provided in GIS format in the digital deliverables.

Label	X Coord	Y Coord	T20 2011	T75 2011	T200 2011	T1000 2011	T200 2061	T200 2086	T200 2111	T200 2011 Lwr Bnd	T200 2011 Upr Bnd	T1000 2011 Lwr Bnd	T1000 2011 Upr Bnd	T200 2111 Upr Bnd
00020200079	341797	360031	6.14	6.25	6.32	6.44	6.51	6.65	6.85	6.21	6.43	6.27	6.58	6.95
00020108670b	341903	360227	6.14	6.24	6.31	6.44	6.51	6.64	6.85	6.20	6.43	6.27	6.57	6.95
00020108190	341947	360676	6.13	6.23	6.30	6.43	6.50	6.63	6.84	6.19	6.42	6.26	6.57	6.94
00020107670	341984	361138	6.11	6.21	6.29	6.42	6.48	6.62	6.82	6.18	6.41	6.24	6.55	6.93
00020107170	342414	361331	6.10	6.20	6.27	6.40	6.47	6.59	6.81	6.16	6.39	6.23	6.53	6.91
00020106720	342149	361589	6.08	6.18	6.26	6.38	6.44	6.58	6.78	6.14	6.37	6.21	6.51	6.89
00020106220	341687	361643	6.07	6.17	6.24	6.36	6.42	6.56	6.76	6.13	6.35	6.20	6.49	6.86
00020105700	341494	362037	6.04	6.15	6.22	6.35	6.40	6.54	6.74	6.11	6.34	6.18	6.48	6.84
00020105200	341611	362514	6.03	6.13	6.21	6.33	6.39	6.53	6.72	6.09	6.32	6.16	6.46	6.83
00020104740	341582	363003	6.02	6.12	6.19	6.32	6.39	6.53	6.72	6.08	6.32	6.15	6.46	6.83
00020104430	341355	363432	6.01	6.12	6.19	6.32	6.39	6.53	6.73	6.08	6.31	6.15	6.46	6.83
00020103930	341231	363914	6.00	6.11	6.18	6.32	6.38	6.52	6.73	6.07	6.31	6.14	6.45	6.82
00020103410	341257	364371	5.99	6.10	6.18	6.31	6.38	6.53	6.74	6.06	6.30	6.13	6.45	6.84
00020102910	341534	364783	6.00	6.11	6.19	6.33	6.41	6.56	6.79	6.07	6.32	6.14	6.48	6.89
00020102410b	341809	365201	5.99	6.11	6.19	6.34	6.41	6.57	6.80	6.06	6.33	6.14	6.49	6.90
00020101930	341887	365670	5.99	6.10	6.18	6.33	6.40	6.56	6.80	6.06	6.32	6.13	6.48	6.90
00020101450	341904	366149	6.00	6.11	6.20	6.33	6.41	6.56	6.81	6.07	6.32	6.14	6.49	6.91
00020100990	341586	366390	6.01	6.13	6.22	6.37	6.45	6.60	6.85	6.09	6.36	6.16	6.52	6.95
00020100500	341204	366087	6.01	6.15	6.23	6.38	6.46	6.61	6.85	6.10	6.37	6.18	6.54	6.94
00020100000f	340819	365894	6.07	6.19	6.29	6.45	6.54	6.70	6.97	6.14	6.44	6.23	6.62	7.04
00020100000g	340723	365767	6.09	6.21	6.31	6.47	6.56	6.72	6.99	6.16	6.46	6.24	6.64	7.07
00010114710	340258	365532	6.10	6.21	6.31	6.47	6.56	6.72	6.99	6.17	6.46	6.25	6.65	7.07
00010114210	339782	365578	6.10	6.21	6.32	6.46	6.55	6.68	7.01	6.17	6.45	6.25	6.62	7.10
00010113710	339680	366030	6.13	6.23	6.35	6.48	6.55	6.66	6.99	6.19	6.48	6.27	6.62	7.07
00010113210u	331422	369164	6.20	6.31	6.42	6.57	6.66	6.84	7.11	6.26	6.57	6.34	6.77	7.18
00010112990	339581	366629	6.20	6.31	6.42	6.58	6.67	6.84	7.11	6.26	6.57	6.34	6.78	7.19
00010112710	339413	366420	6.18	6.29	6.40	6.55	6.64	6.79	7.07	6.24	6.55	6.33	6.74	7.15
00010112210	339090	366037	6.19	6.32	6.43	6.57	6.68	6.86	7.11	6.26	6.57	6.35	6.78	7.19
00010111710	338769	365653	6.20	6.33	6.45	6.60	6.71	6.91	7.15	6.28	6.60	6.37	6.82	7.21

00010111450	338602	365454	6.22	6.34	6.46	6.63	6.74	6.95	7.19	6.29	6.62	6.38	6.86	7.25
00010111210	338367	365402	6.21	6.34	6.46	6.63	6.73	6.94	7.17	6.29	6.62	6.37	6.85	7.24
00010110710	337869	365347	6.23	6.35	6.48	6.65	6.77	6.98	7.22	6.30	6.65	6.39	6.90	7.29
00010110210	337413	365514	6.22	6.35	6.48	6.65	6.78	6.97	7.22	6.30	6.64	6.38	6.90	7.29
00010109710	336984	365773	6.23	6.35	6.49	6.65	6.79	7.01	7.25	6.31	6.64	6.39	6.91	7.32
00010109210	336557	366035	6.23	6.35	6.49	6.66	6.79	7.04	7.26	6.31	6.65	6.39	6.94	7.33
00010108710	336129	366296	6.23	6.36	6.49	6.67	6.82	7.06	7.28	6.31	6.66	6.40	6.97	7.35
00010108210	335701	366557	6.21	6.35	6.49	6.67	6.83	7.05	7.28	6.30	6.66	6.39	6.97	7.36
00010107710	335274	366818	6.21	6.35	6.49	6.69	6.84	7.07	7.28	6.30	6.67	6.39	6.97	7.37
00010107210	334845	367078	6.22	6.36	6.49	6.69	6.84	7.10	7.30	6.31	6.68	6.40	6.98	7.39
00010106710	334417	367339	6.21	6.36	6.48	6.69	6.84	7.12	7.32	6.31	6.68	6.40	7.01	7.40
00010106210	333989	367599	6.20	6.35	6.47	6.69	6.86	7.12	7.33	6.30	6.67	6.39	7.03	7.40
00010105710	333561	367859	6.22	6.35	6.48	6.71	6.88	7.13	7.37	6.30	6.69	6.39	7.04	7.44
00010105210	333133	368120	6.22	6.35	6.48	6.71	6.88	7.15	7.38	6.30	6.69	6.39	7.03	7.45
00010104710	332705	368381	6.22	6.35	6.48	6.70	6.87	7.17	7.40	6.30	6.69	6.39	7.04	7.47
00010104210	332277	368641	6.20	6.34	6.47	6.68	6.86	7.18	7.40	6.29	6.67	6.39	7.06	7.49
00010103710	331849	368901	6.21	6.34	6.48	6.69	6.88	7.18	7.43	6.29	6.68	6.38	7.08	7.53
00010103210	331422	369164	6.21	6.35	6.48	6.70	6.88	7.16	7.44	6.29	6.68	6.39	7.06	7.54
00010102710	331002	369438	6.21	6.35	6.48	6.69	6.87	7.18	7.45	6.30	6.68	6.38	7.04	7.55
00010102220	330583	369713	6.20	6.34	6.48	6.68	6.86	7.19	7.46	6.29	6.67	6.38	7.05	7.58
00010101970	330367	369836	6.21	6.36	6.49	6.70	6.85	7.19	7.47	6.29	6.68	6.40	7.06	7.60
00010101720	330123	369893	6.20	6.35	6.47	6.69	6.85	7.18	7.46	6.28	6.67	6.39	7.05	7.59
00010101240	329625	369943	6.20	6.37	6.49	6.70	6.86	7.15	7.47	6.29	6.69	6.40	7.04	7.62
00010100740	329192	370149	6.21	6.37	6.49	6.71	6.86	7.17	7.47	6.30	6.69	6.41	7.02	7.63
00010100240	329025	370615	6.20	6.36	6.47	6.69	6.83	7.16	7.44	6.28	6.67	6.40	7.02	7.59
00010100000	328871	370804	6.20	6.35	6.47	6.68	6.83	7.15	7.43	6.28	6.66	6.39	7.03	7.58
Est_24000	328069	371550	6.25	6.42	6.54	6.75	6.89	7.19	7.51	6.36	6.72	6.45	7.05	7.66
Est_23000	327307	372191	6.22	6.39	6.52	6.74	6.88	7.15	7.49	6.32	6.72	6.43	7.03	7.66
Est_22000	326572	372848	6.22	6.39	6.52	6.73	6.86	7.13	7.46	6.31	6.71	6.43	7.01	7.64
Est_21000	325841	373506	6.22	6.38	6.50	6.71	6.84	7.11	7.45	6.31	6.69	6.42	6.99	7.64
Est_20000	325192	374187	6.22	6.37	6.50	6.70	6.84	7.12	7.46	6.31	6.68	6.41	6.99	7.64
Est_19000	324852	375111	6.20	6.36	6.49	6.69	6.84	7.13	7.48	6.30	6.68	6.40	7.00	7.65
Est_16000	322649	375610	6.17	6.35	6.47	6.69	6.84	7.13	7.48	6.28	6.67	6.39	7.01	7.64
Est_15000	322091	376418	6.15	6.34	6.47	6.69	6.84	7.13	7.47	6.28	6.67	6.39	7.01	7.64
Est_14000	321265	376979	6.10	6.31	6.45	6.67	6.82	7.13	7.44	6.24	6.65	6.36	6.99	7.62
Est_13000	320918	377846	6.05	6.28	6.42	6.66	6.81	7.11	7.42	6.20	6.64	6.33	6.98	7.60
Est_12000	320451	378658	6.03	6.25	6.41	6.65	6.80	7.08	7.41	6.16	6.63	6.31	6.97	7.58
Est_11000	320248	379623	5.99	6.21	6.36	6.62	6.78	7.08	7.39	6.13	6.60	6.27	6.95	7.55

Est_10000	319896	380564	5.97	6.19	6.34	6.59	6.75	7.06	7.37	6.10	6.57	6.24	6.94	7.53
Est_7000	320594	383146	5.89	6.10	6.25	6.49	6.65	6.96	7.29	6.02	6.47	6.16	6.83	7.44
Est_6000	320174	383930	5.86	6.06	6.21	6.45	6.60	6.92	7.25	5.98	6.43	6.12	6.78	7.41
Est_5000	319627	384740	5.82	6.02	6.17	6.41	6.56	6.87	7.21	5.94	6.39	6.08	6.74	7.37
Est_4000	318992	385519	5.80	5.99	6.13	6.38	6.52	6.82	7.17	5.91	6.35	6.05	6.69	7.34
Est_3000	318347	386290	5.74	5.93	6.08	6.32	6.46	6.74	7.09	5.86	6.29	5.99	6.61	7.28
Est_2000	318017	387214	5.70	5.88	6.02	6.25	6.39	6.68	7.02	5.81	6.22	5.93	6.54	7.21
Est_1000	317700	387800	5.67	5.85	5.98	6.20	6.34	6.63	6.99	5.78	6.18	5.90	6.50	7.19

MODEL FILE NOTE

PROJECT	Tidal Dee Flood Mapping
PURPOSE OF STUDY	Update to present day (2015) and future climate change still water levels along the Dee estuary to assist the development and flood risk side of the business.
WATERCOURSE	Dee Estuary
MODEL TYPE	ISIS-TUFLOW
MODELLER	NRW

Overview

The Tidal Dee Flood Mapping Update Final Report by JBA was completed in 2012 but present day still water levels are for 2011 and future climate change for 2061, 2086 and 2111 (50yr, 75yr and 100yrs of climate change respectively).

The development and flood risk engineers are often asked for updated levels for the present day 2015 and future climate change scenarios, 2065, 2090 and 2115.

This file note is to document the updates that have been made to the Tidal Dee Flood Mapping Model, Tidal Dee Strategy Model.dat, of 2012 to provide more up to date still water levels for the Dee Estuary for the present day and the future.

To achieve new present day and predicted future water levels along the Dee estuary the tidal boundary within the Tidal Dee strategy model needed to be updated and is documented below.

Hydraulic Model

New .ief (event) files have been created for the following events:

- 0.5% 2015
- 0.5% 2065
- 0.5% 2090
- 0.5% 2090 plus upper confidence limit
- 0.5% 2115
- 0.5% 2115 plus upper confidence limit
- 0.1% 2015
- 0.1% 2065
- 0.1% 2090
- 0.1% 2115

Within these files the Est_1000 HTBDY tidal boundary has been altered to contain the updated and relevant tidal boundary head time information as documented below.

Tidal Boundaries

The same methodology as used for the 2012 Tidal Dee Flood Mapping Update by JBA has been applied in this update.

2008 extreme sea levels extracted from the coastal extreme study at the mouth of the Dee estuary, chainage 1150, has been used as the base water levels for calculations, as it was in the 2012 study. See Table 1 for 2008 base levels.

There has still been no new guidance on how the UK climate impacts programme should be

implemented, therefore the FCDPAG3 (Flood and coastal defence appraisal) guidance has been used to calculate future sea levels, as in 2012 also. Table 2 shows the predicted rates of sea level rise.

Table 1: 2008 Tidal still water levels at the mouth of the Dee estuary (mAOD)

0.5% AEP	0.1% AEP
5.97	6.19

Table 2: Predicted rates of sea level rise (mm/year)

1990-2025	2025-2055	2055-2085	2085-2115
3.5	8	11.5	14.5

Starting from the sea levels reported in table 1, the rates of change in table 2 lead to the calculated sea level rises shown in table 3 for the present day (2015), year 50 (2065), year 75 (2090) and year 100 (2115) events that are required for this update.

Table 3: Net mean sea level rise (m) from year 2008

2015	2065	2090	2115
0.02	0.41	0.72	1.08

Present day (2015) extreme sea levels including confidence limits are detailed in table 4 below.

Table 4: 2015 Tidal still water levels at the mouth of the Dee estuary (mAOD) and confidence limits

	1.33% AEP	1% AEP	0.5% AEP	0.1% AEP
Extreme sea level	5.86	5.90	5.99	6.21
Confidence limits	±0.1	±0.2	±0.2	±0.3

Future extreme sea levels for the 0.5% and 0.1% AEP events are detailed in Table 5 below.

Table 5: Present day (2015) and future 0.5% and 0.1% AEP extreme sea levels (mAOD)

	Present day (2015)	Year 50 (2065)	Year 75 (2090)	Year (2115)
0.5% AEP	5.99	6.38	6.69	7.05
0.1% AEP	6.21	6.60	6.91	7.27

It is assumed that the confidence limits applicable to the 0.5% AEP event is appropriate for the same event in future scenarios.

To populate the head time boundary within the ISIS model the same design tidal graph shape was used as that generated as part of the 2012 study, which for reference was derived using a highest astronomical tide series for the Dee estuary, the donor surge shape no.29 for Liverpool and with the peak of the surge timed to coincide with the trough preceding the peak of the event.

Tidal graphs for the present day (2015) and future tidal events were obtained by adding the estimated rise in mean sea level since 2011 to the 2011 series generated in the 2012 study.

The rest of the ISIS part of the model remained unchanged and no alterations were made to the TUFLOW part of the model at all.

The run files remained largely similar to those used for the 2012 study, which included alterations to the default parameter minitr value, which was set to 4 from 2, to correct a bug which was creating an over prediction in water levels. Also for the largest future event (0.1% AEP 2115) the maxitr value was set to 16 from 6 as it was in the 2012 study for the 2111 event. This allows the model more iterations per timestep to give the model more of a chance to converge for particular timesteps.

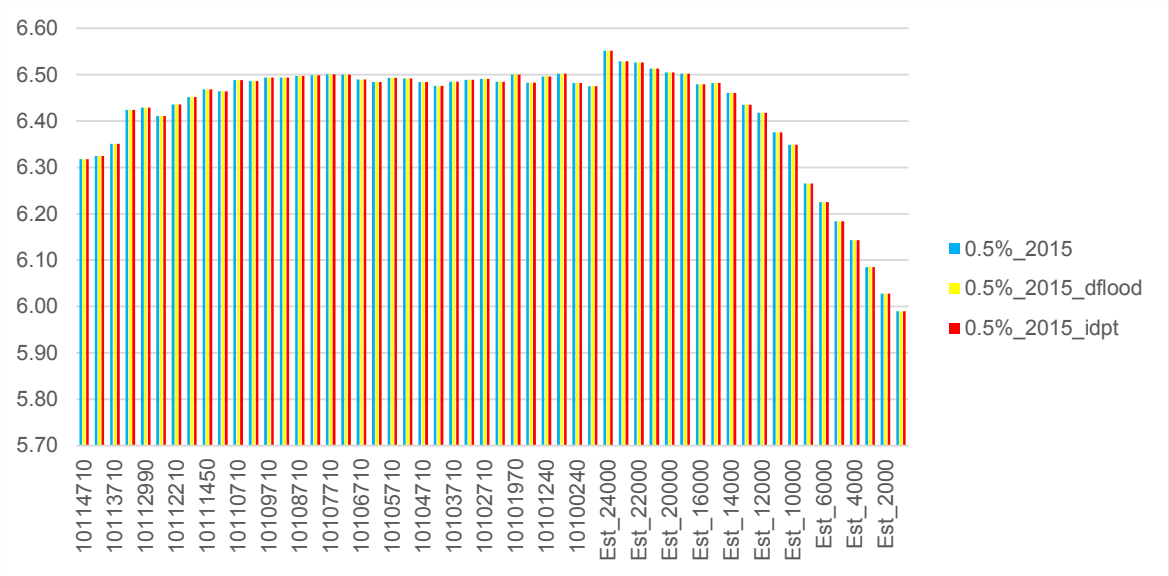
Slight adjustments were made for these updated runs and are listed below.

All models were ran with the Initial Conditions Defended_T200_2111_Upr_Bnd.zzs file.

For the two largest events ran, 0.5% 2115 upper band and the 0.1% 2115 events, Dflood was adjusted from 3 to 6 and the perform 1d corrective timestep was unchecked.

To ensure we were comfortable tweaking the run parameters as stated above, and water levels were not adversely affected, two check runs where carried out to see what affect the alterations have on predicted water levels. The base model used was the 0.5% AEP 2015 event run as this model runs at dflood 3 and with the 1d corrective timestep checked. The two additional runs carried out were with dflood set to 6 and with the 1d corrective timestep unchecked. 1d water levels were then compared between the 3 different runs. No differences in 1d water levels are seen, see figure 1 below, and therefore it was felt acceptable to run the 0.5% 2115 upper band and the 0.1% 2115 events with these slight alterations to the defaults settings in the run files.

Figure 1: Difference in water levels between the 0.5% AEP 2015 event, 0.5% AEP 2015 with dflood 6, 0.5% AEP 2015 unchecked 1d corrective timestep (idpt).



Results

See pages 4 to 6 for the updated tidal Dee defended peak water levels extracted from the tidal Dee strategy model.

REVIEWED BY	Sue Moulton
DATE	11/11/2015

MODEL FILE NOTE

Cyfoeth Naturiol Cymru Natural Resources Wales

Results – Tidal Dee defended peak water levels extracted from the ISIS model.

							Climate Change Scenarios						Sensitivity Analysis Scenarios	
Node Point ID	Easting	Northing	0.5% AEP (2011)	0.5% AEP (2015)	0.1% AEP (2011)	0.1% AEP (2015)	0.5% AEP (2065)	0.5% AEP (2090)	0.5% AEP (2115)	0.1% AEP (2065)	0.1% AEP (2090)	0.1% AEP (2115)	0.5% AEP (2090) Upper Band	0.5% AEP (2115) Upper Band
10114710	340258	365532	6.31	6.32	6.47	6.48	6.58	6.79	7.02	6.68	6.93	7.09	6.93	7.09
10114210	339782	365578	6.32	6.33	6.46	6.46	6.57	6.76	7.05	6.64	6.93	7.13	6.94	7.12
10113710	339680	366030	6.35	6.35	6.48	6.49	6.57	6.77	7.01	6.64	6.94	7.09	6.94	7.09
00010113210u	339762	366511	6.42	6.42	6.57	6.58	6.68	6.86	7.14	6.81	7.05	7.21	7.06	7.20
10112990	339581	366629	6.42	6.43	6.58	6.58	6.69	6.87	7.14	6.82	7.06	7.21	7.06	7.20
10112710	339413	366420	6.4	6.41	6.55	6.56	6.66	6.82	7.09	6.77	7.02	7.17	7.02	7.17
10112210	339090	366037	6.43	6.44	6.57	6.58	6.71	6.88	7.14	6.83	7.05	7.20	7.06	7.19
10111710	338769	365653	6.45	6.45	6.6	6.61	6.74	6.93	7.18	6.88	7.08	7.24	7.08	7.23
10111450	338602	365454	6.46	6.47	6.63	6.63	6.76	6.97	7.21	6.92	7.11	7.27	7.11	7.27
10111210	338367	365402	6.46	6.46	6.63	6.63	6.75	6.96	7.20	6.91	7.10	7.26	7.10	7.26
10110710	337869	365347	6.48	6.49	6.65	6.66	6.80	7.02	7.25	6.95	7.18	7.31	7.16	7.31
10110210	337413	365514	6.48	6.49	6.65	6.65	6.81	7.01	7.25	6.95	7.17	7.31	7.16	7.31
10109710	336984	365773	6.49	6.49	6.65	6.66	6.82	7.05	7.27	6.97	7.20	7.34	7.18	7.33
10109210	336557	366035	6.49	6.49	6.66	6.67	6.82	7.07	7.29	7.00	7.21	7.35	7.19	7.35
10108710	336129	366296	6.49	6.50	6.67	6.68	6.85	7.09	7.31	7.02	7.23	7.37	7.21	7.37
10108210	335701	366557	6.49	6.50	6.67	6.68	6.87	7.10	7.31	7.02	7.23	7.37	7.22	7.38
10107710	335274	366818	6.49	6.50	6.69	6.70	6.87	7.12	7.32	7.03	7.23	7.39	7.23	7.39
10107210	334845	367078	6.49	6.50	6.69	6.70	6.88	7.14	7.34	7.06	7.26	7.41	7.26	7.41

10106710	334417	367339	6.48	6.49	6.69	6.70	6.88	7.16	7.34	7.07	7.28	7.42	7.28	7.42
10106210	333989	367599	6.47	6.48	6.69	6.70	6.90	7.16	7.35	7.08	7.29	7.42	7.29	7.42
10105710	333561	367859	6.48	6.49	6.71	6.72	6.92	7.18	7.39	7.08	7.32	7.46	7.32	7.46
10105210	333133	368120	6.48	6.49	6.71	6.72	6.92	7.20	7.41	7.11	7.34	7.48	7.34	7.48
10104710	332705	368381	6.48	6.48	6.7	6.71	6.91	7.20	7.42	7.12	7.35	7.49	7.35	7.50
10104210	332277	368641	6.47	6.48	6.68	6.69	6.91	7.20	7.43	7.13	7.35	7.51	7.35	7.51
10103710	331849	368901	6.48	6.49	6.69	6.70	6.93	7.21	7.46	7.13	7.37	7.55	7.37	7.55
10103210	331422	369164	6.48	6.49	6.7	6.71	6.93	7.23	7.47	7.12	7.38	7.58	7.37	7.58
10102710	331002	369438	6.48	6.49	6.69	6.71	6.92	7.24	7.48	7.13	7.38	7.60	7.38	7.60
10102220	330583	369713	6.48	6.49	6.68	6.69	6.90	7.24	7.50	7.14	7.39	7.62	7.39	7.63
10101970	330367	369836	649	6.50	6.7	6.71	6.90	7.23	7.51	7.14	7.40	7.64	7.40	7.65
10101720	330123	369893	6.47	6.48	6.69	6.70	6.90	7.22	7.51	7.13	7.39	7.62	7.39	7.63
10101240	329625	369943	6.49	6.50	6.7	6.71	6.91	7.21	7.52	7.11	7.38	7.66	7.38	7.65
10100740	329192	370149	6.49	6.50	6.71	6.72	6.90	7.22	7.52	7.11	7.38	7.68	7.38	7.68
10100240	329025	370615	6.47	6.48	6.69	6.70	6.87	7.20	7.49	7.11	7.36	7.64	7.35	7.64
10100000	328871	370804	6.47	6.48	6.68	6.69	6.88	7.19	7.47	7.10	7.35	7.62	7.34	7.62
Est_24000	328069	371550	6.54	6.55	6.75	6.76	6.93	7.25	7.56	7.16	7.44	7.76	7.43	7.75
Est_23000	327307	372191	6.52	6.53	6.74	6.75	6.92	7.21	7.54	7.13	7.41	7.73	7.40	7.71
Est_22000	326572	372848	6.52	6.53	6.73	6.74	6.90	7.19	7.51	7.11	7.38	7.70	7.37	7.69
Est_21000	325841	373506	6.5	6.51	6.71	6.72	6.88	7.17	7.51	7.08	7.37	7.70	7.36	7.70
Est_20000	325192	374187	6.5	6.51	6.7	6.71	6.88	7.17	7.51	7.08	7.37	7.71	7.36	7.70
Est_19000	324852	375111	6.49	6.50	6.69	6.70	6.88	7.19	7.53	7.09	7.39	7.72	7.38	7.71
Est_16000	322649	375610	6.47	6.48	6.69	6.70	6.89	7.19	7.53	7.10	7.39	7.72	7.38	7.71
Est_15000	322091	376418	6.47	6.48	6.69	6.70	6.89	7.19	7.52	7.09	7.38	7.71	7.37	7.70
Est_14000	321265	376979	6.45	6.46	6.67	6.68	6.86	7.18	7.50	7.09	7.36	7.68	7.35	7.68

Est_13000	320918	377846	6.42	6.44	6.66	6.67	6.85	7.16	7.48	7.07	7.34	7.67	7.33	7.66
Est_12000	320451	378658	6.41	6.42	6.65	6.66	6.84	7.14	7.47	7.05	7.33	7.65	7.32	7.64
Est_11000	320248	379623	6.36	6.38	6.62	6.63	6.82	7.13	7.44	7.04	7.31	7.62	7.30	7.61
Est_10000	319896	380564	6.34	6.35	6.59	6.61	6.79	7.11	7.41	7.02	7.29	7.59	7.28	7.59
Est_7000	320594	383146	6.25	6.27	6.49	6.50	6.69	7.03	7.34	6.93	7.23	7.52	7.22	7.50
Est_6000	320174	383930	6.21	6.23	6.45	6.46	6.65	6.99	7.30	6.89	7.19	7.47	7.18	7.46
Est_5000	319627	384740	6.17	6.18	6.41	6.42	6.60	6.93	7.26	6.84	7.14	7.44	7.13	7.42
Est_4000	318992	385519	6.13	6.14	6.38	6.39	6.56	6.88	7.22	6.79	7.09	7.42	7.07	7.40
Est_3000	318347	386290	6.08	6.09	6.32	6.33	6.50	6.80	7.15	6.72	7.02	7.36	6.99	7.34
Est_2000	318017	387214	6.02	6.03	6.25	6.26	6.43	6.74	7.08	6.65	6.95	7.28	6.93	7.27
Est_1000	317700	387800	5.98	5.99	6.2	6.21	6.38	6.69	7.05	6.60	6.91	7.27	6.89	7.25

Appendix 4

Flood Evacuation Plan

TerraConsult

23rd March 2018

PROPOSED ARROWBIO PLANT, FLINTSHIRE ENTERPRISE ZONE 4, NORTH WALES

Flood Warning and Evacuation Plan

Carried out for: LOGIK WTE

Lead Consultant: Pegasus Planning Group Ltd

PROPOSED ARROWBIO PLANT, FLINTSHIRE ENTERPRISE ZONE 4, NORTH WALES

Flood Warning and Evacuation Plan

Date: 23rd March 2018

Carried Out For:

LOGIK WTE

Prepared By:

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1. INTRODUCTION

1.1 This Flood Warning and Evacuation Plan has been prepared for the occupants of the proposed industrial development at the ArrowBio gas Plant in Deeside, Flintshire, referred to as "the site" herein. The purpose of this document is to identify the flood risk, provide advice on how to prepare for a flood, and, identify the action to be taken during a flood event. It is recommended that the reader of this document also familiarise themselves with the Flood Consequence Assessment (FCA) and Surface Water Management Plan (SWMP) TerraConsult report for the site (Report No. 3484R07-1).

2. IDENTIFIED FLOOD RISK

2.1 The site has been identified with an overall low flood risk from river, sea, surface water, groundwater and reservoir sources as summarized in Table 1 below and depicted in Figure 1. The majority of the site is located in Flood Zone B and is unlikely to be affected by the extreme 0.5% and 0.1% Annual Exceedance Probability (AEP) river and sea flood events (i.e. Flood Zone C) for the site area. The maximum flood depths with climate change assigned to the 0.5% and 0.1% AEP events are 7.5 m AOD and 7.7 mAOD, respectively, while the current surface elevation for the majority of the site sits between 8.3 mAOD to 10.3 mAOD. Whilst a small area of the site along the western boundary sits within a high flood risk zone (i.e. Zone C), this area of the site will largely remain undeveloped and consist of water compatible infrastructure (grass swales, pipes, a culvert and manholes); day to day activities of the staff and the vulnerable infrastructure of the development will remain on the elevated surface areas of the site located above the 0.5% and 0.1% AEP flood levels. Thus the site should remain free from flood water during these extreme flood events.

Table 1 - Existing Site Flood Risk Summary

Type of Flood	Assessed Risk	Control Measures
River and Sea	Based on the NRW long term flood risk maps the majority of the site lies within a very low flood risk (less than 0.1 % inany year). The exception is a lower level area of the site area along the western boundary and site access ramp. Based on the River Dee Tidal Study, the upper level of the site resides at least 0.6 m above the 1 in 1000 AEP event + climate change. Furthermore, the site is not located within the 1 in 1000 AEP + climate change undefended scenario. Low and high flood risk areas adjacent to the eastern and western boundary of the site.	The highly vulnerable sections of the development (i.e. the buildings, biological plant area, storage areas for hazardous and waste materials, internal roads and carpark) will be confined to the upper level area of the site which sits within the very low flood risk zone (i.e. above the 1 in 1000 AEP tidal event level). The lower level area of the site located along the western boundary will largely remain its current condition as an undeveloped vegetated surface with flood compatible drainage (i.e. a grass ditches, pipes, a culvert and manholes). Acceptable consequences for nature of use. The occupiers must be made aware of the flood risk through this FCA. No increase in flooding elsewhere (e.g. from surface waters) through an appropriate surface water management plan outlined in this report.

Surface Water	Site sits outside areas of high surface water flood risk. Risk of flooding less than 0.1 % in any year. Low to medium flood risk areas adjacent to the western and southern boundary of the site.	On site mitigation measures to provide sustainable drainage systems and attenuation features on site through the proposed surface water management plan outlined in this report. This will be done so as to minimise potential for impact to local surface water drainage systems, road network and surrounding land-use.
Reservoir	Outside of maximum extent	None required
Groundwater	Very low	None required
Historic	None recorded on site	None required

3. PREPARING FOR A FLOOD

3.1 The following actions should be undertaken in preparation for a flood event:

- Sign up on the Natural Resources Wales Flood Warning Website or the Environmental Agency Website to receive flood waring events. Similarly potential flood warning events may be posted on various social media platforms such as Facebook or Twitter following @NatResWales or @EnvAgency. Concern parties may also contact Natural Resources Wales or the Environmental Agency via their Floodline number 0345 988 1188;
- Read and be familiar with the Environment Agency personal flood plan – this is depicted in Figure 1 of this document;
- Prepare a list of personnel and emergency contacts and place on the wall at every main entrance / exist of the building at the site;
- Move items of value to a safe place (i.e. off the ground level);
- Check that insurance includes cover for flooding;
- Familiarise yourself on how to turn off your gas, electricity and water mains supplies;
- Be familiar with actions to be taken upon receipt of a flood warning.

4. DURING A FLOOD

4.1 In the event of a flood warning, all personnel present on the site should be ready to evacuate the site taking only essential items. They should make their way out of the flood risk area to an appointed higher ground assembly area, taking the fastest and safest path outlined in the Flood Evacuation Route. Individuals should report to a flood marshal or health and safety officer present for the site if present, and await further instruction from relevant authorities.

4.2 In some instances a flood warning may not be received. In the event of flooding where no prior warning is received, site users should seek safe refuge on the structure lid set above the toilet and office block which is raised above flood levels. Site staff should alert the emergency services (where possible) and await further instruction and rescue. Site users must not evacuate the site into flood water unless instructed to do so otherwise by the emergency services.

5. FLOOD EVACUATION ROUTE

5.1 The flood evacuation route outlines the fastest and safest paths out of a flood risk area. All occupants of the site should familiarise themselves with the flood evacuation route as depicted in Figure 1.

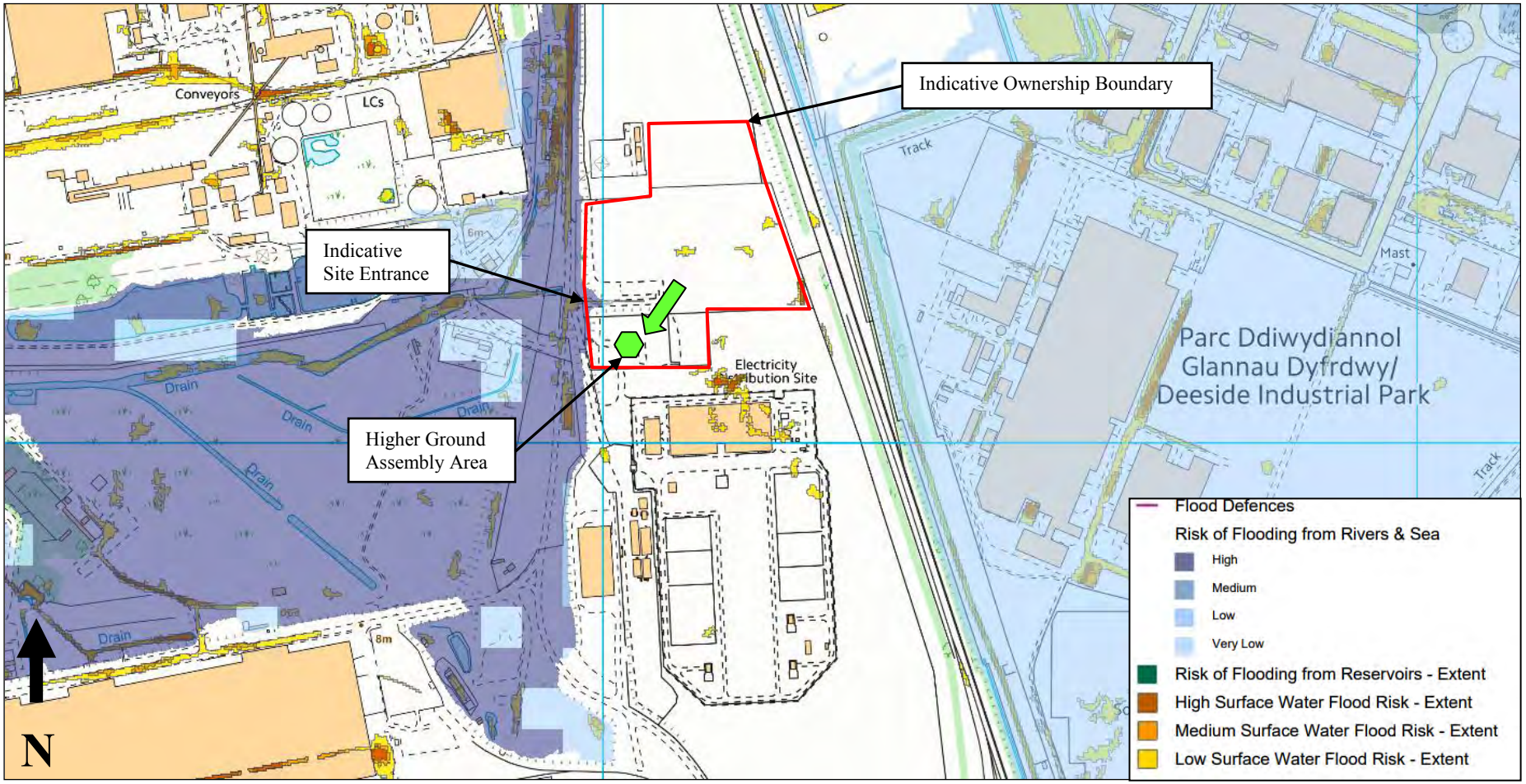


Figure 1 – Flood Evacuation Route (Base Map Source: Natural Resources Wales, 2018)

6. USEFUL LINKS

- Sign up to flood warnings:

  https://naturalresources.wales/flooding/sign-up-to-receive-flood-warnings/?lang=en

  https://www.gov.uk/sign-up-for-flood-warnings

- Real time online flood warnings:

  https://naturalresources.wales/flooding/check-flood-warnings/?lang=en

  https://flood-warning-information.service.gov.uk/warnings

- Preparing for a flood and get help during and after:

  https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/403213/LIT_5216.pdf

6.1 Emergency Contact Details:

Emergency Services - 999

Floodline - 0345 988 1188

Natural Resources Wales / Environmental Agency Incident Services - 0800 80 70 60

Flintshire County Borough Council - 0300 123 3086 / 01352 703020

Gas Utilities – 0800 111 999

Water and Sewerage Utilities (CYMRU Welsh Water) - 0800 052 0130 or 800 085 3968

6.2 This flood plan should be review annually to ensure the emergency contact details are up to date. The plan should be updated every five years to account for updated flood level information.

Personal flood plan

Name

Environment Agency

Are you signed up to receive flood warnings?
If not call Floodline on 0345 988 1188 to see if your area receives free flood warnings.

Let us know when you've completed your flood plan by calling Floodline on **0345 988 1188.** This will help us learn more about how people are preparing for flooding.

General contact list	Company name	Contact name	Telephone
Floodline	Environment Agency		0345 988 1188
Electricity provider			
Gas provider			
Water company			
Telephone provider			
Insurance company and policy number			
Local council			
Local radio station			
Travel/weather info			

Key locations

Service cut-off	Description of location
Electricity	
Gas	
Water	

Who can help/who can you help?

Relationship	Name	Contact details	How can they/you help?
Relative			
Friend or neighbour			

Be prepared for flooding. Act now

Personal flood plan

What can I do NOW?

Environment Agency

- ☐ Put important documents out of flood risk and protect in polythene
- ☐ Check your insurance covers you for flooding
- ☐ Look at the best way of stopping floodwater entering your property
- ☐ Make a flood plan and prepare a flood kit
- ☐ Find out where you can get sandbags
- ☐ Identify who can help you/ who you can help
- ☐ Identify what you would need to take with you if you had to leave your home
- ☐ Understand the flood warning codes

What can you do if a flood is expected in your area?

Actions	Location
Home	
• Move furniture and electrical items to safety	
• Put flood boards, polythene and sandbags in place	
• Make a list now of what you can move away from the risk	
• Turn off electricity, water and gas supplies	
• Roll up carpets and rugs	
• Unless you have time to remove them hang curtains over rods	
• Move sentimental items to safety	
• Put important documents in polythene bags and move to safety	
Garden and outside	
• Move your car out of the flood risk area	
• Move any large or loose items or weigh them down	
Business	
• Move important documents, computers and stock	
• Alert staff and request their help	
• Farmers move animals and livestock to safety	
Evacuation - Prepare a flood kit in advance	
• Inform your family or friends that you may need to leave your home	
• Get your flood kit together and include a torch, warm and waterproof clothing, water, food, medication, toys for children and pets, rubber gloves and wellingtons	

There are a range of flood protection products on the market to help you protect your property from flood damage. A directory of these is available from the **National Flood Forum** at **www.bluepages.org.uk**

Be prepared for flooding. Act now

Appendix 5

Microdrainage Analyses – Greenfield Runoff Rate Values

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 774 Urban 0.000
Area (ha) 5.573 Soil 0.450 Region Number Region 9

Results l/s

QBAR Rural 27.5
QBAR Urban 27.5

Q100 years 60.0

Q1 year 24.2
Q30 years 48.6
Q100 years 60.0

Appendix 6

Microdrainage Analyses – Surface Water Drainage

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	18.000	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.369	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.348	4-8	3.932	8-12	1.292

Total Area Contributing (ha) = 5.573

Total Pipe Volume (m³) = 131.121

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	n	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Design Table for Storm

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	34.000	0.243	140.0	0.330	5.00	0.0	0.015	o	375	Pipe/Conduit	
S2.000	17.000	0.200	85.0	0.157	5.00	0.0	0.015	o	300	Pipe/Conduit	
S1.001	37.500	0.441	85.0	0.000	0.00	0.0	0.015	o	375	Pipe/Conduit	
S3.000	34.500	0.406	85.0	0.241	5.00	0.0	0.015	o	375	Pipe/Conduit	
S4.000	31.500	0.371	85.0	0.306	5.00	0.0	0.015	o	375	Pipe/Conduit	
S5.000	18.500	0.185	100.0	0.146	5.00	0.0	0.015	o	300	Pipe/Conduit	
S1.002	34.200	0.195	175.0	0.023	0.00	0.0	0.015	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.49	8.425	0.330	0.0	0.0	0.0	1.16	128.4	44.7
S2.000	50.00	5.22	8.500	0.157	0.0	0.0	0.0	1.29	90.9	21.2
S1.001	50.00	5.91	8.085	0.487	0.0	0.0	0.0	1.49	164.8	65.9
S3.000	50.00	5.39	8.425	0.241	0.0	0.0	0.0	1.49	164.8	32.6
S4.000	50.00	5.35	8.425	0.306	0.0	0.0	0.0	1.49	164.8	41.4
S5.000	50.00	5.26	8.500	0.146	0.0	0.0	0.0	1.19	83.8	19.8
S1.002	50.00	6.45	7.500	1.203	0.0	0.0	0.0	1.04	114.9«	162.9

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S6.000	10.000	0.100	100.0	0.353	5.00	0.0	0.015	o	300	Pipe/Conduit	
S1.003	40.000	0.200	200.0	0.062	0.00	0.0	0.015	o	450	Pipe/Conduit	
S7.000	30.000	0.200	150.0	0.200	5.00	0.0	0.015	o	300	Pipe/Conduit	
S1.004	27.000	0.200	135.0	0.000	0.00	0.0	0.015	o	525	Pipe/Conduit	
S8.000	17.000	0.170	100.0	0.215	5.00	0.0	0.015	o	300	Pipe/Conduit	
S8.001	16.000	0.160	100.0	0.043	0.00	0.0	0.015	o	375	Pipe/Conduit	
S1.005	14.300	0.179	80.0	0.000	0.00	0.0	0.015	o	600	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S6.000	50.00	5.14	8.000	0.353	0.0	0.0	0.0	1.19	83.8	47.8
S1.003	50.00	7.06	7.300	1.617	0.0	0.0	0.0	1.10	174.7«	219.0
S7.000	50.00	5.52	8.000	0.200	0.0	0.0	0.0	0.97	68.4	27.1
S1.004	50.00	7.36	7.100	1.817	0.0	0.0	0.0	1.48	320.8	246.0
S8.000	50.00	5.24	7.900	0.215	0.0	0.0	0.0	1.19	83.8	29.1
S8.001	50.00	5.43	7.730	0.258	0.0	0.0	0.0	1.38	152.0	34.9
S1.005	50.00	7.48	6.900	2.075	0.0	0.0	0.0	2.10	595.0	281.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S9.000	55.000	0.183	300.0	0.111	5.00	0.0	0.015	o	375	Pipe/Conduit	
S9.001	24.000	0.080	300.0	0.135	0.00	0.0	0.015	o	375	Pipe/Conduit	
S9.002	22.000	0.073	300.0	0.000	0.00	0.0	0.015	o	375	Pipe/Conduit	
S10.000	14.200	0.118	120.0	0.537	5.00	0.0	0.015	o	375	Pipe/Conduit	
S10.001	13.300	0.099	135.0	0.000	0.00	0.0	0.015	o	375	Pipe/Conduit	
S9.003	7.600	0.152	50.0	0.140	0.00	0.0	0.015	o	375	Pipe/Conduit	
S11.000	2.500	0.125	20.0	0.407	5.00	0.0	0.015	o	375	Pipe/Conduit	
S11.001	10.000	0.125	80.0	0.133	0.00	0.0	0.015	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S9.000	50.00	6.15	7.525	0.111	0.0	0.0	0.0	0.79	87.7	15.0
S9.001	50.00	6.66	7.342	0.246	0.0	0.0	0.0	0.79	87.7	33.3
S9.002	50.00	7.12	7.262	0.246	0.0	0.0	0.0	0.79	87.7	33.3
S10.000	50.00	5.19	7.425	0.537	0.0	0.0	0.0	1.26	138.7	72.7
S10.001	50.00	5.38	7.300	0.537	0.0	0.0	0.0	1.18	130.8	72.7
S9.003	50.00	7.18	7.189	0.923	0.0	0.0	0.0	1.95	214.9	125.0
S11.000	50.00	5.01	7.425	0.407	0.0	0.0	0.0	3.08	339.8	55.1
S11.001	50.00	5.12	7.300	0.540	0.0	0.0	0.0	1.54	169.9	73.1

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S9.004	9.800	0.123	80.0	0.000	0.00	0.0	0.015	o	375	Pipe/Conduit	
S12.000	7.000	0.467	15.0	0.151	5.00	0.0	0.015	o	375	Pipe/Conduit	
S9.005	21.000	0.084	250.0	0.000	0.00	0.0	0.015	o	450	Pipe/Conduit	
S13.000	25.000	0.167	150.0	0.258	5.00	0.0	0.015	o	375	Pipe/Conduit	
S9.006	48.000	0.240	200.0	0.000	0.00	0.0	0.015	o	450	Pipe/Conduit	
S14.000	14.500	0.725	20.0	0.534	5.00	0.0	0.015	o	450	Pipe/Conduit	
S9.007	20.000	0.167	120.0	0.000	0.00	0.0	0.015	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S9.004	50.00	7.29	7.006	1.463	0.0	0.0	0.0	1.54	169.9«	198.1
S12.000	50.00	5.03	7.425	0.151	0.0	0.0	0.0	3.55	392.5	20.5
S9.005	50.00	7.65	6.873	1.614	0.0	0.0	0.0	0.98	156.3«	218.6
S13.000	50.00	5.37	6.925	0.258	0.0	0.0	0.0	1.12	124.1	35.0
S9.006	50.00	8.37	6.758	1.872	0.0	0.0	0.0	1.10	174.7«	253.5
S14.000	50.00	5.07	7.350	0.534	0.0	0.0	0.0	3.47	552.5	72.3
S9.007	50.00	8.59	6.518	2.406	0.0	0.0	0.0	1.57	340.2	325.8

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.006	36.500	0.270	135.0	0.000	0.00	0.0	0.015	o	375	Pipe/Conduit	
S1.007	14.000	0.280	50.0	0.000	0.00	0.0	0.015	o	375	Pipe/Conduit	
S1.008	95.000	0.655	145.0	0.010	0.00	0.0	0.027	\/	-3	Pipe/Conduit	
S15.000	45.000	1.500	30.0	0.084	5.00	0.0	0.015	o	300	Pipe/Conduit	
S15.001	17.000	0.100	170.0	0.000	0.00	0.0	0.015	o	300	Pipe/Conduit	
S15.002	17.000	0.100	170.0	0.000	0.00	0.0	0.027	\/	-2	Pipe/Conduit	
S1.009	5.000	0.100	50.0	0.000	0.00	0.0	0.015	o	300	Pipe/Conduit	
S1.010	12.000	0.100	120.0	0.000	0.00	0.0	0.015	[]	-1	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.006	50.00	9.10	6.300	4.481	0.0	0.0	0.0	1.18	130.8«	606.8
S1.007	50.00	9.22	6.000	4.481	0.0	0.0	0.0	1.95	214.9«	606.8
S1.008	50.00	11.26	5.700	4.492	0.0	0.0	0.0	0.78	93.0«	608.2
S15.000	50.00	5.35	6.500	0.084	0.0	0.0	0.0	2.16	153.0	11.3
S15.001	50.00	5.66	5.000	0.084	0.0	0.0	0.0	0.91	64.3	11.3
S15.002	50.00	5.85	4.900	0.084	0.0	0.0	0.0	1.45	1817.2	11.3
S1.009	50.00	11.31	4.500	4.575	0.0	0.0	0.0	1.68	118.5«	619.5
S1.010	50.00	11.42	4.400	4.575	0.0	0.0	0.0	1.84	921.5	619.5

Conduit Sections for Storm

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m^2)
-1	[]	1000	500	90.0		0.667	0.500
-2	\/	2000	500	45.0		1.464	1.250
-3	\/	100	300	45.0		0.506	0.120

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S2	9.400	0.975	Open Manhole	1350	S1.000	8.425	375				
S3	10.000	1.500	Open Manhole	1200	S2.000	8.500	300				
S3	10.000	1.915	Open Manhole	1350	S1.001	8.085	375	S1.000	8.182	375	97
								S2.000	8.300	300	140
S4	9.400	0.975	Open Manhole	1350	S3.000	8.425	375				
S6	9.400	0.975	Open Manhole	1350	S4.000	8.425	375				
S6	10.000	1.500	Open Manhole	1200	S5.000	8.500	300				
S5	10.000	2.500	Open Manhole	1350	S1.002	7.500	375	S1.001	7.644	375	144
								S3.000	8.019	375	519
								S4.000	8.054	375	554
								S5.000	8.315	300	740
S9	9.500	1.500	Open Manhole	1200	S6.000	8.000	300				
S10	9.500	2.200	Open Manhole	1350	S1.003	7.300	450	S1.002	7.305	375	
								S6.000	7.900	300	450
S11	9.500	1.500	Open Manhole	1200	S7.000	8.000	300				
S13	9.400	2.300	Open Manhole	1500	S1.004	7.100	525	S1.003	7.100	450	
								S7.000	7.800	300	475
S12	9.400	1.500	Open Manhole	1200	S8.000	7.900	300				
S14	9.400	1.670	Open Manhole	1350	S8.001	7.730	375	S8.000	7.730	300	
S14	9.400	2.500	Open Manhole	1500	S1.005	6.900	600	S1.004	6.900	525	
								S8.001	7.570	375	445
S20	9.100	1.575	Open Manhole	1350	S9.000	7.525	375				
S21	8.950	1.608	Open Manhole	1350	S9.001	7.342	375	S9.000	7.342	375	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S21	9.000	1.738	Open Manhole	1350	S9.002	7.262	375	S9.001	7.262	375	
S22	9.000	1.575	Open Manhole	1350	S10.000	7.425	375				
S23	9.000	1.700	Open Manhole	1350	S10.001	7.300	375	S10.000	7.307	375	7
S24	8.800	1.611	Open Manhole	1350	S9.003	7.189	375	S9.002	7.189	375	
								S10.001	7.201	375	12
S25	9.000	1.575	Open Manhole	1350	S11.000	7.425	375				
S26	9.000	1.700	Open Manhole	1350	S11.001	7.300	375	S11.000	7.300	375	
S27	8.900	1.894	Open Manhole	1350	S9.004	7.006	375	S9.003	7.037	375	31
								S11.001	7.175	375	169
S28	9.000	1.575	Open Manhole	1350	S12.000	7.425	375				
S29	8.800	1.927	Open Manhole	1350	S9.005	6.873	450	S9.004	6.884	375	
								S12.000	6.958	375	10
S30	8.500	1.575	Open Manhole	1350	S13.000	6.925	375				
S31	8.800	2.042	Open Manhole	1350	S9.006	6.758	450	S9.005	6.789	450	31
								S13.000	6.758	375	
S31	9.000	1.650	Open Manhole	1350	S14.000	7.350	450				
S33	9.300	2.782	Open Manhole	1500	S9.007	6.518	525	S9.006	6.518	450	
								S14.000	6.625	450	32
S33	9.400	3.100	Open Manhole	1500	S1.006	6.300	375	S1.005	6.721	600	646
								S9.007	6.351	525	201
S34	9.400	3.400	Open Manhole		S1.007	6.000	375	S1.006	6.030	375	30
S34	6.100	0.400	Junction	0	S1.008	5.700	-3	S1.007	5.720	375	95
S34	8.000	1.500	Open Manhole	1200	S15.000	6.500	300				

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S35	6.000	1.000	Open Manhole	1200	S15.001	5.000	300	S15.000	5.000	300	
S36	5.400	0.500	Open Manhole	2000	S15.002	4.900	-2	S15.001	4.900	300	
S39	5.350	0.850	Open Manhole	2000	S1.009	4.500	300	S1.008	5.045	-3	545
								S15.002	4.800	-2	500
S33	5.350	0.950	Open Manhole	2000	S1.010	4.400	-1	S1.009	4.400	300	
S	5.350	1.050	Open Manhole	0		OUTFALL		S1.010	4.300	-1	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	375	S2	9.400	8.425	0.600	Open Manhole	1350
S2.000	o	300	S3	10.000	8.500	1.200	Open Manhole	1200
S1.001	o	375	S3	10.000	8.085	1.540	Open Manhole	1350
S3.000	o	375	S4	9.400	8.425	0.600	Open Manhole	1350
S4.000	o	375	S6	9.400	8.425	0.600	Open Manhole	1350
S5.000	o	300	S6	10.000	8.500	1.200	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	34.000	140.0	S3	10.000	8.182	1.443	Open Manhole	1350
S2.000	17.000	85.0	S3	10.000	8.300	1.400	Open Manhole	1350
S1.001	37.500	85.0	S5	10.000	7.644	1.981	Open Manhole	1350
S3.000	34.500	85.0	S5	10.000	8.019	1.606	Open Manhole	1350
S4.000	31.500	85.0	S5	10.000	8.054	1.571	Open Manhole	1350
S5.000	18.500	100.0	S5	10.000	8.315	1.385	Open Manhole	1350

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.002	o	375	S5	10.000	7.500	2.125	Open Manhole	1350
S6.000	o	300	S9	9.500	8.000	1.200	Open Manhole	1200
S1.003	o	450	S10	9.500	7.300	1.750	Open Manhole	1350
S7.000	o	300	S11	9.500	8.000	1.200	Open Manhole	1200
S1.004	o	525	S13	9.400	7.100	1.775	Open Manhole	1500
S8.000	o	300	S12	9.400	7.900	1.200	Open Manhole	1200
S8.001	o	375	S14	9.400	7.730	1.295	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.002	34.200	175.0	S10	9.500	7.305	1.820	Open Manhole	1350
S6.000	10.000	100.0	S10	9.500	7.900	1.300	Open Manhole	1350
S1.003	40.000	200.0	S13	9.400	7.100	1.850	Open Manhole	1500
S7.000	30.000	150.0	S13	9.400	7.800	1.300	Open Manhole	1500
S1.004	27.000	135.0	S14	9.400	6.900	1.975	Open Manhole	1500
S8.000	17.000	100.0	S14	9.400	7.730	1.370	Open Manhole	1350
S8.001	16.000	100.0	S14	9.400	7.570	1.455	Open Manhole	1500

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.005	o	600	S14	9.400	6.900	1.900	Open Manhole	1500
S9.000	o	375	S20	9.100	7.525	1.200	Open Manhole	1350
S9.001	o	375	S21	8.950	7.342	1.233	Open Manhole	1350
S9.002	o	375	S21	9.000	7.262	1.363	Open Manhole	1350
S10.000	o	375	S22	9.000	7.425	1.200	Open Manhole	1350
S10.001	o	375	S23	9.000	7.300	1.325	Open Manhole	1350
S9.003	o	375	S24	8.800	7.189	1.236	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.005	14.300	80.0	S33	9.400	6.721	2.079	Open Manhole	1500
S9.000	55.000	300.0	S21	8.950	7.342	1.233	Open Manhole	1350
S9.001	24.000	300.0	S21	9.000	7.262	1.363	Open Manhole	1350
S9.002	22.000	300.0	S24	8.800	7.189	1.236	Open Manhole	1350
S10.000	14.200	120.0	S23	9.000	7.307	1.318	Open Manhole	1350
S10.001	13.300	135.0	S24	8.800	7.201	1.224	Open Manhole	1350
S9.003	7.600	50.0	S27	8.900	7.037	1.488	Open Manhole	1350

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S11.000	o	375	S25	9.000	7.425	1.200	Open Manhole	1350
S11.001	o	375	S26	9.000	7.300	1.325	Open Manhole	1350
S9.004	o	375	S27	8.900	7.006	1.519	Open Manhole	1350
S12.000	o	375	S28	9.000	7.425	1.200	Open Manhole	1350
S9.005	o	450	S29	8.800	6.873	1.477	Open Manhole	1350
S13.000	o	375	S30	8.500	6.925	1.200	Open Manhole	1350
S9.006	o	450	S31	8.800	6.758	1.592	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S11.000	2.500	20.0	S26	9.000	7.300	1.325	Open Manhole	1350
S11.001	10.000	80.0	S27	8.900	7.175	1.350	Open Manhole	1350
S9.004	9.800	80.0	S29	8.800	6.884	1.542	Open Manhole	1350
S12.000	7.000	15.0	S29	8.800	6.958	1.467	Open Manhole	1350
S9.005	21.000	250.0	S31	8.800	6.789	1.561	Open Manhole	1350
S13.000	25.000	150.0	S31	8.800	6.758	1.667	Open Manhole	1350
S9.006	48.000	200.0	S33	9.300	6.518	2.332	Open Manhole	1500

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S14.000	o	450	S31	9.000	7.350	1.200	Open Manhole	1350
S9.007	o	525	S33	9.300	6.518	2.257	Open Manhole	1500
S1.006	o	375	S33	9.400	6.300	2.725	Open Manhole	1500
S1.007	o	375	S34	9.400	6.000	3.025	Open Manhole	1350
S1.008	\/	-3	S34	6.100	5.700	0.100	Junction	
S15.000	o	300	S34	8.000	6.500	1.200	Open Manhole	1200
S15.001	o	300	S35	6.000	5.000	0.700	Open Manhole	1200
S15.002	\/	-2	S36	5.400	4.900	0.000	Open Manhole	2000

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S14.000	14.500	20.0	S33	9.300	6.625	2.225	Open Manhole	1500
S9.007	20.000	120.0	S33	9.400	6.351	2.524	Open Manhole	1500
S1.006	36.500	135.0	S34	9.400	6.030	2.995	Open Manhole	1350
S1.007	14.000	50.0	S34	6.100	5.720	0.005	Junction	
S1.008	95.000	145.0	S39	5.350	5.045	0.005	Open Manhole	2000
S15.000	45.000	30.0	S35	6.000	5.000	0.700	Open Manhole	1200
S15.001	17.000	170.0	S36	5.400	4.900	0.200	Open Manhole	2000
S15.002	17.000	170.0	S39	5.350	4.800	0.050	Open Manhole	2000

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.009	o	300	S39	5.350	4.500	0.550	Open Manhole	2000
S1.010	[]	-1	S33	5.350	4.400	0.450	Open Manhole	2000

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.009	5.000	50.0	S33	5.350	4.400	0.650	Open Manhole	2000
S1.010	12.000	120.0	S	5.350	4.300	0.550	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.330	0.330	0.330
2.000	-	-	89	0.176	0.157	0.157
1.001	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.241	0.241	0.241
4.000	-	-	100	0.306	0.306	0.306
5.000	-	-	86	0.170	0.146	0.146
1.002	-	-	76	0.030	0.023	0.023
6.000	-	-	80	0.441	0.353	0.353
1.003	-	-	80	0.077	0.062	0.062
7.000	-	-	80	0.250	0.200	0.200
1.004	-	-	100	0.000	0.000	0.000
8.000	-	-	80	0.269	0.215	0.215
8.001	-	-	70	0.061	0.043	0.043
1.005	-	-	100	0.000	0.000	0.000
9.000	-	-	71	0.156	0.111	0.111
9.001	-	-	55	0.246	0.135	0.135
9.002	-	-	100	0.000	0.000	0.000
10.000	-	-	100	0.537	0.537	0.537
10.001	-	-	100	0.000	0.000	0.000
9.003	-	-	81	0.173	0.140	0.140
11.000	-	-	100	0.407	0.407	0.407
11.001	-	-	82	0.162	0.133	0.133
9.004	-	-	100	0.000	0.000	0.000
12.000	-	-	84	0.180	0.151	0.151
9.005	-	-	100	0.000	0.000	0.000
13.000	-	-	54	0.478	0.258	0.258
9.006	-	-	100	0.000	0.000	0.000
14.000	-	-	100	0.534	0.534	0.534
9.007	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	10	0.103	0.010	0.010
15.000	-	-	34	0.246	0.084	0.084
15.001	-	-	100	0.000	0.000	0.000

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
15.002	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				5.573	4.575	4.575

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
S1.000	S2	375	0.600	1.443	Unclassified	1350	0	0.600	Unclassified
S2.000	S3	300	1.200	1.400	Unclassified	1200	0	1.200	Unclassified
S1.001	S3	375	1.540	1.981	Unclassified	1350	0	1.540	Unclassified
S3.000	S4	375	0.600	1.606	Unclassified	1350	0	0.600	Unclassified
S4.000	S6	375	0.600	1.571	Unclassified	1350	0	0.600	Unclassified
S5.000	S6	300	1.200	1.385	Unclassified	1200	0	1.200	Unclassified
S1.002	S5	375	1.820	2.125	Unclassified	1350	0	2.125	Unclassified
S6.000	S9	300	1.200	1.300	Unclassified	1200	0	1.200	Unclassified
S1.003	S10	450	1.750	1.850	Unclassified	1350	0	1.750	Unclassified
S7.000	S11	300	1.200	1.300	Unclassified	1200	0	1.200	Unclassified
S1.004	S13	525	1.775	1.975	Unclassified	1500	0	1.775	Unclassified
S8.000	S12	300	1.200	1.370	Unclassified	1200	0	1.200	Unclassified
S8.001	S14	375	1.295	1.455	Unclassified	1350	0	1.295	Unclassified
S1.005	S14	600	1.900	2.079	Unclassified	1500	0	1.900	Unclassified
S9.000	S20	375	1.200	1.233	Unclassified	1350	0	1.200	Unclassified
S9.001	S21	375	1.233	1.363	Unclassified	1350	0	1.233	Unclassified
S9.002	S21	375	1.236	1.363	Unclassified	1350	0	1.363	Unclassified
S10.000	S22	375	1.200	1.318	Unclassified	1350	0	1.200	Unclassified
S10.001	S23	375	1.224	1.325	Unclassified	1350	0	1.325	Unclassified
S9.003	S24	375	1.236	1.488	Unclassified	1350	0	1.236	Unclassified
S11.000	S25	375	1.200	1.325	Unclassified	1350	0	1.200	Unclassified
S11.001	S26	375	1.325	1.350	Unclassified	1350	0	1.325	Unclassified
S9.004	S27	375	1.519	1.542	Unclassified	1350	0	1.519	Unclassified
S12.000	S28	375	1.200	1.467	Unclassified	1350	0	1.200	Unclassified
S9.005	S29	450	1.477	1.561	Unclassified	1350	0	1.477	Unclassified
S13.000	S30	375	1.200	1.667	Unclassified	1350	0	1.200	Unclassified
S9.006	S31	450	1.592	2.332	Unclassified	1350	0	1.592	Unclassified
S14.000	S31	450	1.200	2.225	Unclassified	1350	0	1.200	Unclassified
S9.007	S33	525	2.257	2.524	Unclassified	1500	0	2.257	Unclassified
S1.006	S33	375	2.725	2.995	Unclassified	1500	0	2.725	Unclassified
S1.007	S34	375	0.005	3.025	Unclassified	1350	0	3.025	Unclassified
S1.008	S34	-3	0.005	0.100	Unclassified				Junction

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
S15.000	S34	300	0.700	1.200	Unclassified	1200	0	1.200	Unclassified
S15.001	S35	300	0.200	0.700	Unclassified	1200	0	0.700	Unclassified
S15.002	S36	-2	0.000	0.050	Unclassified	2000	0	0.000	Unclassified
S1.009	S39	300	0.550	0.650	Unclassified	2000	0	0.550	Unclassified
S1.010	S33	-1	0.450	0.550	Unclassified	2000	0	0.450	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.010	S	5.350	4.300	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000
Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000	Run Time (mins)	60
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	6	Number of Storage Structures	5	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	Site Location GB 331126 371270 SJ 31126 71270		Winter Storms	No
Return Period (years)	100	Data Type	Point	Cv (Summer)	0.750
FEH Rainfall Version	2013	Summer Storms	Yes	Cv (Winter)	0.840

Synthetic Rainfall Details

Storm Duration (mins) 30

Online Controls for Storm

Non Return Valve Manhole: S23, DS/PN: S10.001, Volume (m³): 3.9

Non Return Valve Manhole: S26, DS/PN: S11.001, Volume (m³): 2.6

Non Return Valve Manhole: S33, DS/PN: S9.007, Volume (m³): 14.4

Hydro-Brake® Optimum Manhole: S33, DS/PN: S1.006, Volume (m³): 13.1

Unit Reference	MD-SHE-0193-1900-1100-1900	Sump Available	Yes
Design Head (m)	1.100	Diameter (mm)	193
Design Flow (l/s)	19.0	Invert Level (m)	6.300
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.100	19.0	Kick-Flo®	0.769	16.0
Flush-Flo™	0.353	19.0	Mean Flow over Head Range	-	16.1

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.7	0.300	18.9	0.500	18.6	0.800	16.3	1.200	19.8	1.600	22.7
0.200	17.9	0.400	18.9	0.600	18.2	1.000	18.2	1.400	21.3	1.800	24.0

Hydro-Brake® Optimum Manhole: S33, DS/PN: S1.006, Volume (m³): 13.1

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
2.000	25.3	2.600	28.7	4.000	35.3	5.500	41.1	7.000	46.2	8.500	50.8
2.200	26.4	3.000	30.7	4.500	37.3	6.000	42.9	7.500	47.8	9.000	52.2
2.400	27.6	3.500	33.1	5.000	39.3	6.500	44.6	8.000	49.3	9.500	53.6

Non Return Valve Manhole: S36, DS/PN: S15.002, Volume (m³): 2.7

Hydro-Brake® Optimum Manhole: S39, DS/PN: S1.009, Volume (m³): 32.7

Unit Reference	MD-SHE-0228-2700-0800-2700	Sump Available	Yes
Design Head (m)	0.800	Diameter (mm)	228
Design Flow (l/s)	27.0	Invert Level (m)	4.500
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	300
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	27.0	Kick-Flo®	0.625	24.0
Flush-Flo™	0.349	27.0	Mean Flow over Head Range	-	21.7

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.6	0.600	24.6	1.600	37.6	2.600	47.5	5.000	65.3	7.500	79.5
0.200	22.8	0.800	27.0	1.800	39.8	3.000	50.9	5.500	68.4	8.000	82.1
0.300	26.8	1.000	30.0	2.000	41.9	3.500	54.9	6.000	71.3	8.500	84.0
0.400	26.8	1.200	32.8	2.200	43.9	4.000	58.6	6.500	74.2	9.000	86.5
0.500	26.2	1.400	35.3	2.400	45.7	4.500	62.0	7.000	76.9	9.500	88.9

Storage Structures for Storm

Cellular Storage Manhole: S5, DS/PN: S1.002

Invert Level (m) 7.500 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.94
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	215.0	215.0	1.400	0.0	291.2	2.800	0.0	291.2	4.200	0.0	291.2
0.200	215.0	226.7	1.600	0.0	291.2	3.000	0.0	291.2	4.400	0.0	291.2
0.400	215.0	238.5	1.800	0.0	291.2	3.200	0.0	291.2	4.600	0.0	291.2
0.600	215.0	250.2	2.000	0.0	291.2	3.400	0.0	291.2	4.800	0.0	291.2
0.800	215.0	261.9	2.200	0.0	291.2	3.600	0.0	291.2	5.000	0.0	291.2
1.000	215.0	273.7	2.400	0.0	291.2	3.800	0.0	291.2			
1.200	215.0	285.4	2.600	0.0	291.2	4.000	0.0	291.2			

Cellular Storage Manhole: S23, DS/PN: S10.001

Invert Level (m) 7.300 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.94
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	364.0	364.0	1.400	0.0	402.2	2.800	0.0	402.2	4.200	0.0	402.2
0.200	364.0	379.3	1.600	0.0	402.2	3.000	0.0	402.2	4.400	0.0	402.2
0.400	364.0	394.5	1.800	0.0	402.2	3.200	0.0	402.2	4.600	0.0	402.2
0.600	0.0	402.2	2.000	0.0	402.2	3.400	0.0	402.2	4.800	0.0	402.2
0.800	0.0	402.2	2.200	0.0	402.2	3.600	0.0	402.2	5.000	0.0	402.2
1.000	0.0	402.2	2.400	0.0	402.2	3.800	0.0	402.2			
1.200	0.0	402.2	2.600	0.0	402.2	4.000	0.0	402.2			

Cellular Storage Manhole: S26, DS/PN: S11.001

Invert Level (m) 7.300 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.94
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	273.0	273.0	1.400	0.0	306.0	2.800	0.0	306.0	4.200	0.0	306.0
0.200	273.0	286.2	1.600	0.0	306.0	3.000	0.0	306.0	4.400	0.0	306.0
0.400	273.0	299.4	1.800	0.0	306.0	3.200	0.0	306.0	4.600	0.0	306.0
0.600	0.0	306.0	2.000	0.0	306.0	3.400	0.0	306.0	4.800	0.0	306.0
0.800	0.0	306.0	2.200	0.0	306.0	3.600	0.0	306.0	5.000	0.0	306.0
1.000	0.0	306.0	2.400	0.0	306.0	3.800	0.0	306.0			
1.200	0.0	306.0	2.600	0.0	306.0	4.000	0.0	306.0			

Cellular Storage Manhole: S27, DS/PN: S9.004

Invert Level (m) 7.006 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.94
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	120.0	130.0	1.400	0.0	152.8	2.800	0.0	152.8	4.200	0.0	152.8
0.200	120.0	139.1	1.600	0.0	152.8	3.000	0.0	152.8	4.400	0.0	152.8
0.400	120.0	148.2	1.800	0.0	152.8	3.200	0.0	152.8	4.600	0.0	152.8
0.600	0.0	152.8	2.000	0.0	152.8	3.400	0.0	152.8	4.800	0.0	152.8
0.800	0.0	152.8	2.200	0.0	152.8	3.600	0.0	152.8	5.000	0.0	152.8
1.000	0.0	152.8	2.400	0.0	152.8	3.800	0.0	152.8			
1.200	0.0	152.8	2.600	0.0	152.8	4.000	0.0	152.8			

Cellular Storage Manhole: S33, DS/PN: S1.006

Invert Level (m) 6.300 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.94
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Cellular Storage Manhole: S33, DS/PN: S1.006

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	2800.0	2800.0	1.400	0.0	3075.2	2.800	0.0	3075.2	4.200	0.0	3075.2
0.200	2800.0	2842.3	1.600	0.0	3075.2	3.000	0.0	3075.2	4.400	0.0	3075.2
0.400	2800.0	2884.7	1.800	0.0	3075.2	3.200	0.0	3075.2	4.600	0.0	3075.2
0.600	2800.0	2927.0	2.000	0.0	3075.2	3.400	0.0	3075.2	4.800	0.0	3075.2
0.800	2800.0	2969.3	2.200	0.0	3075.2	3.600	0.0	3075.2	5.000	0.0	3075.2
1.000	2800.0	3011.7	2.400	0.0	3075.2	3.800	0.0	3075.2			
1.200	2800.0	3054.0	2.600	0.0	3075.2	4.000	0.0	3075.2			

Manhole Headloss for Storm

PN	US/MH Name	US/MH Headloss
S1.000	S2	0.500
S2.000	S3	0.500
S1.001	S3	0.500
S3.000	S4	0.500
S4.000	S6	0.500
S5.000	S6	0.500
S1.002	S5	0.500
S6.000	S9	0.500
S1.003	S10	0.500
S7.000	S11	0.500
S1.004	S13	0.500
S8.000	S12	0.500
S8.001	S14	0.500
S1.005	S14	0.500
S9.000	S20	0.500
S9.001	S21	0.500
S9.002	S21	0.500
S10.000	S22	0.500
S10.001	S23	0.500
S9.003	S24	0.500
S11.000	S25	0.500
S11.001	S26	0.500
S9.004	S27	0.500
S12.000	S28	0.500
S9.005	S29	0.500
S13.000	S30	0.500
S9.006	S31	0.500
S14.000	S31	0.500
S9.007	S33	0.500
S1.006	S33	0.500
S1.007	S34	0.500
S1.008	S34	0.000
S15.000	S34	0.500
S15.001	S35	0.500

Manhole Headloss for Storm

PN	US/MH Name	US/MH Headloss
S15.002	S36	0.500
S1.009	S39	0.500
S1.010	S33	0.500

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 6 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 331126 371270 SJ 31126 71270 Cv (Summer) 0.750
FEH Rainfall Version 2013 Data Type Point Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 100.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440, 10080
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S2	15 Winter	100	+20%	30/15 Summer				9.400	0.600	0.000	1.22		146.8	FLOOD RISK	
S2.000	S3	15 Winter	100	+20%	100/15 Summer				9.279	0.479	0.000	0.94		77.9	SURCHARGED	
S1.001	S3	15 Winter	100	+20%	30/15 Summer				9.133	0.673	0.000	1.35		209.1	SURCHARGED	
S3.000	S4	30 Winter	100	+20%					8.748	-0.052	0.000	0.70		108.3	OK	
S4.000	S6	15 Winter	100	+20%	100/15 Summer				8.865	0.065	0.000	1.10		168.2	SURCHARGED	
S5.000	S6	15 Winter	100	+20%	100/15 Winter				8.820	0.020	0.000	1.06		81.4	SURCHARGED	
S1.002	S5	30 Winter	100	+20%	30/15 Summer				8.717	0.842	0.000	1.90		204.0	SURCHARGED	
S6.000	S9	15 Winter	100	+20%	30/15 Summer				8.937	0.637	0.000	2.69		193.5	SURCHARGED	
S1.003	S10	30 Winter	100	+20%	30/15 Summer				8.294	0.544	0.000	1.62		264.2	SURCHARGED	
S7.000	S11	15 Winter	100	+20%	30/15 Summer				8.681	0.381	0.000	1.71		110.5	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.004	S13	15 Winter	100	+20%	100/15 Summer				7.819	0.194	0.000	1.21		343.4	SURCHARGED	
S8.000	S12	15 Winter	100	+20%	30/15 Summer				8.522	0.322	0.000	1.55		117.8	SURCHARGED	
S8.001	S14	15 Winter	100	+20%	100/15 Winter				8.112	0.007	0.000	1.06		140.5	SURCHARGED	
S1.005	S14	15 Winter	100	+20%	100/15 Winter				7.523	0.023	0.000	1.13		478.6	SURCHARGED	
S9.000	S20	15 Winter	100	+20%	100/15 Summer				8.553	0.653	0.000	0.60		50.9	SURCHARGED	
S9.001	S21	15 Winter	100	+20%	30/15 Summer				8.504	0.787	0.000	1.35		107.8	SURCHARGED	
S9.002	S21	15 Winter	100	+20%	30/15 Winter				8.414	0.777	0.000	1.22		96.9	SURCHARGED	
S10.000	S22	15 Winter	100	+20%	30/15 Summer				8.412	0.612	0.000	2.49		297.8	SURCHARGED	
S10.001	S23	60 Winter	100	+20%	100/15 Winter				8.341	0.666	0.000	0.74		82.8	SURCHARGED	
S9.003	S24	15 Winter	100	+20%	30/15 Winter				8.334	0.770	0.000	0.99		151.7	SURCHARGED	
S11.000	S25	30 Winter	100	+20%	30/15 Summer				8.380	0.580	0.000	1.33		183.5	SURCHARGED	
S11.001	S26	30 Winter	100	+20%	100/15 Summer				8.358	0.683	0.000	0.76		105.1	SURCHARGED	
S9.004	S27	30 Winter	100	+20%	30/15 Summer				8.282	0.901	0.000	1.39		190.5	SURCHARGED	
S12.000	S28	15 Winter	100	+20%	100/15 Summer				8.144	0.344	0.000	0.32		85.7	SURCHARGED	
S9.005	S29	15 Winter	100	+20%	30/15 Summer				8.124	0.801	0.000	1.33		182.9	SURCHARGED	
S13.000	S30	15 Winter	100	+20%	30/15 Summer				8.111	0.811	0.000	1.17		132.4	SURCHARGED	
S9.006	S31	15 Winter	100	+20%	30/15 Summer				7.981	0.773	0.000	1.65		271.7	SURCHARGED	
S14.000	S31	15 Winter	100	+20%					7.618	-0.182	0.000	0.65		302.4	OK	
S9.007	S33	960 Winter	100	+20%	30/15 Summer				7.350	0.307	0.000	0.29		83.5	SURCHARGED	
S1.006	S33	960 Winter	100	+20%	30/30 Winter				7.347	0.672	0.000	0.15		18.9	SURCHARGED	
S1.007	S34	15 Winter	100	+20%					6.080	-0.295	0.000	0.10		18.9	OK	
S1.008	S34	60 Winter	100	+20%					5.854	-0.146	0.000	0.23		21.0	OK	
S15.000	S34	15 Winter	100	+20%					6.617	-0.183	0.000	0.32		46.7	OK	
S15.001	S35	15 Winter	100	+20%					5.207	-0.093	0.000	0.80		47.0	OK	
S15.002	S36	60 Winter	100	+20%					5.147	-0.253	0.000	0.02		24.6	OK	
S1.009	S39	60 Winter	100	+20%	30/15 Summer				5.147	0.347	0.000	0.34		26.8	SURCHARGED	
S1.010	S33	15 Summer	100	+20%					4.437	-0.463	0.000	0.04		26.8	OK	

Appendix 7

Dwr Cymru Welsh Water – Foul Water Response and Assets Map

Dŵr Cymru
Welsh Water

Developer Services
PO Box 3146
Cardiff
CF30 0EH

Tel: +44 (0)800 917 2652
Fax: +44 (0)2920 740472
E.mail: developer.services@dwrcymru.com

Gwasanaethau Datblygu
Blwch Post 3146
Caerdydd
CF30 0EH

Ffôn: +44 (0)800 917 2652
Ffacs: +44 (0)2920 740472
E.bost: developer.services@dwrcymru.com

Mr Bruce Wickham
TerraConsult
Bold Business Centre
Bold Lane Sutton
St Helens
Merseyside
WA9 4TX

Date: 05/02/2018
Our Ref: PPA0002769

Dear Mr Wickham

Grid Ref: 331101 371241
Site Address: 49 Weighbridge Rd Deeside
Development: 3484-ArrowBio Plant

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

SEWERAGE

The domestic foul flows only from the proposed development can be accommodated within the public sewerage system. We advise that the flows should be communicated to the foul sewer between manholes SJ31712356 and SJ31712257 located along the eastern boundary.

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. The discharge of trade effluent may need to be attenuated to ensure the receiving public sewer has adequate capacity. In order to assess this aspect further we welcome further information regarding the likely trade effluent discharge.

Should a planning application be submitted for this development we will seek to control these points of communication and a drainage strategy via appropriate planning conditions and therefore recommend that any drainage layout or strategy submitted as part of your application takes this into account. We therefore recommend that early discussions commence to establish an effective drainage strategy in advance of a planning application being submitted to the Local Planning Authority. However, should you wish for an alternative connection point to be considered please provide further information to us in the form of a drainage strategy, preferably in advance of a planning application being submitted.

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.

The drainage network in the vicinity of the proposed development is foul only, therefore with reference to the surface water flows we would not consider the communication of these flows to the public sewerage 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. You may need to apply to Dwr Cymru Welsh Water for any connection to the public sewer under Section 106 of the Water industry Act 1991. However, if the connection to the public sewer network is either via a lateral drain (i.e. a drain which extends beyond the connecting property boundary) or via a new sewer (i.e. serves more than one property), it is now a mandatory requirement to first enter into a Section 104 Adoption Agreement (Water Industry Act 1991). The design of the sewers and lateral drains must also conform to the Welsh Ministers Standards for Foul Sewers and Lateral Drains, and conform with the publication "Sewers for Adoption"- 7th Edition. Further information can be obtained via the Developer Services pages of www.dwrcymru.com

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

SEWAGE TREATMENT

No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site. If the proposed development is of an industrial or commercial nature, the developer is required to obtain a license to discharge trade effluent. The authorization of this planning application does not exclude the requirement to obtain a Letter of Authorization for trade effluent discharges.

WATER SUPPLY

A water supply can be made available to service this proposed development. However, this would require the installation of off-site mains from our '6" CI' diameter watermain in 'grid 330926,371262' location. Under Sections 40 - 41 of the Water Industry Act 1991 the above cost is requisitionable and, subject to us receiving your detailed site layout plan and your programme for construction, we would be able to provide a more accurate assessment of the developer's contribution. These details should be sent to the above address.

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

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

Please quote our reference number in all communications and correspondence.

Yours faithfully,

[redacted]

Owain George
Planning Liaison Manager
Developer Services

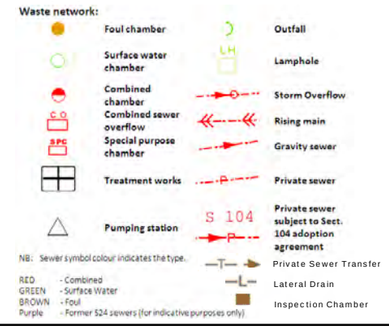
<u>Please Note</u> that demands upon the water and sewerage systems change continually; consequently the information given above should be regarded as reliable for a maximum period of 12 months from the date of this letter.

Dŵr Cymru
Welsh Water

49 Weighbridge Rd

N
W E
S

LEGEND(Representative of most common features)



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

Dwr Cymru Cyf gives this information as to the position of its underground apparatus by way of general guidance only on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the Company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. It must be understood that the furnishing of the information is entirely without prejudice to the provision of the New Roads and Streetworks Act 1991 and of the Company's right to be compensated for any damage to its apparatus.

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

EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

Map Ref:	331012,371239
Map scale:	1:2500
Printed by:	Parker Amanda
Printed on:	31 Oct 2017

Bruce Wickham

From: Gaskin Louise <Louise.Gaskin@dwrcymru.com>
Sent: 22 March 2018 11:49
To: Bruce Wickham
Subject: RE: Exisitng Trade effluent Dischagre Consent

Hi Bruce,

I have spoken with our Network manager. 15 litres per second would not be possible, 5 litres per second should be acceptable.

Kind regards,
Louise

Louise Gaskin
Trade Effluent Officer
| Science & Business Improvement | Trade Effluent |Dwr Cymru Welsh Water
Kinmel Park Depot, Royal Welch Avenue, Bodelwyddan, Denbighshire, LL19 5TQ
☎: 07392282591
☎: 01286 832961
✉Louise.Gaskin@Dwrcymru.com

Dŵr Cymru
Welsh Water

From: Bruce Wickham [mailto:brucewickham@terraconsult.co.uk]
Sent: 15 March 2018 12:02
To: Gaskin Louise <Louise.Gaskin@dwrcymru.com>
Cc: Deepak Kharat <deepakkharat@terraconsult.co.uk>
Subject: RE: Exisitng Trade effluent Dischagre Consent

******** External Mail ********
Hi Louise,

Thanks for getting back to me. As for the chlorine treatment, I am not sure what levels the treated trade effluent will have for chloride or free chlorine, I will find this out from the client.

I will aim to have the compete the application froms ready and submitted to you either on Friday or early next week.

Kind regards,

Bruce Wickham

Environmental Engineer

01925 291111

TerraConsult

St Helens: Bold Business Centre, Bold Lane, Sutton, St. Helens, WA9 4TX **Tel:** +44 (0)1925 291111
Colchester: Dugard House, Peartree Road, Colchester, Essex, CO3 0UL **Tel:** +44 (0)1206 585600
Email: mailbox@terraconsult.co.uk **Website:** www.terraconsult.co.uk

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From: Gaskin Louise [mailto:Louise.Gaskin@dwrcymru.com]
Sent: 15 March 2018 11:56
To: Bruce Wickham
Subject: FW: Exisitng Trade effluent Dischagre Consent

Good Morning,

I can confirm there was a trade effluent consent held by GDF Suez Shotton. This was surrendered by them once all infrastructure was removed from the site to prevent any illegal discharge to sewer. The consent was formally revoked in March 2015, as such I do not have a copy readily available.
Each application is assessed on a case by case basis and as such any previous consents held are not considered when assessing new applications.

Kind regards,
Louise

Louise Gaskin
Trade Effluent Officer
| Science & Business Improvement | Trade Effluent |Dwr Cymru Welsh Water
Kinmel Park Depot, Royal Welch Avenue, Bodelwyddan, Denbighshire, LL19 5TQ
☎: 07392282591
☎: 01286 832961
✉Louise.Gaskin@Dwrcymru.com

Dŵr Cymru
Welsh Water

From: Bruce Wickham [mailto:brucewickham@terraconsult.co.uk]
Sent: 14 March 2018 12:35
To: Trade Effluent <Trade.Effluent@dwrcymru.com>
Subject: Exisitng Trade effluent Dischagre Consent

******** External Mail ********
Dear Sir/ Madam,

I would like to enquire about an existing (or previous) trade effluent Consent to Discharge for the previous PowerStation (CHP Shotton Power station) located at the following address: 49 Weighbridge Rd, Deeside, CH5 2LF (See attachment for more details). Could you check your resister to see if you have a record of the trade effluent Consent to Discharge, and forward it to me please.

Kind regards,

Bruce Wickham

Environmental Engineer

01925 291111

TerraConsult

St Helens: Bold Business Centre, Bold Lane, Sutton, St. Helens, WA9 4TX **Tel:** +44 (0)1925 291111

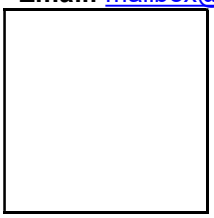
Colchester: Dugard House, Peartree Road, Colchester, Essex, CO3 0UL **Tel:** +44 (0)1206 585600

Email: mailbox@terraconsult.co.uk **Website:** www.terraconsult.co.uk

St Helens: Bold Business Centre, Bold Lane, Sutton, St. Helens, WA9 4TX **Tel:** +44 (0)1925 291111

Colchester: Dugard House, Peartree Road, Colchester, Essex, CO3 0UL **Tel:** +44 (0)1206 585600

Email: mailbox@terraconsult.co.uk **Website:** www.terraconsult.co.uk



St Helens: Bold Business Centre, Bold Lane, Sutton, St. Helens, WA9 4TX **Tel:** +44 (0)1925 291111

Colchester: Dugard House, Peartree Road, Colchester, Essex, CO3 0UL **Tel:** +44 (0)1206 585600

Email: mailbox@terraconsult.co.uk **Website:** www.terraconsult.co.uk

_____ Dwr Cymru Welsh Water is firmly committed to water conservation and promoting water efficiency. Please log on to our website www.dwrcymru.com/waterefficiency to find out how you can become water wise. Mae Dwr Cymru Welsh Water wedi ymrwymo i warchod adnoddau dwr a hyrwyddo defnydd dwr effeithiol. Mae cyngor i' ch helpu i ddefnyddio dwr yn ddoeth yn www.dwrcymru.com/waterefficiency

_____

********** This email and any file attached is confidential. If you are not a named recipient or believe you may have received this email in error please delete from your system and promptly inform the sender. Dwr Cymru Cyf (trading as Welsh Water) is a company registered in England and Wales, number 02366777, registered office Pentwyn Road, Nelson, Treharris, Mid Glamorgan CF46 6LY. Mae'r neges e-bost yma ac unrhyw ffeil sydd ynghlwm wrthi'n gyfrinachol. Os nad chi yw'r derbynnydd a enwir, neu os ydych chi'n credu eich bod wedi derbyn y neges yma ar gam, dylech ei dileu o'ch system ar unwaith a hysbysu'r anfonwr. Cwmni sydd wedi ei

gofrestru yng Nghymru yw Dŵr Cymru Cyf (yn masnachu fel Dŵr Cymru), ei rif cofrestredig yw 02366777, ac mae ei swyddfa gofrestredig yn Heol Pentwyn, Nelson, Treharris, Morgannwg Ganol CF46 6LY. **********

Appendix 8

Microdrainage Analyses – Foul Water Drainage

Time Area Diagram for Foul - Main

Time (mins)	Area (ha)
0-4	0.000

Total Area Contributing (ha) = 0.000

Total Pipe Volume (m^3) = 4.459

Existing Network Details for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
F1.000	38.000	0.475	80.0	0.000	2.00	4.6	1.500	o	150	Pipe/Conduit
F1.001	45.000	0.563	80.0	0.000	0.00	0.0	1.500	o	150	Pipe/Conduit
F1.002	58.000	0.725	80.0	0.000	0.00	0.0	1.500	o	150	Pipe/Conduit
F2.000	13.000	0.650	20.0	0.000	2.00	0.5	1.500	o	150	Pipe/Conduit
F1.003	41.000	0.513	80.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit
F1.004	2.700	0.034	80.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
F1.000	9.350	0.000	4.6	0.98	17.3
F1.001	8.875	0.000	4.6	0.98	17.3
F1.002	8.313	0.000	4.6	0.98	17.3
F2.000	8.350	0.000	0.5	1.96	34.7
F1.003	7.588	0.000	5.1	1.28	51.1
F1.004	7.076	0.000	5.1	1.28	51.1

Manhole Schedules for Foul - Main

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
F1	10.000	0.650	Open Manhole	1200	F1.000	9.350	150				
F2	9.800	0.925	Open Manhole	1200	F1.001	8.875	150	F1.000	8.875	150	
F3	9.400	1.088	Open Manhole	1200	F1.002	8.313	150	F1.001	8.313	150	
F7	9.000	0.650	Open Manhole	1200	F2.000	8.350	150				
F8	9.100	1.512	Open Manhole	1200	F1.003	7.588	225	F1.002	7.588	150	
								F2.000	7.700	150	37
F9	8.500	1.425	Open Manhole	1200	F1.004	7.076	225	F1.003	7.076	225	
F	8.500	1.458	Open Manhole	0		OUTFALL		F1.004	7.042	225	

PIPELINE SCHEDULES for Foul - Main

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	o	150	F1	10.000	9.350	0.500	Open Manhole	1200
F1.001	o	150	F2	9.800	8.875	0.775	Open Manhole	1200
F1.002	o	150	F3	9.400	8.313	0.937	Open Manhole	1200
F2.000	o	150	F7	9.000	8.350	0.500	Open Manhole	1200
F1.003	o	225	F8	9.100	7.588	1.287	Open Manhole	1200
F1.004	o	225	F9	8.500	7.076	1.199	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	38.000	80.0	F2	9.800	8.875	0.775	Open Manhole	1200
F1.001	45.000	80.0	F3	9.400	8.313	0.938	Open Manhole	1200
F1.002	58.000	80.0	F8	9.100	7.588	1.362	Open Manhole	1200
F2.000	13.000	20.0	F8	9.100	7.700	1.250	Open Manhole	1200
F1.003	41.000	80.0	F9	8.500	7.076	1.200	Open Manhole	1200
F1.004	2.700	80.0	F	8.500	7.042	1.233	Open Manhole	0

Area Summary for Foul - Main

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.000	0.000	0.000
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
2.000	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.000	0.000	0.000

Network Classifications for Foul - Main

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
F1.000	F1	150	0.500	0.775	Unclassified	1200	0	0.500	Unclassified
F1.001	F2	150	0.775	0.938	Unclassified	1200	0	0.775	Unclassified
F1.002	F3	150	0.937	1.362	Unclassified	1200	0	0.937	Unclassified
F2.000	F7	150	0.500	1.250	Unclassified	1200	0	0.500	Unclassified
F1.003	F8	225	1.200	1.287	Unclassified	1200	0	1.287	Unclassified
F1.004	F9	225	1.199	1.233	Unclassified	1200	0	1.199	Unclassified

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.004	F	8.500	7.042	0.000	0	0

Simulation Criteria for Foul - Main

Volumetric Runoff Coeff	0.840	Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000
Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000	Run Time (mins)	60
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Region	England and Wales	Ratio R	0.370
Return Period (years)	100	M5-60 (mm)	18.000	Profile Type	Winter

Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

Manhole Headloss for Foul - Main

PN	US/MH Name	US/MH Headloss
F1.000	F1	0.500
F1.001	F2	0.500
F1.002	F3	0.500
F2.000	F7	0.500
F1.003	F8	0.500
F1.004	F9	0.500

Summary of Critical Results by Maximum Level (Rank 1) for Foul - Main

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.370 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 100.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
F1.000	F1	30 Summer	30	+0%					9.403	-0.097	0.000	0.27		4.6	OK	
F1.001	F2	240 Winter	30	+0%					8.928	-0.097	0.000	0.27		4.6	OK	
F1.002	F3	360 Winter	100	+0%					8.366	-0.097	0.000	0.27		4.6	OK	
F2.000	F7	15 Summer	30	+0%					8.361	-0.139	0.000	0.02		0.5	OK	
F1.003	F8	60 Winter	100	+0%					7.636	-0.177	0.000	0.10		5.1	OK	
F1.004	F9	480 Summer	30	+0%					7.138	-0.163	0.000	0.17		5.1	OK	