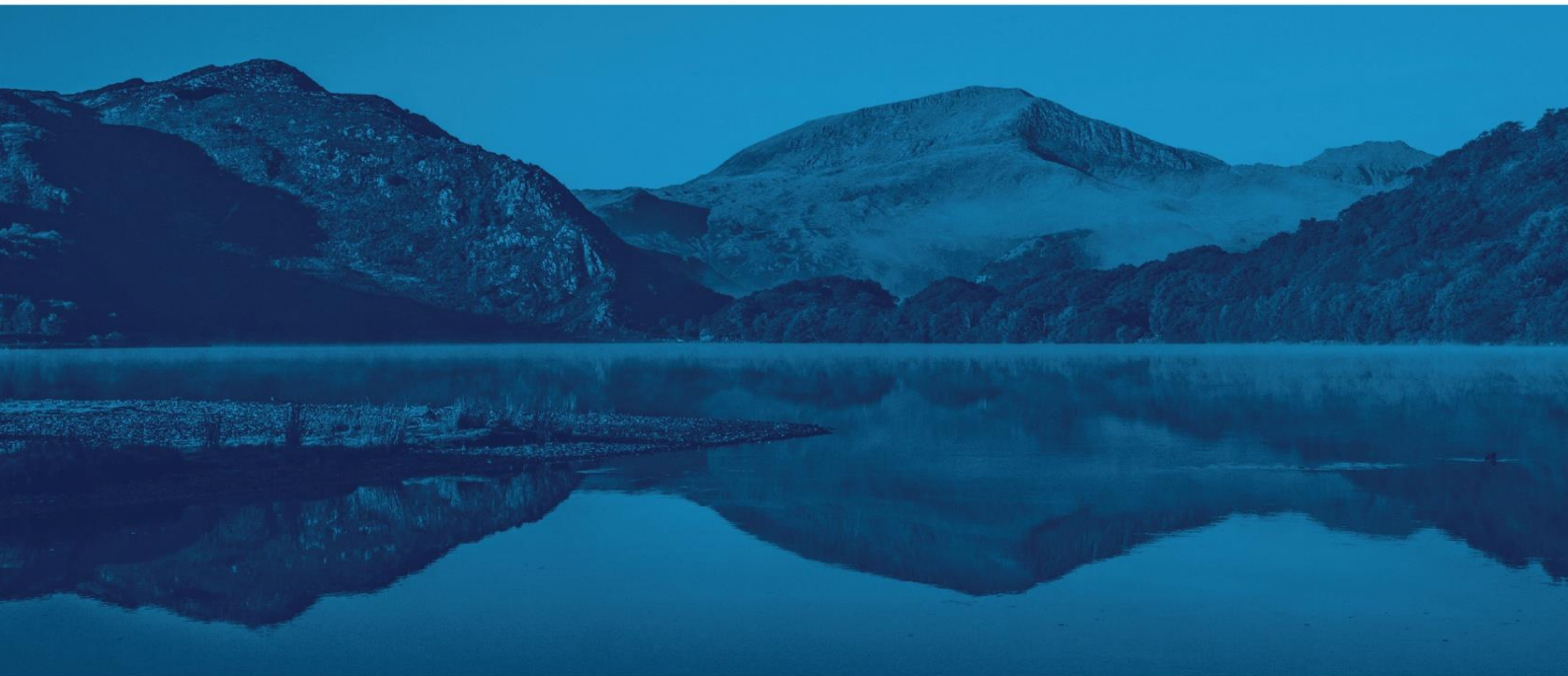




Cinders Farm, Wrexham

Flood Consequences Assessment & Drainage Strategy

January 2018



Assessment / Modelling / Design

waterco.co.uk

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Contents

Introduction	1
Existing Conditions	1
Development Proposals	2
Flood Zone Category and Policy Context	3
Consultation	5
Sources of Flooding and Probability	7
Surface Water Management	10
Surface Water Treatment	14
Maintenance	15
Foul Drainage	16
Conclusions	17
Recommendations	19

Appendices

Appendix 11.1.1 – Location Plan & Aerial Image
Appendix 11.1.2 – Topographical Data
Appendix 11.1.3 – Flood Maps
Appendix 11.1.4 – WCBC Correspondence
Appendix 11.1.5 – NRW Correspondence
Appendix 11.1.6 – ReFH2 Runoff Rates
Appendix 11.1.7 – MicroDrainage Storage Volumes
Appendix 11.1.8 – Concept Drainage Sketch
Appendix 11.1.9 – Maintenance Schedules

Tables

Table 1 – Pollution Hazard Indices.....	15
--	----

Table 2 – SuDS Mitigation Indices	15
--	----

Introduction

Waterco Consultants have been instructed to prepare a Flood Consequences Assessment (FCA) and Drainage Strategy in respect of a proposed agricultural development at Cinders Farm, Ruabon, Wrexham, LL14 6HL.

The purpose of this report is to outline the potential flood risk to the site, the impact of the proposed development on flood risk elsewhere, and the proposed measures which could be incorporated to mitigate the identified flood risk. This report has been prepared in accordance with the guidance contained in Planning Policy Wales (PPW) and Technical Advice Note 15 (TAN15): Development and Flood Risk. Reference has also been made to the Wrexham County Borough Council (WCBC) Preliminary Flood Risk Assessment (PFRA) (June 2011).

From April 2015, WCBC as the Lead Local Flood Authority (LLFA) is a statutory consultee for major planning applications in relation to surface water drainage, requiring that all planning applications are accompanied by a Sustainable Drainage Strategy. The aim of the Sustainable Drainage Strategy is to identify water management measures, including Sustainable Drainage Systems (SuDS), to provide surface water runoff reduction and treatment.

Existing Conditions

The 5.1hectare (ha) site is located at National Grid Reference: 332382E 344047N. A location plan and an aerial image are included in Appendix 11.1.1.

The site is greenfield and is bordered by agricultural land on all sides. Notable features in the area include an unnamed road to the south-east and Cinders Farm to the south. There are also unnamed watercourses located immediately north and south-east of the site. Access to the site is provided from the unnamed road to the south-east.

Local Topography

A Topographical Survey has been undertaken by A.R.M. Surveys Ltd in July 2017 and is submitted with the planning application pack (drawing reference: 755-0717-T). The Topographical Survey shows that the site slopes from 102.25 metres Above Ordnance Datum (m AOD) in the west to 95.79m AOD in the east.

Topographic levels to m AOD have also been derived from a 2m resolution Natural Resources Wales (NRW) composite 'Light Detecting and Ranging' (LiDAR) Digital Terrain Model (DTM). LiDAR data only covers the north-western extent of the site. A review of LiDAR data shows that the topography of the site generally slopes from south-west to north-east. A LiDAR extract is included in Appendix 11.1.2.

Ground Conditions

Reference to the British Geological Survey online mapping (1:50,000 scale) indicates that the majority of the site is underlain by superficial deposits of Devensian Till, generally comprising Diamicton. The eastern extent of the site is underlain by Devensian Glaciofluvial Deposits generally comprising Sand and Gravel.

The superficial deposits are identified as being underlain by the Salop Formation consisting of Mudstone, Sandstone and Conglomerate.

According to the Environment Agency's online Groundwater Vulnerability Mapping, the superficial Devensian Till is classified as unproductive strata having low permeability and negligible significance for water supply or river base flow. The Devensian Glaciofluvial Deposits are classified as a Secondary A aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases form an important source of base flow to rivers. The underlying bedrock is also described as a Secondary A aquifer.

The Cranfield University 'Soilscapes' map indicates that the site is underlain by 'slowly permeable seasonally wet loamy and clayey soils' with 'impeded drainage'.

Local Drainage

The Dwr Cymru Welsh Water sewer records show that there are no public sewers within the vicinity of the site.

Development Proposals

The proposed development is for the erection of four agricultural buildings for rearing livestock (table fowl); ancillary buildings and plant; associated infrastructure; and landscaping. It is proposed to form a level development platform in the location of the four agricultural buildings. The development platform will be set at 98.5m AOD. A Biomass Building is proposed in the south-eastern extent of the

site. The Biomass Building will be situated on land at approximately 98m AOD. An access road will be provided off the unnamed road to the east, culverting a section of the unnamed watercourse. A proposed site layout plan and site cross sections are submitted with the planning application (drawing references GM-MZ228-181 and GM-MZ228-301 respectively).

The proposed development will introduce hardstanding areas in the form of buildings, an access road and concrete aprons. Hardstanding will comprise 1.52ha or 30% of the total site area. The remaining permeable, soft landscaped areas, including stone surrounds to the buildings will occupy 3.58ha or 70% of the total site area.

Flood Zone Category and Policy Context

Flood Zone Category

The Welsh Government Development Advice Map included in Appendix 11.1.3 shows that the site is located within Flood Zone A – an area considered to be at little / no risk of fluvial or tidal flooding, with a less than 0.1% (1 in 1000) annual probability of flooding.

The NRW 'Flood Map for Planning' included in Appendix 11.1.3 shows that the site is located within an area outside of the extreme flood extent (Flood Zone 1), meaning it has a less than 0.1% annual probability of flooding.

National Planning Policy

The proposed agricultural development is considered to be 'less vulnerable' in accordance with Figure 2 of the Welsh Government's Technical Advice Note 15 – Development and Flood Risk (TAN15).

The site will be located wholly within Flood Zone A. In accordance with Section 9 of TAN15, 'less vulnerable' development is considered acceptable in Flood Zone A subject to demonstrating no increase in flood risk elsewhere.

Local Planning Policy

The Wrexham Unitary Development Plan (UDP) 1996 – 2011 was adopted in February 2005 and is the current UDP for the area. The UDP contains the following policies in relation to flood risk and sustainable drainage:

Development and Flood Risk

Policy EC12 Development (including the raising of land) within defined flood plains will only be permitted if it:-

- a) would not be subject to an unacceptable risk of flooding on-site; and/or
- b) does not result in an unacceptable risk of flooding on or off-site; and/or
- c) does not adversely affect flood management or maintenance schemes.

Surface Water Run-off

Policy EC13 Development which would result in an unacceptable adverse impact on the water environment due to additional surface water run-off will not be permitted.

5.18 Development on green field sites usually results in an increase in the amount of impermeable land. This can alter the natural water cycle as rates and volumes of surface water reaching a watercourse generally increase. Drains and sewers generally convey surface water from impermeable areas directly, or via a sewerage system, to a watercourse. Such arrangements not only reduce the natural recharge of groundwater, which wastes a valuable resource and increases pollution risk (for example from contaminated urban run-off and combined sewage overflows) but can also increase river flows. Increased river flows can cause physical damage to the banks and bed of a watercourse, and increase the risk of flooding.

5.19 Wherever practicable surface water should be disposed of as close to the source as possible. Where potential risks are identified appropriate flow attenuation facilities or mitigation measures may be a pre-requisite for development. Consideration should be given to the use of softer engineering structures referred to as Sustainable Urban Drainage Systems (SUDS). SUDS is a concept that focuses decisions about drainage design, construction and maintenance on the quality of the receiving environment and people. SUDS are physical structures built to receive surface water runoff. They typically include swales, ponds, infiltration basins and porous surfaces and should be considered as alternatives to conventional drainage where appropriate. The Environment Agency Wales can provide guidance on the design of SUDS and have produced a document entitled "Protecting the Quality of Our Environment, Sustainable Urban Drainage Systems – An Introduction". The Council will require the developer to demonstrate, both financially and practically, how the long term maintenance of any attenuation facilities or mitigation measures will be achieved.

Protection of Controlled Waters

Policy EC14 *Development which would have an unacceptable adverse impact upon the capacity, flow, quality or availability of controlled waters and associated land will not be permitted.*

The WCBC Preliminary Flood Risk Assessment (PFRA) (June 2011) has been reviewed for site specific flooding information.

Consultation

WCBC as the LLFA have been consulted to establish any site-specific requirements in relation to flood risk and surface water drainage. WCBC correspondence, dated 12th October 2017, is included in Appendix 11.1.4 and states:

'We hold no specific information in relation to the local drainage network or recorded incidents of flooding in the vicinity.

The attached guidance note will provide details of the information we would normally expect to see included within any drainage strategy for the proposed development and expected flows/discharge. Consideration of a 30% increase in rainfall is normally accepted to represent the impacts of climate change unless better evidence becomes available.'

The guidance note referred to in the above response comprises the 'WCBC Management of Surface Water Generated from New Development', adopted September 2015. The guidance states:

Protection of Controlled Waters

Wrexham County Borough Council advocates that surface water run-off should be controlled as near to its source as possible. Preferably sustainable drainage systems (SuDS) should be utilised. The variety of SuDS techniques available means that virtually any development should be able to include a scheme based around these principles. Surface water should be disposed of to the receptors listed in order of priority below:

- a) infiltrated to ground;*
- b) to a watercourse;*
- c) to a surface water sewer;*
- d) other*

Undeveloped (Greenfield) Sites:

Discharge rates and volumes are normally required to be limited to the equivalent greenfield runoff rate (with on-site attenuation for all events up to the 1% (1 in 100 year) rainfall event with an appropriate allowance for climate change) ...

Storage of Water on Site:

The drainage system should be designed so that flooding does not occur on any part of the development for the 3.33% (1 in 30 year) rainfall event other than in those areas/systems designated to store or convey water. It may be acceptable to allow some on-site flooding of roads etc. for rainfall events beyond this. However flooding within the development site should not occur in any part of a building or utility plant susceptible to water during a 1% (1 in 100 year) + climate change rainfall event.

Practicable Minimum Limit of Discharge:

A practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating to a satisfactorily low flow rate while keeping the risk of blockage to an acceptable level. It is suggested that this is 5 litres per second, using an appropriate vortex flow control device or other technically acceptable flow control device. The minimum size of pipe discharging from a flow attention device should be 150mm laid at a gradient not flatter than 1 in 150, which meets the requirements of Sewers for Adoption 7th Edition.'

NRW have also been contacted for a pre-planning opinion. Correspondence dated 26th October 2017 is included in Appendix 11.1.5. In relation to flood risk, NRW state:

'A watercourse flows along part of the site boundary. The watercourse is classified as that of an 'ordinary' watercourse (rather than a main river) and as such there may be a local flood risk associated with the watercourse. Due to the relative small catchment size of the watercourse (less than 3km²), it has not been captured by our nationalised modelling technique to generate our flood zones. We would advise that you approach Wrexham Council's Flood and Water management team who may be able to advise on possible flood risk from the adjacent watercourse along with requirements for any surface water drainage design/strategy associated with the proposal.

Surface water drainage should mimic existing runoff rates/volumes and post development rates should not be increased. The use of Sustainable drainage systems would be supported.'

Following NRW correspondence, Waterco Consultants contacted WCBC with regards to the scope of assessment required to determine the flood risk from adjacent watercourses. The following scope was put forward by Waterco:

'Each watercourse originates within 470m of the site. Therefore, it can be assumed that the watercourses do not serve a significant catchment and would not convey significant flow. The NRW 'Flood Map for Surface Water' shows the flood risk from surface water and minor watercourses. The map identifies flow routes should the unnamed watercourses exceed their capacity. As you can see from the map, flooded areas are confined to land immediately adjacent to the watercourses during all events including the 1 in 1000 year event. No flooding is estimated in areas where development is proposed. The LiDAR plan shows that site levels are elevated above watercourse levels.'

Please can you advise if you are happy with the above approach to assessing flood risk from these watercourses and confirm that a more detailed (modelling) assessment will not be required.'

WCBC responded on 10th November 2017, with correspondence included in Appendix 11.1.4 stating 'I have reviewed your suggested proposal and would agree with the approach proposed. I would suggest considering the impact of any structures on the watercourse and implications of blockage/failure.'

Sources of Flooding and Probability

Fluvial

The site is bordered to the north and south-east by unnamed watercourses. The unnamed watercourse in the south-east flows north-east along the south-eastern boundary before crossing under the unnamed road east of the site and continuing south-east. The unnamed watercourse adjacent to the northern boundary of the site flows south-east and converges with the watercourse along the south-eastern boundary before crossing under the unnamed road. There are no other watercourses in the immediate vicinity of the site.

The PFRA contains no records of flooding at the site. The NRW 'Historic Flood Map' included in Appendix 11.1.3 confirms that there have been no recorded flooding incidents at or near to the site.

Detailed flood level data is not currently available for the unnamed watercourses. Therefore, as agreed with the council, an assessment of fluvial flood risk has been made using NRW mapping and topography. The NRW 'Flood Map for Surface Water' (Appendix 11.1.3) shows the flood risk from

surface water and minor watercourses. The map identifies flow routes should the unnamed watercourses exceed their capacity.

The flood extent from the watercourse to the north is shown to be minimal and contained immediately adjacent to the watercourse. The flood extent of the watercourse to the south-east is confined to the south-eastern extent of the site. No flooding is estimated in the location of the proposed buildings. The NRW 'Flood Risk Map' included in Appendix 11.1.3 shows that potential flood depths in the south-eastern extent of the site are estimated to be less than 150mm during the 1 in 1000 annual probability event.

Both watercourses originate within 470m of the site and do not serve a large catchment. As such, the watercourses would not convey significant flow. It is therefore unlikely that the watercourses would exceed their channel capacity.

The development platform containing the four agricultural buildings will be set at 98.5m AOD and approximately 2m above the watercourse to the north and 2.5m above the watercourse to the south-east. The Biomass Building in the south-east will be situated at 98m AOD and a minimum of 2m above the watercourse on the south-eastern boundary. Any potential flooding from these watercourses would therefore not affect the proposed buildings.

A residual risk arises from a blockage of the existing culvert under the unnamed road to the east. In the event of a blockage, flows would back up behind the culvert with flood water behind the culvert inlet reaching a level of 96.27m AOD before spilling over the unnamed road and to the channel downstream. Flooding would be localised to areas immediately upstream of the culvert and the majority of the site, including the location of the proposed buildings, is not at risk should blockage of the culvert occur.

Access to the site will be provided from the unnamed road to the east, which will result in culverting a section of the unnamed watercourse which borders the south-eastern extent of the site. Similar to the existing culvert, in the event of a blockage, flows would back up behind the culvert, before spilling over the unnamed road and to the channel downstream.

The majority of the site, including the proposed buildings, is considered to be at low risk of fluvial flooding.

Tidal

The site is situated at a minimum of 95.79m AOD and is significantly above sea level. The site is therefore not at risk of tidal flooding.

Surface Water

Surface water flooding occurs when rainwater does not drain away through the normal drainage system or soak into the ground. It is usually associated with high intensity rainfall events, but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen or developed, resulting in overland flow and ponding in depressions in topography. Surface water flooding can occur anywhere without warning. However, flow paths can be determined by consideration of contours and relative levels.

The NRW 'Flood Map for Surface Water' map (Appendix 11.1.3) shows that the majority of the site is at very low risk of surface water flooding, meaning it has a less than 0.1% annual probability of flooding. The northern boundary and south-eastern extents of the site are identified at low risk of surface water flooding. Low risk is defined as between a 1% and 0.1% annual probability of flooding. An isolated topographical low in the southern extent of the site is identified at high risk of surface water flooding, meaning it has a greater than 3.3% annual probability of flooding.

The surface water flood risk identified by NRW mapping is associated with the unnamed watercourses to the north and south-east of the site. The associated risk has been reviewed under fluvial flooding. The flood risk to the majority of the site, including the proposed buildings, is low.

The PFRA contains no records of flooding at the site. Any potential surface water flooding arising at or near to the site would be directed east, away from the site, following the local topography.

It can be concluded that the site is at low risk of surface water flooding.

Sewer Flooding

Flooding from sewers can occur when a sewer is overwhelmed by heavy rainfall, becomes blocked, is damaged, or is of inadequate capacity. Flooding is mostly applicable to combined and surface water sewers.

The site is located in a rural area and there are no public sewers in the immediate vicinity of the site. As such, there is no risk of flooding from public sewers.

Groundwater Flooding

Groundwater flooding occurs when water levels underneath the ground rise above normal levels. Prolonged heavy rainfall soaks into the ground and can cause the ground to become saturated. This results in rising groundwater levels which leads to flooding above ground.

The PFRA states that *'there were no records of past groundwater flooding within WCBC; this is due to the topography and geology of the area'*. There are no records of groundwater flooding at or near to the site.

It can therefore be concluded that the risk of groundwater flooding is low.

Artificial Sources of Flooding

There are no canals in the immediate vicinity of the site. The NRW online 'Risk of Flooding from Reservoirs' map shows that the site is not at risk of flooding from reservoirs. It can therefore be concluded that there is no risk of flooding from artificial sources.

Summary of Potential Flooding

It can be concluded that the majority of the site, including the location of the proposed buildings, is at low risk of flooding from all sources. Therefore, no flood risk mitigation measures are considered necessary.

Surface Water Management

The site is currently greenfield and is not served by a formal drainage system.

The proposed development will introduce 1.81ha of hardstanding in the form of buildings, concrete aprons and an access road.

The introduction of hardstanding area will result in an increase in surface water runoff rates and volumes. In order to ensure the proposed development will not increase flood risk elsewhere, surface water discharge from the site will be controlled.

In accordance with TAN15, new development should not create additional runoff when compared with the undeveloped situation.

The WBCB 'Management of Surface Water Generated from New Development' states that for undeveloped (greenfield) sites '*discharge rates and volumes are normally required to be limited to the equivalent greenfield runoff rate.*'

Existing greenfield runoff rates have been estimated using the Revitalised Flood Hydrograph (ReFH2) method (see Appendix 11.1.6). The greenfield 1 in 2-year (equivalent to QMED) runoff rate for the 1.81ha developable area is 13.6 l/s.

Discharge Method

Section 3 of the Welsh Government: 'Recommended non-statutory standards for sustainable drainage (SuDS) in Wales' (2017) includes Standard S1 which sets out the following hierarchy of surface water drainage options:

1. Surface water runoff is collected for use;
2. Surface water runoff is infiltrated to ground;
3. Surface water runoff is discharged to a surface water body;
4. Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system;
5. Surface water runoff is discharged to a combined sewer.

The first consideration for surface water drainage is collection for re-use. The development will seek opportunities for water re-use i.e. re-use of water for the wash down procedure. However, the development only has limited potential for water re-use (wash downs are typically infrequent) and the runoff generated by the development will exceed the water supply requirement. Therefore, the following surface water disposal techniques have been considered:

Infiltration

The first consideration for the disposal of surface water is infiltration (soakaways). As described above, the site is underlain by Devensian Till and Devensian Glaciofluvial Deposits. The Cranfield University 'Soilscales' map indicates that the site is underlain by 'slowly permeable seasonally wet loamy and clayey soils' with 'impeded drainage'.

Given the identified ground conditions, soakaways may not be suitable for surface water disposal. Infiltration tests should be undertaken in accordance with the BRE 365 specification to determine the suitability of soakaways. Soakaways should be located a minimum of 5m from buildings.

Watercourse

Where soakaways are not suitable, a connection to watercourse is the next consideration. There are unnamed watercourses located adjacent to the south-eastern and northern boundaries of the site.

In order to avoid a pumped solution and to mimic the existing greenfield runoff regime, it is proposed to have two separate outfalls to watercourse. An outfall will be formed to the watercourse at the northern boundary and will serve the four proposed agricultural buildings and adjoining hard-standing. A second outfall will be formed to the watercourse on the south-eastern boundary and will serve the proposed Biomass Building, adjoining concrete apron and part of the proposed access road. Gravity discharge appears feasible based on utilising two outfalls.

The greenfield runoff rate of 13.6 l/s has been divided between the two proposed outfall structures.

Discharge to the watercourse north of the site will be restricted to 8.6 l/s. Discharge to the watercourse south-east of the site will be restricted to 5 l/s.

Sewer

There are no public surface water or combined sewers within the vicinity of the site. Therefore, a connection to the public sewer network is not possible.

Attenuation Storage

In order to achieve a greenfield discharge rate, attenuation storage will be required. Attenuation storage estimates are included in Appendix 11.1.7.

Northern Watercourse

Discharge to the northern watercourse will be restricted to 8.6 l/s. To achieve a discharge rate of 8.6 l/s, an estimated storage volume of 984m³ will be required to accommodate the 1 in 100 year plus 30% Climate Change (CC) event. The storage estimate is based on storage within a tank or pond structure, an impermeable drainage area of 13,522m², a design head of 0.6m and hydro-brake flow control.

South-eastern Watercourse

Discharge to the south-eastern watercourse will be restricted to 5 l/s. To achieve a discharge rate of 5 l/s an estimated storage volume of 85m³ will be required to accommodate the 1 in 100 year plus

30% CC event. The storage estimate is based on storage within a tank or pond structure, an impermeable drainage area of 1,709m², a design head of 0.6m and hydro-brake flow control.

The attenuation volumes are provided for indicative purposes only and will be verified during the detailed design stage.

Sustainable Drainage Systems

Attenuation storage should be provided in the form of Sustainable Drainage Systems (SuDS) where practical. The following SuDS options have been considered:

Soakaways

As described above, the use of soakaways should be determined by carrying out infiltration tests in accordance with the BRE 365 specification.

Detention basins and ponds

Sufficient space is available on site to utilise a pond or basin as an above ground attenuation feature. Attenuation ponds are identified on the Site Layout Plan (drawing reference GM-MZ228-181) in the northern extent of the site (serving the agricultural buildings) and in the south-eastern extent of the site (serving the Biomass Building).

Porous / Permeable Paving

The site includes an access road and concrete aprons. These areas would not be suitable for the use of permeable paving due to the movement of heavy goods vehicles on site.

French Drains

The proposed development includes french drains (perforated pipe with stone surround to allow for infiltration and treatment of runoff) located between the four agricultural buildings. The french drains will allow for partial infiltration (subject to infiltration test results) and will provide additional attenuation storage. The amount of attenuation storage offered by french drains will be investigated at the detailed design stage. The size of the downstream attenuation pond could be reduced subject to the storage volume and infiltration capacity of the french drains.

Concept Surface Water Drainage Scheme

Where soakaways are not feasible, surface water runoff will be discharged to the unnamed watercourses located adjacent to the northern and south-eastern boundaries of the site. An outfall

will be formed to the watercourse at the northern boundary and will serve the four proposed agricultural buildings and adjoining hard-standing. A second outfall will be formed to the watercourse on the south-eastern boundary and will serve the proposed Biomass Building, adjoining concrete apron and part of the proposed access road. Runoff will be restricted to the greenfield runoff rate of 13.6 l/s, split between the two discharge points (at 8.6 l/s and 5 l/s respectively).

Surface water runoff up to the 1 in 100 year plus 30% climate change allowance event will be attenuated on site. Attenuation storage will be provided in the form of attenuation ponds. There is also potential for infiltration and attenuation storage through the use of french drains.

A concept drainage sketch, based on attenuation storage within attenuation ponds, is included in Appendix 11.1.8. Full drainage details are to be provided as under a suitably worded planning condition.

The proposed development will not increase flood risk elsewhere and is compliant with TAN15.

Exceedance Event

Storage will be provided for the 1 in 100 year plus 30% CC event. Storm events in excess of the 1 in 100 year plus 30% CC event should be permitted to produce temporary shallow depth flooding within landscaped areas.

Surface Water Treatment

In accordance with the CIRIA C753 publication 'The SuDS Manual' (2015), other roofs and low traffic roads have a 'low' pollution hazard level. Furthermore, dust extraction fans from the roof area have potential to direct high levels of ammonia to the surface water drainage system. Table 1 overleaf shows the pollution hazard indices for each land use.

Table 1 – Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Other Roofs (typically commercial/industrial roofs)	Low	0.3	0.2	0.05
Low Traffic Roads (eg general access roads)	Low	0.5	0.4	0.4

Table extract taken from the CIRIA C753 publication 'The SuDS Manual' – Table 26.2

** Indices values range from 0-1.*

Runoff from agricultural roofs will be direct to french drains and attenuation ponds. Runoff from the yard areas, the Biomass Building and the access road will be directed to attenuation ponds. Table 2 below shows the amount of treatment provided by french drains and attenuation ponds.

Table 2 – SuDS Mitigation Indices

Type of SuDS	Mitigation Indices		
	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Filter drain (French drain)	0.4	0.4	0.4
Pond	0.7	0.7	0.5

Table extract taken from the CIRIA C753 publication 'The SuDS Manual' – Table 26.3

It can be concluded that the inclusion of french drains and attenuation ponds will provide a sufficient level of treatment.

Maintenance

Maintenance of drainage features such as the french drains and the attenuation ponds will be the responsibility of the site owner.

Maintenance schedules for ponds and french drains (filter drains) are included in Appendix 11.1.9.

Maintenance of the proposed culvert to form part of the new access will be the responsibility of the site owner.

Foul Drainage

Foul water from the shed wash-down will be directed to a dirty water tank. The waste product generated by the wash-down procedure will be collected and spread on agricultural land. The frequency of emptying is subject to the frequency of the wash-down procedure. It is recommended that the dirty water tank has an audible and visual high-level alarm system.

Conclusions

The proposed development is for the erection of four agricultural buildings for rearing livestock (table fowl); ancillary buildings and plant; associated infrastructure; and landscaping. Access to the site will be provided from the unnamed road to the east.

The site is located within Flood Zone A on the Welsh Government Development Advice Map – an area considered to be at little or no risk of fluvial or tidal flooding, with a less than 0.1% (1 in 1000) annual probability of flooding.

The principal source of flooding at this site is fluvial flooding from the unnamed watercourses adjacent to the site.

Detailed flood level data is currently not available for the unnamed watercourses. Therefore, an assessment of flood risk has been made based on NRW mapping and topography, as agreed with Wrexham County Borough Council.

From a review of NRW surface water mapping, which shows the flood risk from surface water and minor watercourses, the flood extent from the watercourse to the north is shown to be minimal and contained immediately adjacent to the watercourse. The flood extent of the watercourse to the south-east is confined to the south-eastern extent of the site. No flooding is estimated in the location of the proposed buildings. Flood depths within the southern extent are estimated to be less than 150mm during the 1 in 1000 annual probability event.

The proposed buildings will be set approximately 2m above the unnamed watercourses that border the site.

A residual risk arises from a blockage of the existing and proposed culverts. In the event of a blockage, flows would back up behind the culverts and flood land below 96.27m AOD. Flows reaching a level above 96.27m AOD would overspill over the unnamed road to the east and to the channel downstream.

Flooding would be localised to areas immediately upstream of the culverts and the majority of the site, including the location of the proposed buildings, is not at risk should blockage of the culverts occur.

It can be concluded that the majority of the site is at low risk of flooding from all sources. Areas immediately adjacent to the watercourses are identified at risk of flooding, however, no development is proposed within the flood extent. Therefore, no mitigation measures are considered necessary.

The proposed development will introduce impermeable drainage area in the form of buildings and access. This will result in an increase in surface water runoff. In order to ensure the increase in surface water runoff will not increase flood risk elsewhere, flow control will be used and attenuation provided on site to accommodate storm events up to and including the 1 in 100 year plus 30% climate change event.

All methods of surface water discharge have been assessed. Where soakaways are not feasible, surface water runoff will be discharged to the unnamed watercourses located adjacent to the northern and south-eastern boundaries of the site. An outfall will be formed to the watercourse at the northern boundary and will serve the four proposed agricultural buildings and adjoining hard-standing. A second outfall will be formed to the watercourse on the south-eastern boundary and will serve the proposed Biomass Building, adjoining concrete apron and part of the proposed access road. Runoff will be restricted to the greenfield runoff rate of 13.6 l/s, split between the two discharge points (at 8.6 l/s and 5 l/s respectively).

Attenuation storage will be provided in the form of attenuation ponds. There is also potential for infiltration and attenuation storage through the use of french drains.

Treatment of surface water will be provided by french drains and ponds. The site owner will be responsible for the maintenance of the drainage system.

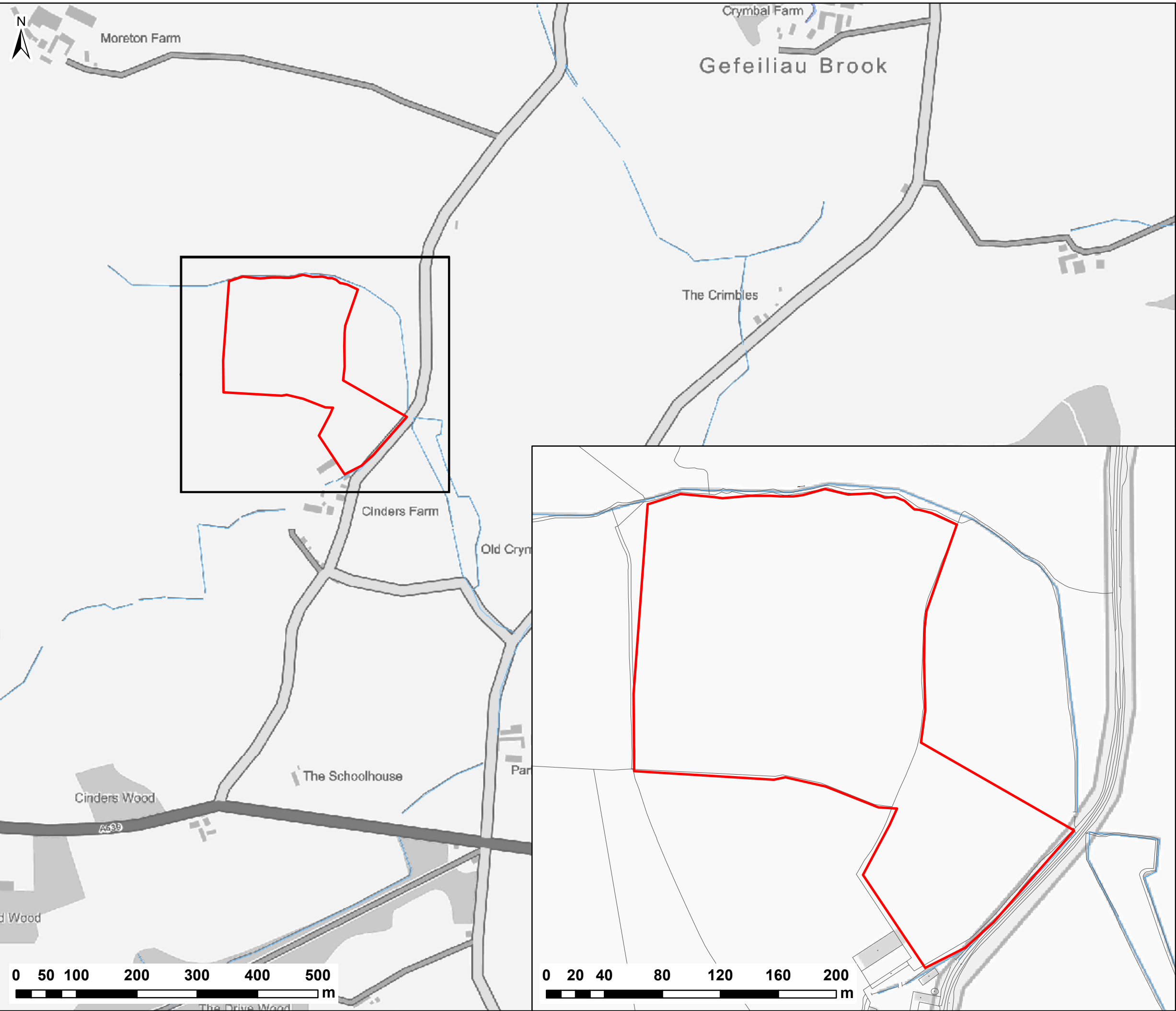
The proposed drainage system will ensure that the proposed development will not increase flood risk elsewhere and is compliant with TAN15.

Foul water from the shed wash-down should be directed to a dirty water tank. The waste product generated by the wash-down procedure will be collected and spread on agricultural land. The frequency of emptying is subject to the frequency of the wash-down procedure.

Recommendations

1. Submit this Flood Consequences Assessment and Drainage Strategy to the Planning Authority in support of the Planning Application;
2. Undertake infiltration testing to determine the suitability of infiltration techniques;
3. Verify the attenuation volumes included in this report when undertaking detailed drainage design;
4. Install an audible and visual high-level alarm system on the dirty water tank.

Appendix 11.1.1 – Location Plan & Aerial Image



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

Watercourses / Water Bodies

CLIENT:

**WYNNSTAY HOME
FARM PARTNERSHIP**

waterco
consultants

www.waterco.co.uk

SCHEME:

**CINDERS FARM,
WREXHAM**

PLOT TITLE:

LOCATION PLAN

PLOT STATUS:			DATE:
FINAL			17/10/2017

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
IJ	AW	VG	1:6,000
			(UNLESS STATED OTHERWISE)

PLOT NAME:	REV:
w10493-Location_Plan	-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

CLIENT:

**WYNNSTAY HOME
FARM PARTNERSHIP**

www.waterco.co.uk

SCHEME:

**CINDERS FARM,
WREXHAM**

PLOT TITLE:

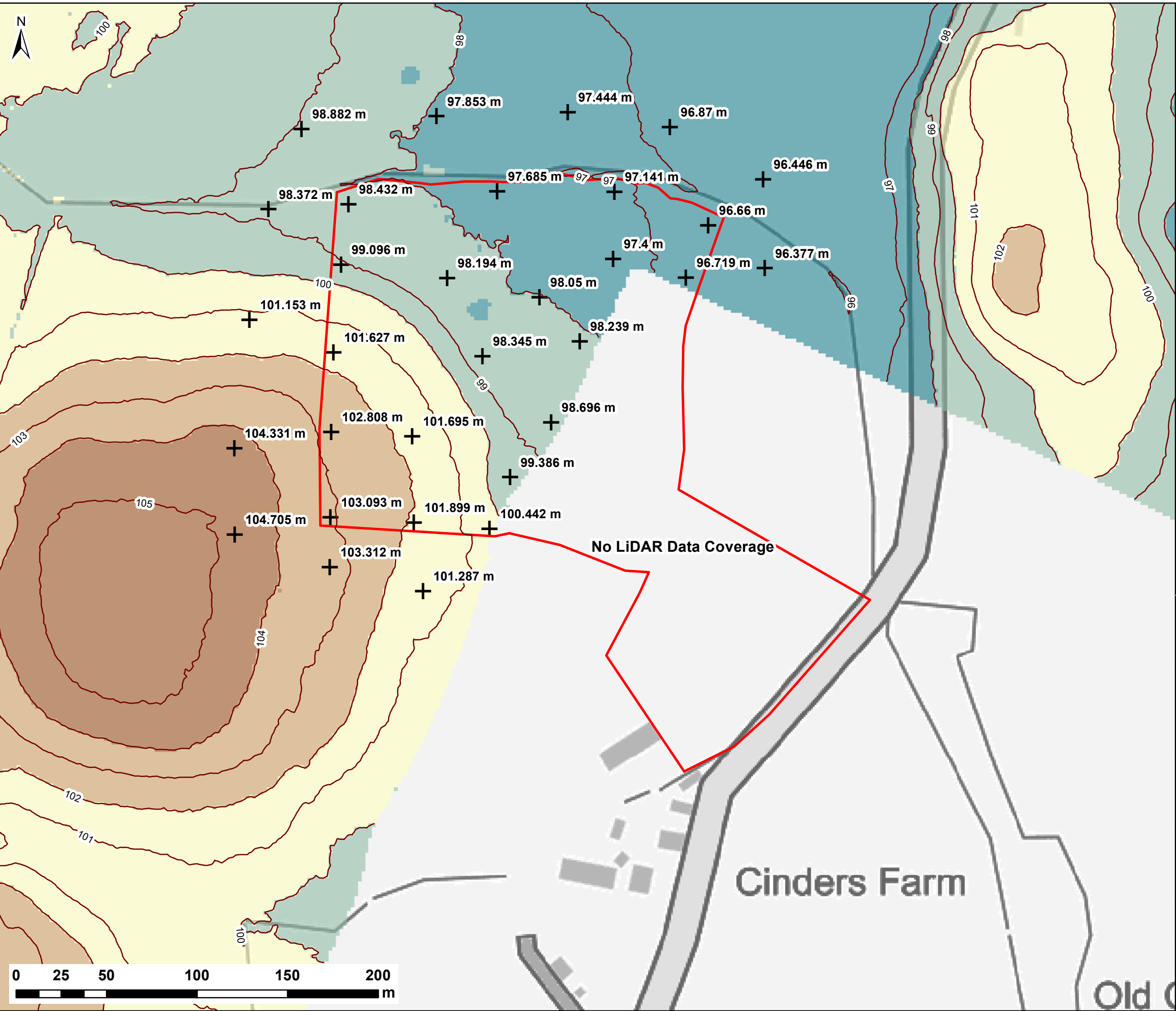
AERIAL PLAN

PLOT STATUS:			DATE:
FINAL			16/10/2017

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
IJ	AW	VG	1:5,000
			(UNLESS STATED OTHERWISE)

PLOT NAME:	REV:
w10493-Aerial_Plan	-

Appendix 11.1.2 – Topographical Data



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

+ Topographic Levels

Ground Elevations (m AOD)

	< 98
	98 - 100
	100 - 102
	102 - 104
	> 104

CLIENT:

**WYNNSTAY HOME
FARM PARTNERSHIP**

waterco
consultants

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SCHEME:

**CINDERS FARM,
WREXHAM**

PLOT TITLE:

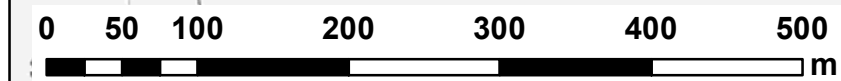
LIDAR ELEVATIONS
2m RESOLUTION

PLOT STATUS:			DATE:
FINAL			16/10/2017

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
IJ	AW	VG	1:2,000
			(UNLESS STATED OTHERWISE)

PLOT NAME:	REV:
w10493-LIDAR_Plan	-

Appendix 11.1.3 – Flood Maps



CONTAINS OS DATA © CROWN COPYRIGHT (2017)
NRW TAN15 DEVELOPMENT ADVICE MAP DATA © NRW (2017) - DATA DOWNLOADED FROM THE LLE GEO-PORTAL

NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

TAN15 Classification

Zone A

Zone B

Zone C1

Zone C2

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www.waterco.co.uk

SCHEME:

**CINDERS FARM,
WREXHAM**

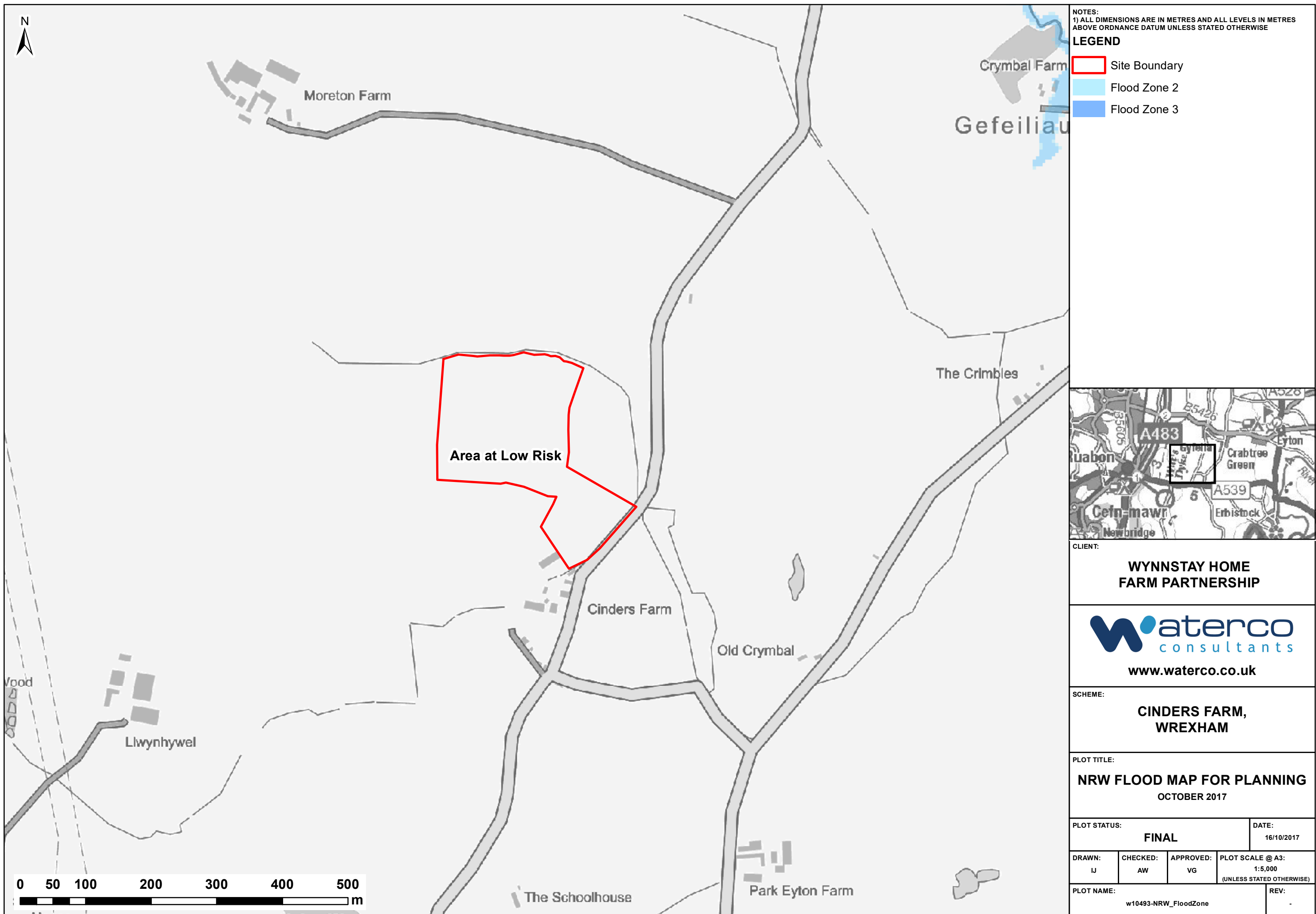
PLOT TITLE:

**WELSH GOVERNMENT
DEVELOPMENT ADVICE MAP**
OCTOBER 2017

PLOT STATUS:			DATE:
FINAL			16/10/2017

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
IJ	AW	VG	1:5,000
			(UNLESS STATED OTHERWISE)

PLOT NAME:	REV:
w10493-TAN15	-





NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

- Site Boundary
- NRW Historic Flood Map



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waterco
consultants

www.waterco.co.uk

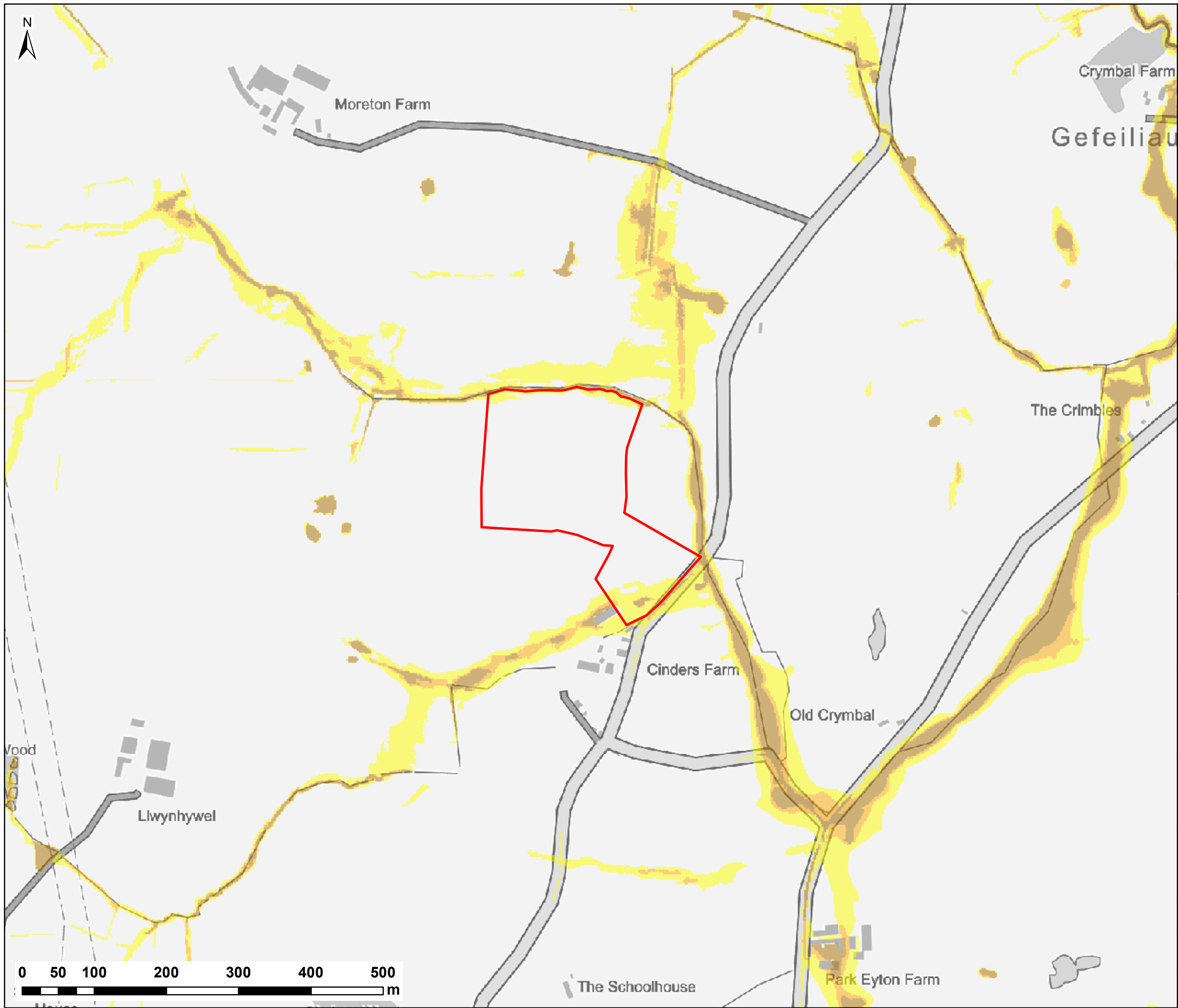
SCHEME:

**CINDERS FARM,
WREXHAM**

PLOT TITLE:

**NRW HISTORIC FLOOD MAP
OCTOBER 2017**

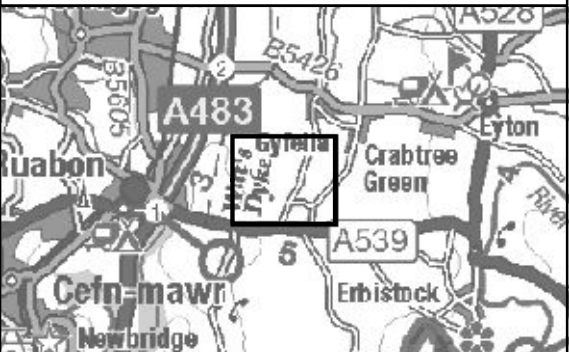
PLOT STATUS:			DATE:
FINAL			16/10/2017
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
IJ	AW	VG	1:5,000 (UNLESS STATED OTHERWISE)
PLOT NAME:			REV:
w10493-NRW_HIS			-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

- Site Boundary
- High Risk (3.33% AEP Event)
- Medium Risk (1.0% AEP Event)
- Low Risk (0.1% AEP Event)



CLIENT: WYNNSTAY HOME FARM PARTNERSHIP			
 www.waterco.co.uk			
SCHEME: CINDERS FARM, WREXHAM			
PLOT TITLE: NRW FLOOD MAP FOR SURFACE WATER OCTOBER 2017			
PLOT STATUS: FINAL			DATE: 17/10/2017
DRAWN: IJ	CHECKED: AW	APPROVED: VG	PLOT SCALE @ A3: 1:5,000 (UNLESS STATED OTHERWISE)
PLOT NAME: w10493-NRW_SW			REV: -



Map Title

Map Perygl Llifogydd / Flood Risk Map

Allwedd / Map Key

High Surface Water Flood Risk - Depth (m)

-  Less than 0.15m
-  0.15m - 0.30m
-  0.30m - 0.90m
-  Greater than 0.9m

Medium Surface Water Flood Risk - Depth (m)

-  Less than 0.15m
-  0.15m - 0.30m
-  0.30m - 0.90m
-  Greater than 0.9m

Low Surface Water Flood Risk - Depth (m)

-  Less than 0.15m
-  0.15m - 0.30m
-  0.30m - 0.90m
-  Greater than 0.9m

Graddfa / Scale 1: 5,001

Dyddiad / Date
13/11/2017



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Appendix 11.1.4 – WCBC Correspondence

Jordan Jones

From: Neil Taunt <Neil.Taunt@wrexham.gov.uk>
Sent: 10 November 2017 10:53
To: Jordan Jones
Subject: RE: w10493-Cinders Farm, Ruabon-LLFA Pre-Planning Opinion

Follow Up Flag: Follow up
Flag Status: Completed

Hi Jordan,

Apologies for the delay in responding.

I have reviewed your suggested proposal and would agree with the approach proposed. I would suggest considering the impact of any structures on the watercourse and implications of blockage/failure.

As mentioned below, you should already have a copy of our surface water guidance document that outlines the level of information required.

Many thanks

Neil

From: Jordan Jones [mailto:jordan.jones@waterco.co.uk]
Sent: 26 October 2017 17:42
To: Neil Taunt
Subject: w10493-Cinders Farm, Ruabon-LLFA Pre-Planning Opinion

This email's attachments were cleaned of potential threats by Wrexham Council's Security Gateway.
Click [here](#) if the original attachments are required (justification needed).

Hi Neil,

Further to your recent correspondence with my colleague Ifan, we have received the attached correspondence from Natural Resources Wales, who have advised that we contact you in relation to the ordinary watercourses adjacent to the site.

Each watercourse originates within 470m of the site. Therefore, it can be assumed that the watercourses do not serve a significant catchment and would not convey significant flow. The NRW 'Flood Map for Surface Water' (attached) shows the flood risk from surface water and minor watercourses. The map identifies flow routes should the unnamed watercourses exceed their capacity. As you can see from the attached map, flooded areas are confined to land immediately adjacent to the watercourses during all events including the 1 in 1000 year event. No flooding is estimated in areas where development is proposed. The attached LiDAR plan shows that site levels are elevated above watercourse levels.

Please can you advise if you are happy with the above approach to assessing flood risk from these watercourses and confirm that a more detailed (modelling) assessment will not be required.

Kind regards,

Jordan Jones BSc (Hons) MCIWEM
Environmental Consultant

01824 702220



Assessment, Modelling, Design

Ruthin - Chester - Manchester - Hyderabad



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From: Neil Taunt [<mailto:Neil.Taunt@wrexham.gov.uk>]

Sent: 12 October 2017 10:35

To: Ifan Jones <Ifan.Jones@waterco.co.uk>

Subject: FW: w10493-Cinders Farm, Ruabon-LLFA Pre-Planning Opinion

Dear Mr Jones,

Thanks you for your recent enquiry.

We hold no specific information in relation to the local drainage network or recorded incidents of flooding in the vicinity.

The attached guidance note will provide details of the information we would normally expect to see included within any drainage strategy for the proposed development and expected flows/discharge. Consideration of a 30% increase in rainfall is normally accepted to represent the impacts of climate change unless better evidence becomes available.

If you have any queries please let me know.

Regards

Neil

Neil Taunt MCIWEM C.WEM CEnv CSci

Uwch Swyddog Rheoli Llifogydd / Senior Flood Management Officer



01978 729734 / 07808 787632



Amgylchedd a Chynllunio, Cyngor Bwrdeistref Sirol Wrecsam, De Ffordd yr Abaty, Ystad Ddiwydiannol Wrecsam, Wrecsam LL13 9PW



Environment & Planning, Wrexham County Borough Council, Abbey Road South, Wrexham Industrial Estate, Wrexham LL13 9PW



wrecsam.gov.uk | wrexham.gov.uk



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facebook.com/cyngorwrecsam | facebook.com/wrexhamcouncil

From: Ifan Jones [<mailto:Ifan.Jones@waterco.co.uk>]

Sent: 11 October 2017 14:05

To: highwaymaintenance <highwaymaintenance@wrexham.gov.uk>; contact-us <contact-us@wrexham.gov.uk>

Subject: w10493-Cinders Farm, Ruabon-LLFA Pre-Planning Opinion

Proposed poultry units at Cinders Farm, Ruabon, Wrexham, LL14 6HL. Grid Reference: 332382E 344047N.

Dear Sir / Madam,

Please can you provide me with a pre-planning opinion for the proposed development at the above site. I have attached Location/Development plan for reference.

The proposed development is for four poultry units.

Please could you advise if there will be any specific requirements for a Flood Consequence Assessment & Surface Water Drainage Strategy at this site i.e. specify any flow rate requirements and attenuation storage requirements (i.e. should 20%, 30% or 40% climate change be applied when sizing attenuation features).

Please could you also advise if you have any records of historical flooding in this area?

If you have any questions or require any further information to process my request please don't hesitate to contact me.

Kind regards,

Ifan Jones BSc (Hons) MSc
Environmental Consultant

01824 702220



Assessment, Modelling, Design

Ruthin - Chester - Manchester - Hyderabad



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Rydym yn croesawu gohebiaeth yn Gymraeg. Byddwn yn ymateb i unrhyw ohebiaeth yn Gymraeg ac ni fydd hyn yn arwain at unrhyw oedi.

Ewch i weld - mi fedrwch chi dalu, rhoi gwybod, gwneud cais, dweud eich dweud, a dod o hyd i wybodaeth ar-lein yn www.wrecsam.gov.uk. Arbedwch bapur - meddylwch cyn argraffu!

Mae'r neges e-bost hon ac unrhyw atodiadau wedi eu bwriadu ar gyfer yr unigolyn neu'r sefydliad y'i cyfeirir atynt yn unig. Am yr amodau llawn ynglŷn ? chynnwys a defnyddio'r neges e-bost hon, ac unrhyw atodiadau, cyfeiriwch at www.wrecsam.gov.uk/top_navigation/disclaimersw.htm

We welcome correspondence in Welsh. We will respond to any correspondence in Welsh and this will not lead to any delay.

Take a look - you can pay, report, request, have your say and find information online at www.wrexham.gov.uk. Save paper - think before you print!

This e-mail message and any attachments are intended solely for the individual or organisation to whom it is addressed. For full conditions in relation to content and use of this e-mail message and any attachments, please refer to www.wrexham.gov.uk/top_navigation/disclaimers.htm

Rydym yn croesawu gohebiaeth yn Gymraeg. Byddwn yn ymateb i unrhyw ohebiaeth yn Gymraeg ac ni fydd hyn yn arwain at unrhyw oedi.

Ewch i weld - mi fedrwch chi dalu, rhoi gwybod, gwneud cais, dweud eich dweud, a dod o hyd i wybodaeth ar-lein yn www.wreccsam.gov.uk. Arbedwch bapur - meddylwch cyn argraffu!

Mae'r neges e-bost hon ac unrhyw atodiadau wedi eu bwriadu ar gyfer yr unigolyn neu'r sefydliad y'i cyfeirir atynt yn unig. Am yr amodau llawn ynglŷn ? chynnwys a defnyddio'r neges e-bost hon, ac unrhyw atodiadau, cyfeiriwch at www.wreccsam.gov.uk/top_navigation/disclaimersw.htm

We welcome correspondence in Welsh. We will respond to any correspondence in Welsh and this will not lead to any delay.

Take a look - you can pay, report, request, have your say and find information online at www.wrexham.gov.uk. Save paper - think before you print!

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Appendix 11.1.5 – NRW Correspondence

26/10/2017

Dear Ifan Jones,

PRELIMINARY PRE-APPLICATION ADVICE

PROPOSAL: Commercial development consisting four poultry units
LOCATION: Land North-West of Cinders Farm, Ruabon, Wrexham.

Thank you for consulting Natural Resources Wales about the above proposed development at pre-application stage.

We have considered your enquiry in relation to our Development Planning [checklist](#). We advise that the following matters are relevant to your site / proposed development and suggest you consider these further prior to the submission of any planning application:

Any statutory Major application to NRW or a planning application would need to be submitted with the relevant information provided within NRWs Quick Guide 9 – Poultry Units: planning permission and environmental assessment (attached).

Air Quality & Protected Sites

The planning application will need to demonstrate acceptable levels of atmospheric ammonia concentrations and nitrogen deposition on nearby protected sites. This can be done using the free online tool – SCAIL (Simple Calculation of Ammonia Impact Limits) available at <http://www.scail.ceh.ac.uk/>

Applications need to include a report from SCAIL or another air quality modelling package that includes:

- The input data
- Background levels.
- Process Contributions (PC).
- The predicted new environmental concentrations (PEC) of ammonia/nitrogen

In cases where SCAIL indicates that thresholds of insignificance are exceeded further detailed modelling may be required to support the application.

We will apply the new (post-April 2017 guidance) screening distance of 5km (that would exclude the SSSIs, SACs and Ramsar which are further than 5km). We would apply the new thresholds of 1% for initial screening for both ammonia emissions and nitrogen deposition.

The site lies within 5km of River Dee SAC/SSSI and Johnstown Newt SAC

Special Area of Conservation

The Local Planning Authority is a Competent Authority for the purposes of the *Conservation of Habitats and Species 2010 Regulations (as amended)*. As such, they must not agree to any plan or project unless they are certain that it will not adversely affect the integrity of a Special Area of Conservation (SAC).

The Local Planning Authority should carry out a test of likely significant effects (TLSE) for the SAC, which is required under Regulation 61 of the *Conservation of Habitats and Species Regulations 2010 (as amended)*. This test applies to impacts on the SACs from the proposed works, either alone or in combination with other plans and projects.

If the test concludes there is likely to be a significant effect then an appropriate assessment of the impacts on the SAC from the proposed works, either alone or in combination with other plans and projects, will be required. We would be able to assist with that assessment in our role as the statutory nature conservation body under the above Regulations.

Site of Special Scientific Interest

The site lies within 5km of Stryt Las a'r Hafod SSSI, Nant y Belan and Prynela SSSI, Sontley Marsh SSSI

The Wildlife and Countryside Act 1981 (as amended) places a duty on public authorities in exercising their functions, so far as this is likely to affect the flora, fauna, geological or physiographical features of a SSSI, to take reasonable steps consistent with the proper exercise of their functions to further the conservation and enhancement of those features.

By satisfying the requirements regarding the SACs, as indicated above, it is likely the requirements for the SSSIs will also be met.

We refer you to our [website](#) for further advice

Flood Risk

A watercourse flows along part of the site boundary. The watercourse is classified as that of an 'ordinary' watercourse (rather than a main river) and as such there may be a local flood risk associated with the watercourse. Due to the relative small catchment size of the watercourse (less than 3km²), it has not been captured by our nationalised modelling technique to generate our flood zones. We would advise that you approach Wrexham Council's Flood and Water management team who may be able to advise on possible flood risk from the adjacent watercourse along with requirements for any surface water drainage design/strategy associated with the proposal.

Surface water drainage should mimic existing run off rates/volumes and post development rates should not be increased. The use of Sustainable drainage systems would be supported.

Protected Species

Our records show there may be bats in the vicinity of the site. We advise liaison with the LPA ecologist to discuss and agree the scope of any surveys required.

We refer you to our [website](#) for further advice.

Environmental Management

Applications need to include details of the livestock range area in order to assess the risk of runoff polluting nearby watercourses.

Applications need to include a manure management plan.

Applications need to include a plan of the proposed site that indicates all of the new and existing features that will control pollution from the development.

Due to the proximity of the site to watercourses, all works at the site must be carried out in accordance with GPP5 and PPG6: 'Works in, near or over watercourses' and 'Working at construction and demolition sites' which are available on the following website:

<http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/>

The activity of importing waste into the site for use as, for example hardcore, must be registered with Natural Resources Wales as an exempt/permittable activity under Environmental Permitting Regulations 2010. The developer should contact Natural Resources Wales to discuss the necessity for an exemption/permit for any material imported to and exported from the site.

If during construction/excavation works any contaminated material is revealed, then the movement of such material either on or off site should be done in consultation with Natural Resources Wales. Any waste excavation material or building waste generated in the course of the development must be disposed of satisfactorily and in accordance with Section 34 of the Environmental Protection Act 1990. Carriers transporting waste from the site must be registered waste carriers and movement of any Hazardous Waste from the site must be accompanied by Hazardous waste consignment notes.

Environmental Permitting

If the proposal accommodates in excess of 40,000 birds, an Environmental Permit under the Environmental Permitting Regulations 2010 will be required from Natural Resources Wales.

We advise that you engage with NRW's Permitting Service as early as possible and at pre-application stage, by calling 0300 065 3000 or sending an enquiry to:

enquiries@naturalresourceswales.gov.uk

Please note the view expressed in this letter is a response to a pre-planning enquiry only. We trust these comments will prove helpful but they should not set a precedent for any future Natural Resources Wales' response to any formal application for planning permission or other legal consent. Such applications shall be assessed on the information submitted and regulations of relevance at that time. The details contained in this letter are based on the information available to date.

Yn gywir / yours faithfully

Siôn M Williams

Siôn M. Williams

Ymgynghorydd Cynllunio Datblygu / Development Planning Advisor

Cyfoeth Naturiol Cymru / Natural Resources Wales

Appendix 11.1.6 – ReFH2 Runoff Rates

Job number: w10493	Author: JJ
Scheme name: Cinders Farm, Wrexham	Checked: AW
ReFH2 Runoff Rates	Date: 14/11/2017

Return period (yrs)	As-rural peak flow (m ³ /s)	As-rural peak flow (l/s)
1	0.01170353	11.70353
2	0.013634329	13.634329
5	0.020460765	20.460765
10	0.026039899	23.039899
30	0.03677526	36.77526
50	0.042779769	42.779769
75	0.04798372	47.98372
100	0.051901871	51.901871
200	0.062107865	62.107865
1000	0.089043613	89.043613

Appendix 11.1.7 – MicroDrainage Storage Volumes

Waterco Ltd					Page 1
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ		Cinders Farm Wrexham 0.17ha			
Date 27/11/2017 File w10493-171127-Attenuati...		Designed by JJ Checked by AW			
XP Solutions		Source Control 2017.1.2			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.755	0.355	5.0	44.9	Flood Risk
30 min Summer	9.849	0.449	5.0	59.3	Flood Risk
60 min Summer	9.927	0.527	5.0	72.3	Flood Risk
120 min Summer	9.934	0.534	5.0	73.4	Flood Risk
180 min Summer	9.919	0.519	5.0	70.9	Flood Risk
240 min Summer	9.902	0.502	5.0	68.0	Flood Risk
360 min Summer	9.866	0.466	5.0	62.1	Flood Risk
480 min Summer	9.830	0.430	5.0	56.4	Flood Risk
600 min Summer	9.791	0.391	5.0	50.2	Flood Risk
720 min Summer	9.753	0.353	5.0	44.6	Flood Risk
960 min Summer	9.684	0.284	5.0	34.7	O K
1440 min Summer	9.584	0.184	5.0	21.4	O K
2160 min Summer	9.515	0.115	4.7	13.0	O K
2880 min Summer	9.494	0.094	3.8	10.5	O K
4320 min Summer	9.474	0.074	2.8	8.2	O K
5760 min Summer	9.464	0.064	2.3	7.0	O K
7200 min Summer	9.457	0.057	1.9	6.3	O K
8640 min Summer	9.453	0.053	1.7	5.8	O K
10080 min Summer	9.450	0.050	1.6	5.4	O K
15 min Winter	9.793	0.393	5.0	50.5	Flood Risk
30 min Winter	9.896	0.496	5.0	67.0	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	149.792	0.0	48.0	16	
30 min Summer	102.231	0.0	65.5	31	
60 min Summer	66.719	0.0	85.5	60	
120 min Summer	38.982	0.0	99.9	116	
180 min Summer	28.203	0.0	108.5	144	
240 min Summer	22.354	0.0	114.6	176	
360 min Summer	16.071	0.0	123.6	244	
480 min Summer	12.723	0.0	130.5	312	
600 min Summer	10.602	0.0	135.9	378	
720 min Summer	9.124	0.0	140.4	440	
960 min Summer	7.168	0.0	147.0	560	
1440 min Summer	5.125	0.0	157.7	792	
2160 min Summer	3.641	0.0	168.1	1108	
2880 min Summer	2.857	0.0	175.8	1472	
4320 min Summer	2.038	0.0	188.1	2204	
5760 min Summer	1.618	0.0	199.2	2936	
7200 min Summer	1.379	0.0	212.1	3672	
8640 min Summer	1.221	0.0	225.4	4344	
10080 min Summer	1.109	0.0	239.0	5136	
15 min Winter	149.792	0.0	53.7	16	
30 min Winter	102.231	0.0	73.4	30	
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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ		Cinders Farm Wrexham 0.17ha			
Date 27/11/2017 File w10493-171127-Attenuati...		Designed by JJ Checked by AW			
XP Solutions		Source Control 2017.1.2			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	9.984	0.584	5.0	82.2	Flood Risk
120 min Winter	9.997	0.597	5.0	84.6	Flood Risk
180 min Winter	9.979	0.579	5.0	81.3	Flood Risk
240 min Winter	9.959	0.559	5.0	77.7	Flood Risk
360 min Winter	9.912	0.512	5.0	69.8	Flood Risk
480 min Winter	9.863	0.463	5.0	61.6	Flood Risk
600 min Winter	9.806	0.406	5.0	52.6	Flood Risk
720 min Winter	9.748	0.348	5.0	43.8	Flood Risk
960 min Winter	9.645	0.245	5.0	29.3	O K
1440 min Winter	9.525	0.125	4.9	14.1	O K
2160 min Winter	9.490	0.090	3.6	10.0	O K
2880 min Winter	9.475	0.075	2.9	8.3	O K
4320 min Winter	9.460	0.060	2.0	6.6	O K
5760 min Winter	9.452	0.052	1.6	5.6	O K
7200 min Winter	9.447	0.047	1.4	5.1	O K
8640 min Winter	9.444	0.044	1.2	4.7	O K
10080 min Winter	9.441	0.041	1.1	4.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	66.719	0.0	95.8	60	
120 min Winter	38.982	0.0	111.9	116	
180 min Winter	28.203	0.0	121.5	164	
240 min Winter	22.354	0.0	128.4	186	
360 min Winter	16.071	0.0	138.5	264	
480 min Winter	12.723	0.0	146.1	340	
600 min Winter	10.602	0.0	152.2	410	
720 min Winter	9.124	0.0	157.2	470	
960 min Winter	7.168	0.0	164.7	586	
1440 min Winter	5.125	0.0	176.6	778	
2160 min Winter	3.641	0.0	188.2	1124	
2880 min Winter	2.857	0.0	196.9	1468	
4320 min Winter	2.038	0.0	210.7	2204	
5760 min Winter	1.618	0.0	223.1	2936	
7200 min Winter	1.379	0.0	237.6	3672	
8640 min Winter	1.221	0.0	252.5	4368	
10080 min Winter	1.109	0.0	267.6	5096	
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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	Cinders Farm Wrexham 0.17ha	
Date 27/11/2017 File w10493-171127-Attenuati...	Designed by JJ Checked by AW	
XP Solutions	Source Control 2017.1.2	

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 332382 344057	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.171

Time (mins)	Area
From:	To: (ha)

0	1 0.171
---	---------

Waterco Ltd		Page 4
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	Cinders Farm Wrexham 0.17ha	
Date 27/11/2017 File w10493-171127-Attenuati...	Designed by JJ Checked by AW	
XP Solutions Source Control 2017.1.2		

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.400

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	106.0	0.600	181.0

Hydro-Brake® Optimum Outflow Control

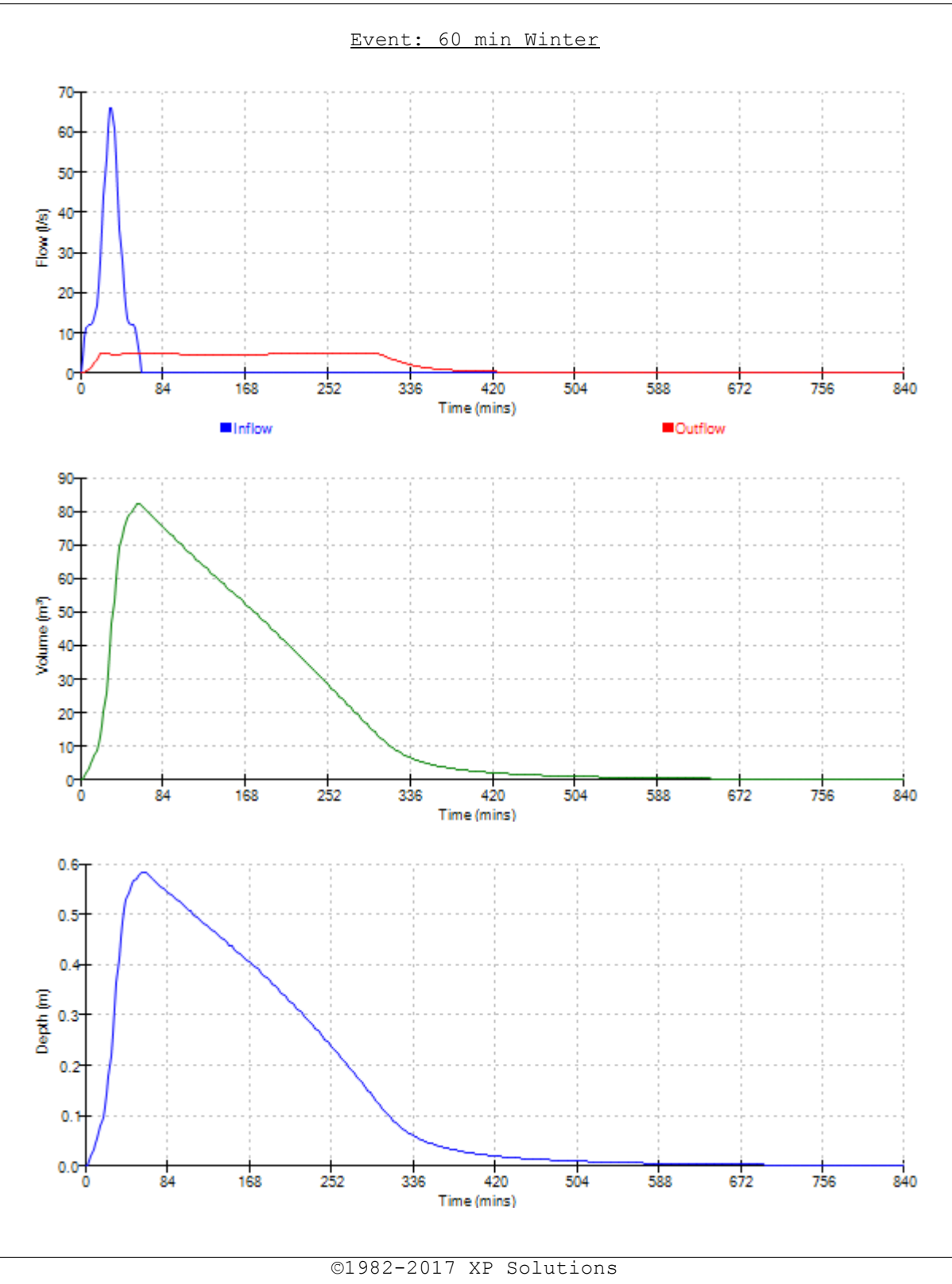
Unit Reference	MD-SHE-0111-5000-0600-5000
Design Head (m)	0.600
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	9.395
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	5.0
Flush-Flo™	0.193	5.0
Kick-Flo®	0.428	4.3
Mean Flow over Head Range	-	4.2

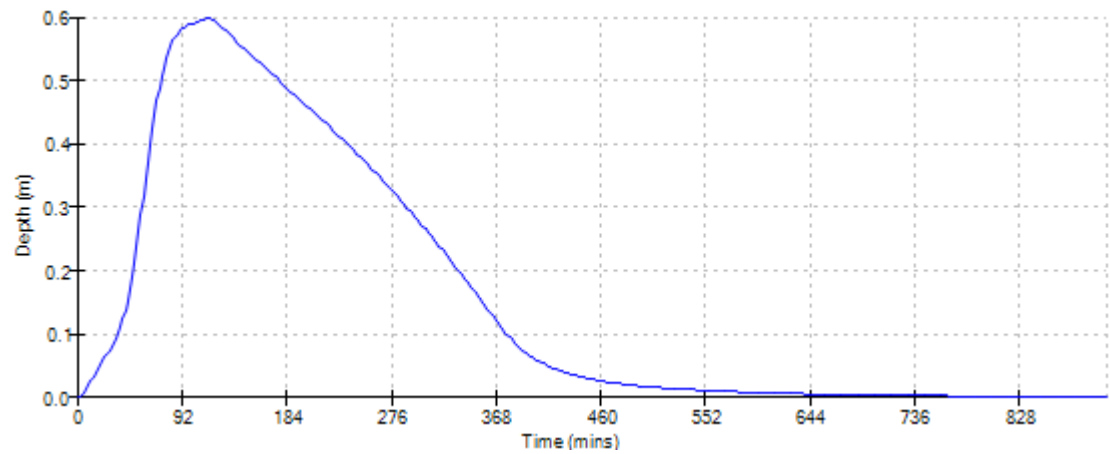
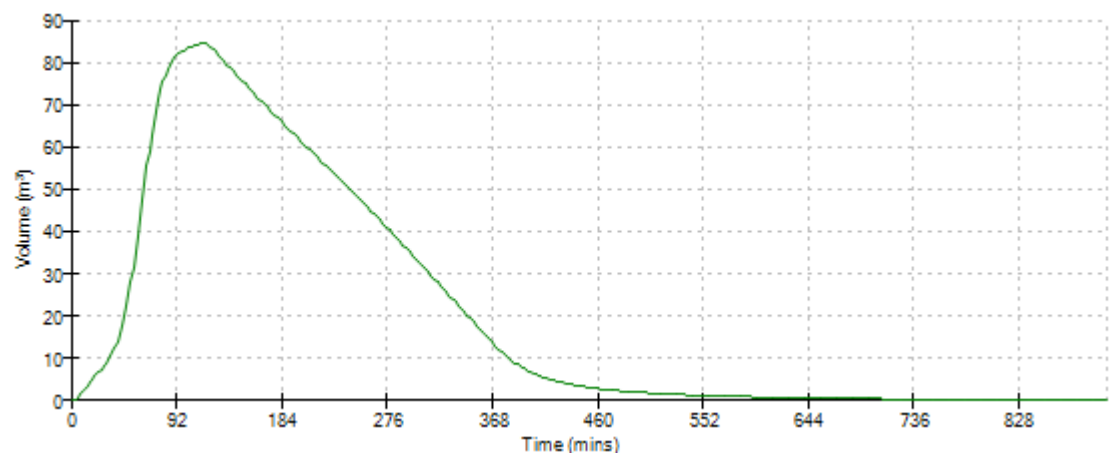
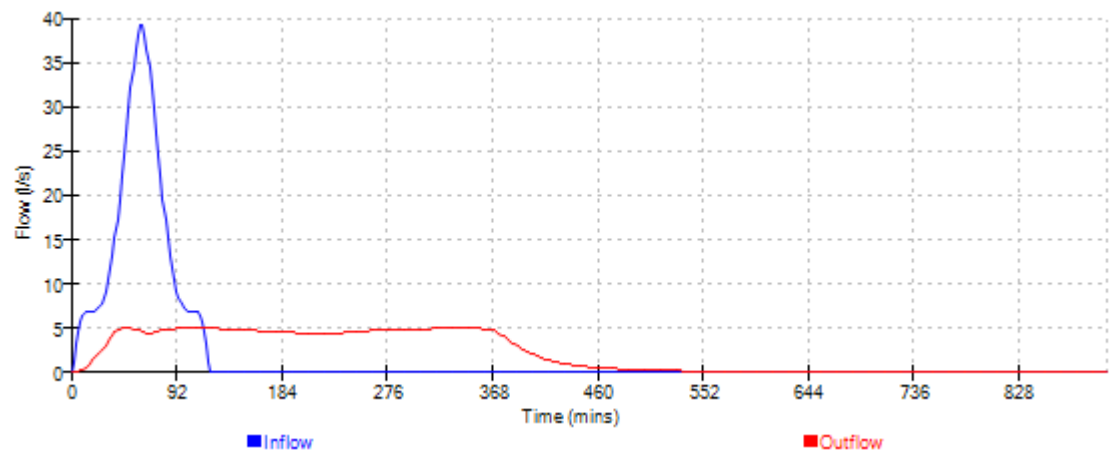
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	6.9	3.000	10.6	7.000	15.9
0.200	5.0	1.400	7.4	3.500	11.4	7.500	16.5
0.300	4.9	1.600	7.9	4.000	12.2	8.000	17.0
0.400	4.5	1.800	8.4	4.500	12.9	8.500	17.6
0.500	4.6	2.000	8.8	5.000	13.6	9.000	18.1
0.600	5.0	2.200	9.2	5.500	14.2	9.500	18.6
0.800	5.7	2.400	9.6	6.000	14.8		
1.000	6.3	2.600	9.9	6.500	15.3		

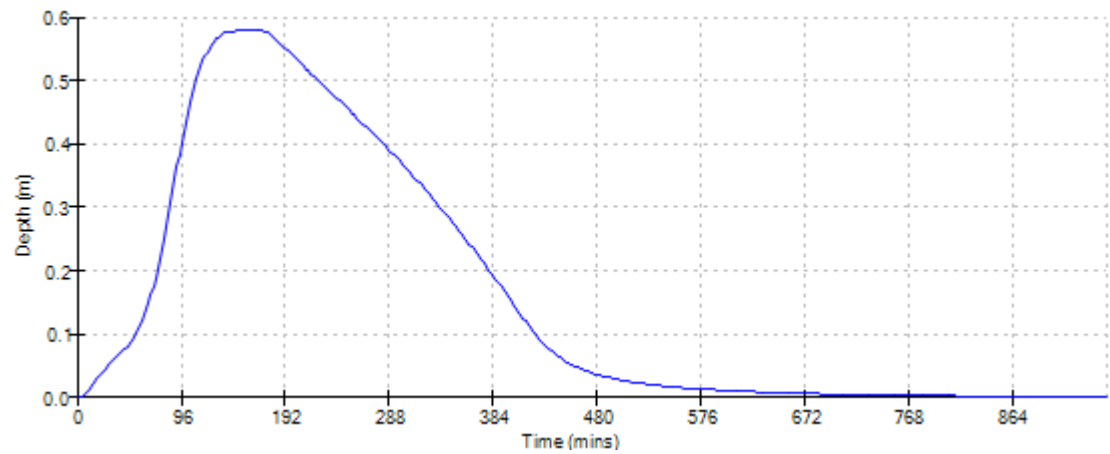
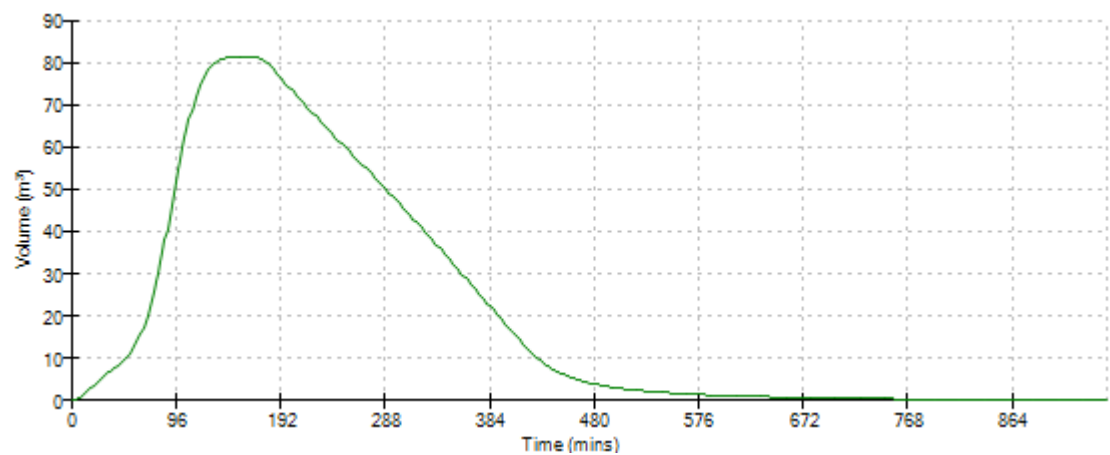
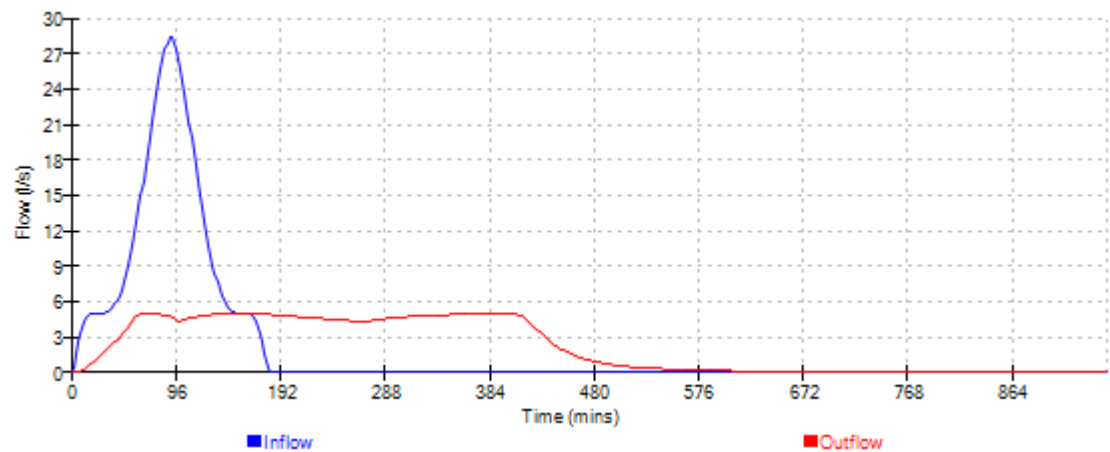
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Event: 120 min Winter



Event: 180 min Winter



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Date 04/12/2017 File w10493-171204-Attenuati...		Designed by JJ Checked by AW			
XP Solutions		Source Control 2017.1.2			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.639	0.239	8.6	375.0	O K
30 min Summer	9.720	0.320	8.6	508.6	Flood Risk
60 min Summer	9.809	0.409	8.6	656.4	Flood Risk
120 min Summer	9.864	0.464	8.6	750.7	Flood Risk
180 min Summer	9.891	0.491	8.6	797.5	Flood Risk
240 min Summer	9.907	0.507	8.6	825.1	Flood Risk
360 min Summer	9.923	0.523	8.6	853.5	Flood Risk
480 min Summer	9.930	0.530	8.6	864.8	Flood Risk
600 min Summer	9.930	0.530	8.6	864.8	Flood Risk
720 min Summer	9.926	0.526	8.6	857.4	Flood Risk
960 min Summer	9.912	0.512	8.6	833.7	Flood Risk
1440 min Summer	9.889	0.489	8.6	794.3	Flood Risk
2160 min Summer	9.851	0.451	8.6	727.7	Flood Risk
2880 min Summer	9.809	0.409	8.6	657.3	Flood Risk
4320 min Summer	9.739	0.339	8.6	539.2	Flood Risk
5760 min Summer	9.684	0.284	8.6	448.2	O K
7200 min Summer	9.646	0.246	8.6	386.9	O K
8640 min Summer	9.618	0.218	8.6	341.1	O K
10080 min Summer	9.597	0.197	8.6	306.8	O K
15 min Winter	9.667	0.267	8.6	420.4	O K
30 min Winter	9.758	0.358	8.6	570.4	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	149.792	0.0	339.9	16	
30 min Summer	102.231	0.0	465.2	31	
60 min Summer	66.719	0.0	655.8	62	
120 min Summer	38.982	0.0	765.6	122	
180 min Summer	28.203	0.0	829.8	182	
240 min Summer	22.354	0.0	875.7	242	
360 min Summer	16.071	0.0	941.7	360	
480 min Summer	12.723	0.0	990.9	480	
600 min Summer	10.602	0.0	1028.6	600	
720 min Summer	9.124	0.0	1058.2	720	
960 min Summer	7.168	0.0	1098.7	826	
1440 min Summer	5.125	0.0	1143.8	1068	
2160 min Summer	3.641	0.0	1317.2	1472	
2880 min Summer	2.857	0.0	1376.2	1872	
4320 min Summer	2.038	0.0	1464.5	2636	
5760 min Summer	1.618	0.0	1574.1	3400	
7200 min Summer	1.379	0.0	1674.1	4104	
8640 min Summer	1.221	0.0	1775.1	4832	
10080 min Summer	1.109	0.0	1872.6	5544	
15 min Winter	149.792	0.0	381.9	16	
30 min Winter	102.231	0.0	519.0	31	
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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ		Cinders Farm Wrexham 1.3ha			
Date 04/12/2017 File w10493-171204-Attenuati...		Designed by JJ Checked by AW			
XP Solutions		Source Control 2017.1.2			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	9.856	0.456	8.6	737.1	Flood Risk
120 min Winter	9.918	0.518	8.6	843.7	Flood Risk
180 min Winter	9.948	0.548	8.6	897.2	Flood Risk
240 min Winter	9.967	0.567	8.6	929.6	Flood Risk
360 min Winter	9.987	0.587	8.6	964.4	Flood Risk
480 min Winter	9.996	0.596	8.6	980.4	Flood Risk
600 min Winter	9.998	0.598	8.6	984.1	Flood Risk
720 min Winter	9.995	0.595	8.6	979.8	Flood Risk
960 min Winter	9.981	0.581	8.6	954.4	Flood Risk
1440 min Winter	9.950	0.550	8.6	900.6	Flood Risk
2160 min Winter	9.901	0.501	8.6	813.9	Flood Risk
2880 min Winter	9.847	0.447	8.6	721.3	Flood Risk
4320 min Winter	9.738	0.338	8.6	538.0	Flood Risk
5760 min Winter	9.656	0.256	8.6	402.4	O K
7200 min Winter	9.602	0.202	8.6	314.9	O K
8640 min Winter	9.566	0.166	8.5	257.9	O K
10080 min Winter	9.545	0.145	8.3	224.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	66.719	0.0	734.4	62	
120 min Winter	38.982	0.0	856.5	120	
180 min Winter	28.203	0.0	927.7	180	
240 min Winter	22.354	0.0	978.4	238	
360 min Winter	16.071	0.0	1050.8	354	
480 min Winter	12.723	0.0	1104.0	468	
600 min Winter	10.602	0.0	1144.0	582	
720 min Winter	9.124	0.0	1174.4	692	
960 min Winter	7.168	0.0	1212.7	904	
1440 min Winter	5.125	0.0	1232.6	1126	
2160 min Winter	3.641	0.0	1474.9	1596	
2880 min Winter	2.857	0.0	1540.5	2048	
4320 min Winter	2.038	0.0	1641.2	2812	
5760 min Winter	1.618	0.0	1763.2	3568	
7200 min Winter	1.379	0.0	1875.5	4248	
8640 min Winter	1.221	0.0	1989.3	4840	
10080 min Winter	1.109	0.0	2100.3	5440	
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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	Cinders Farm Wrexham 1.3ha	
Date 04/12/2017 File w10493-171204-Attenuati...	Designed by JJ Checked by AW	
XP Solutions Source Control 2017.1.2		

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 332382 344057	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 1.352

Time (mins)	Area
From:	To: (ha)
0	1 1.352

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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	Cinders Farm Wrexham 1.3ha	
Date 04/12/2017 File w10493-171204-Attenuati...	Designed by JJ Checked by AW	
XP Solutions Source Control 2017.1.2		

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.400

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1520.0	0.600	1778.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0141-8600-0600-8600
Design Head (m)	0.600
Design Flow (l/s)	8.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	141
Invert Level (m)	9.395
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	8.6
Flush-Flo™	0.224	8.6
Kick-Flo®	0.448	7.5
Mean Flow over Head Range	-	7.1

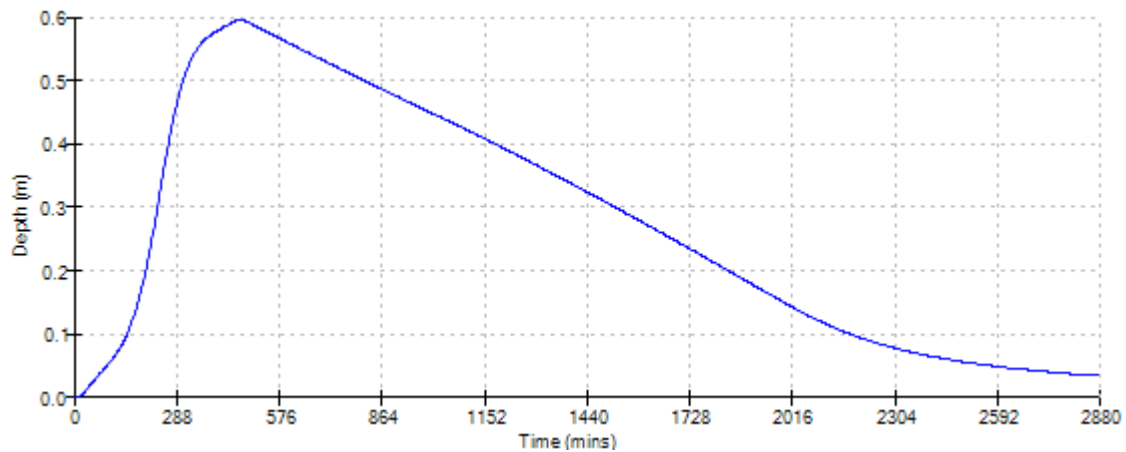
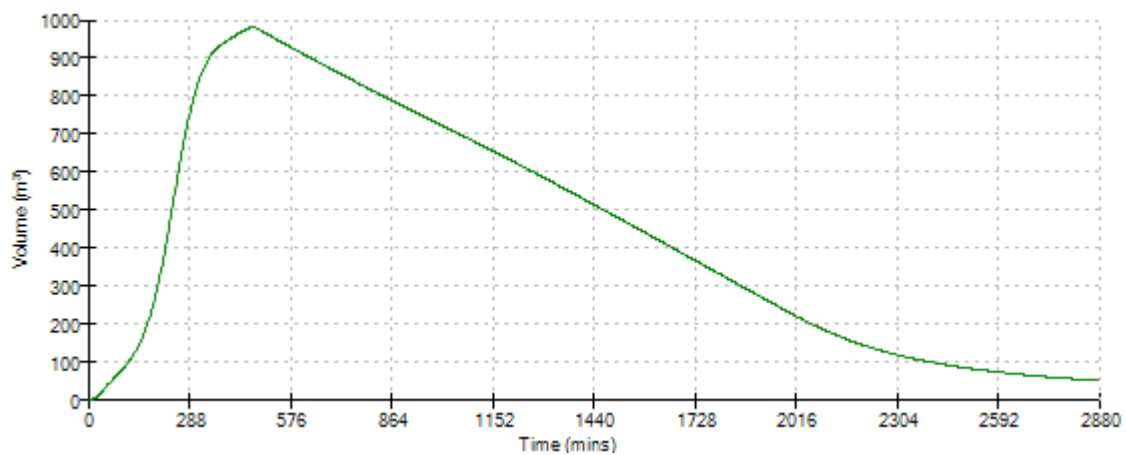
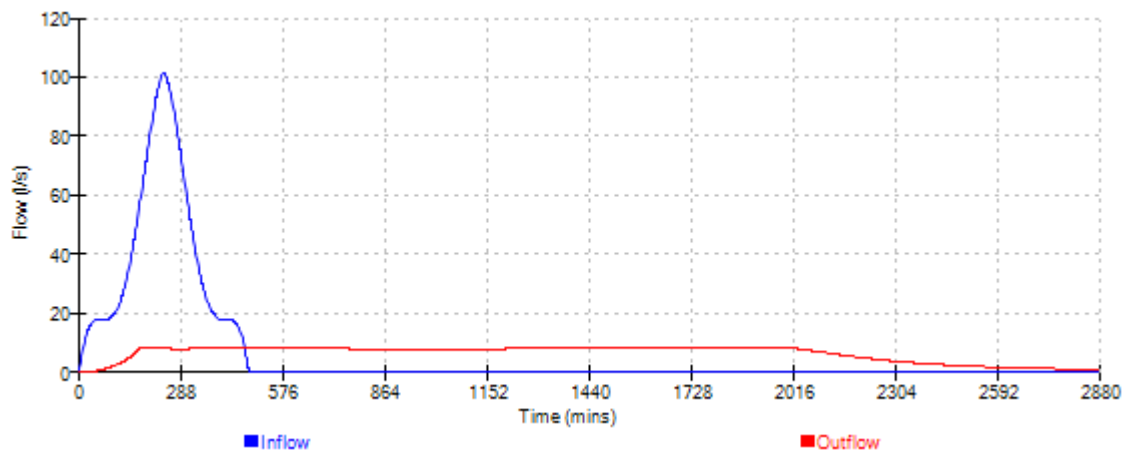
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.1	1.200	11.9	3.000	18.4	7.000	27.6
0.200	8.5	1.400	12.8	3.500	19.8	7.500	28.6
0.300	8.4	1.600	13.6	4.000	21.1	8.000	29.6
0.400	8.0	1.800	14.4	4.500	22.4	8.500	30.5
0.500	7.9	2.000	15.2	5.000	23.5	9.000	31.4
0.600	8.6	2.200	15.9	5.500	24.6	9.500	32.2
0.800	9.8	2.400	16.6	6.000	25.7		
1.000	10.9	2.600	17.2	6.500	26.6		

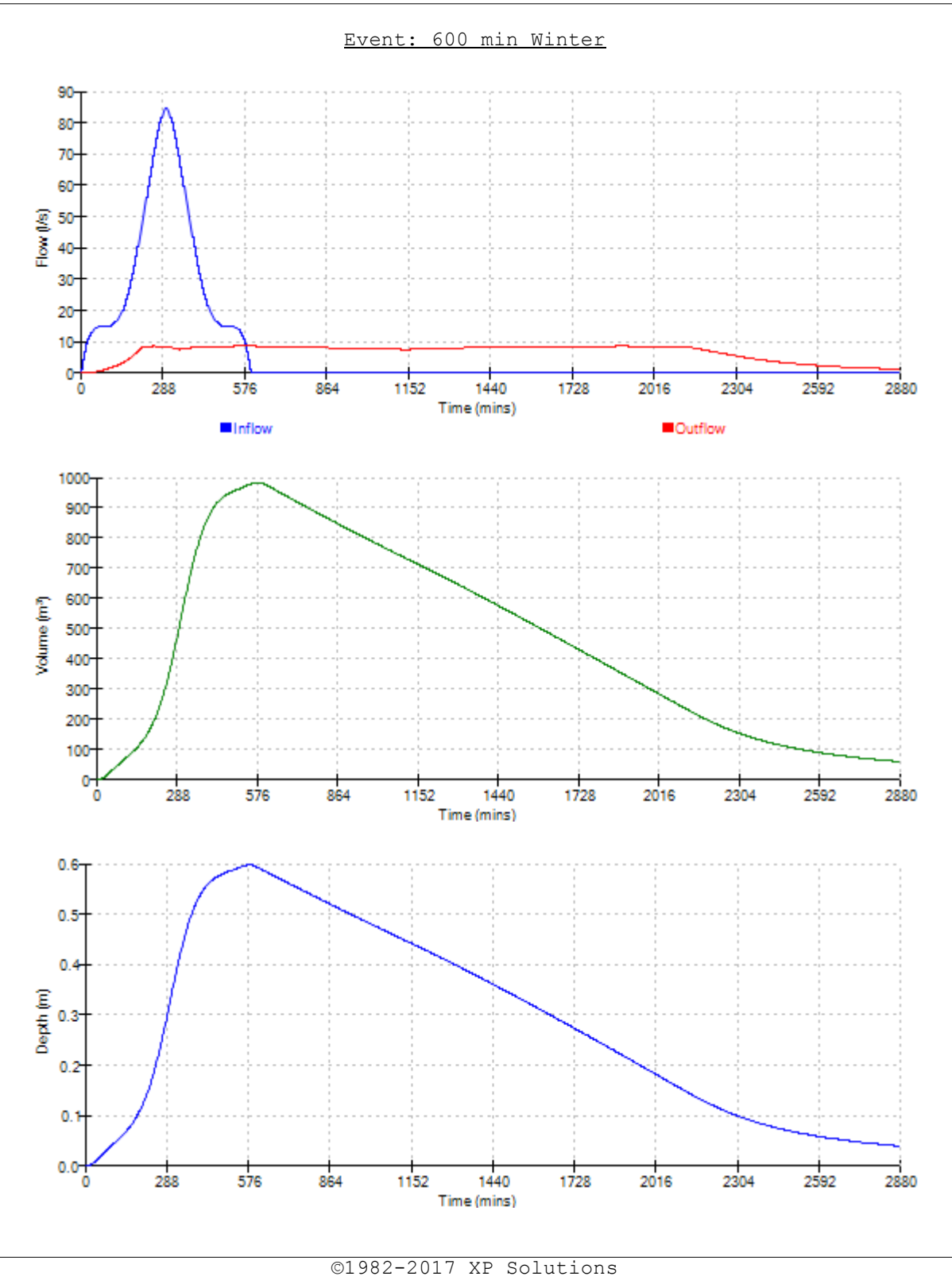
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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	Cinders Farm Wrexham 1.3ha	
Date 04/12/2017 File w10493-171204-Attenuati...	Designed by JJ Checked by AW	
XP Solutions	Source Control 2017.1.2	

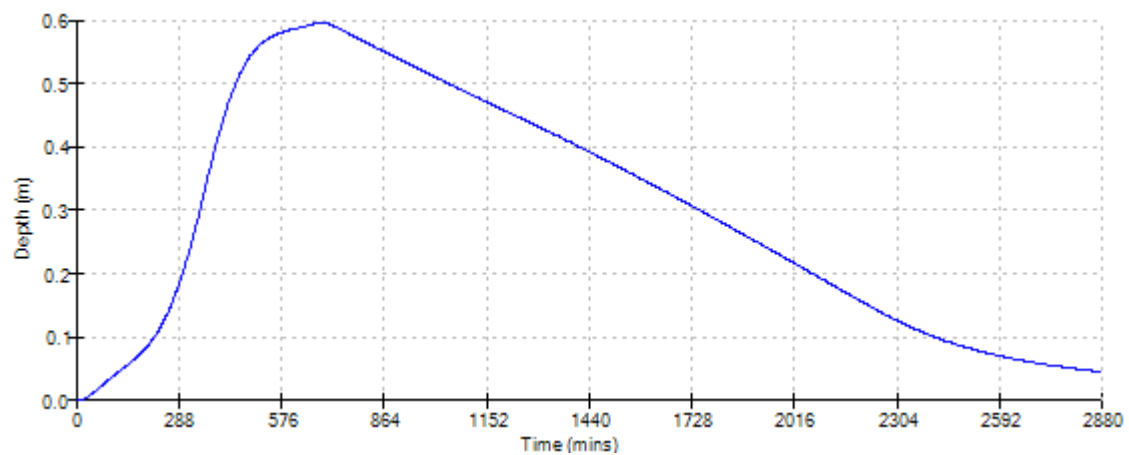
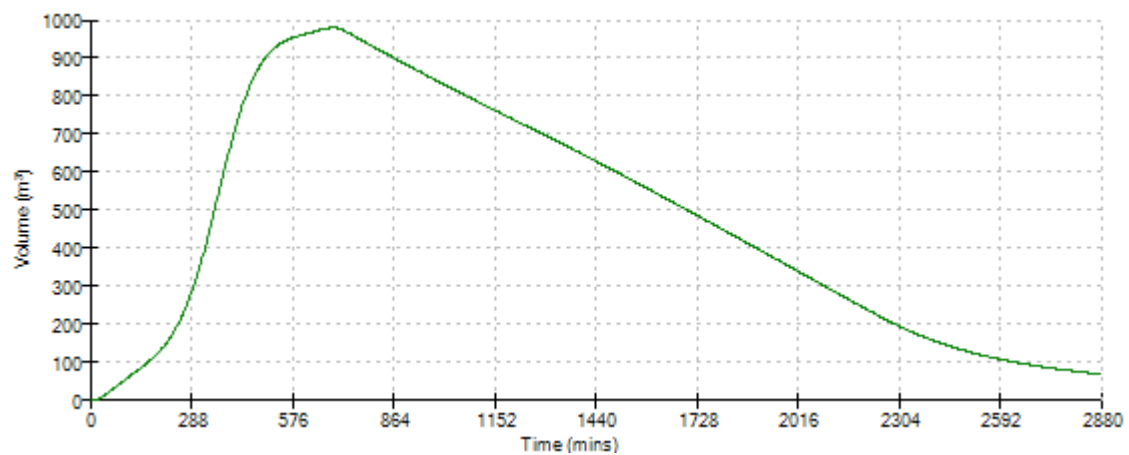
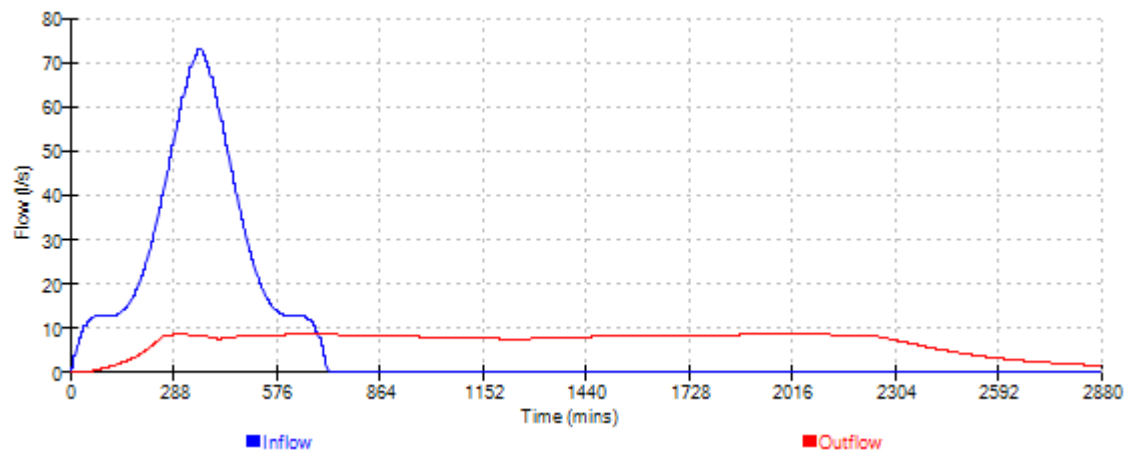
Event: 480 min Winter



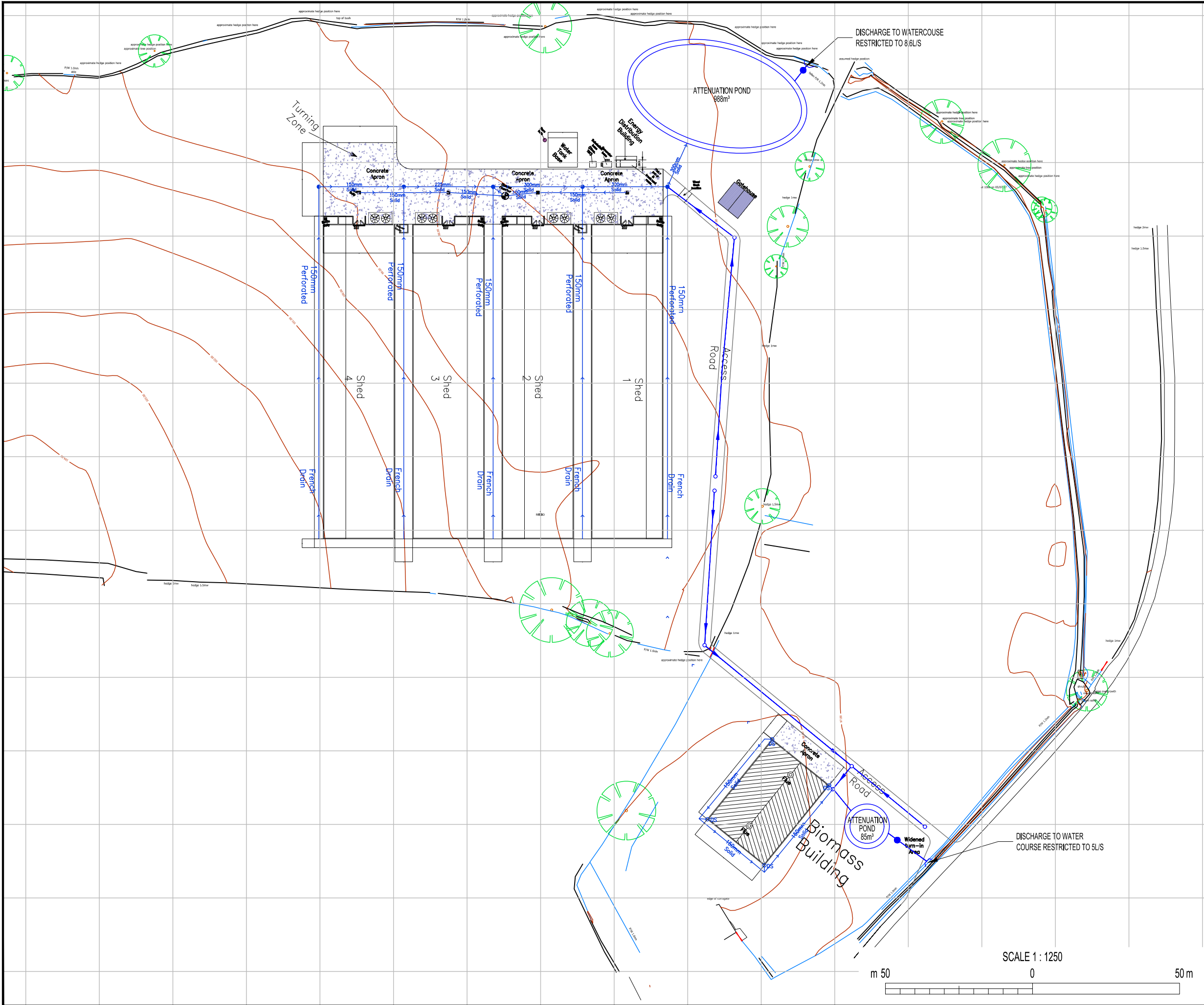
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Date 04/12/2017 File w10493-171204-Attenuati...	Designed by JJ Checked by AW	
XP Solutions	Source Control 2017.1.2	



Event: 720 min Winter



Appendix 11.1.8 – Concept Drainage Sketch



- NOTES**
- ALL DIMENSIONS IN MILLIMETRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS SHOWN OTHERWISE.
 - THIS DRAWING IS AN AMENDMENT OF THE DRAWING G711 2442-O-CLE DRAWN BY KNIGHTS CONSTRUCTION LTD PROVIDED BY INDIGO PLANNING LTD.
 - THIS DRAWING PROVIDES A DRAINAGE CONCEPT ONLY AND IS NOT INTENED FOR DETAILED DESIGN.

- KEY**
- PROPOSED ATTENUATION STORAGE POND WITH A DEPTH OF 0.6m AND 1 IN 3 SLOPE
 - PROPOSED SURFACE WATER DRAIN
 - PROPOSED SURFACE WATER INSPECTION CHAMBER
 - PROPOSED SURFACE WATER HYDROBRAKE CHAMBER

SITE LOCATION
GRID REFERENCE: 332382, 344047
SITE ADDRESS: CINDERS FARM
RUABON
WREXHAM
LL14 6HL

P00	27-11-17	FIRST ISSUE	JJ	AW	VG
REV.	DATE	DESCRIPTION	DSGND	CHKD	APPD

CLIENT
WYNNSTAY HOME FARM
PARTNERSHIP

PRINCIPAL DESIGNER
-

waterco consultants
Waterco Ltd., Eden Court,
Lon Parcwr Business Park, Ruthin LL15 1NJ
tel (+44) 1824 702220
www.waterco.co.uk

SCHEME
CINDERS FARM, WREXHAM

TITLE
CONCEPT DRAINAGE SKETCH

STATUS
PRELIMINARY

DESIGNED	CHECKED	APPROVED	SCALE / SHEET SIZE
JJ	AW	VG	1 : 1250 / A3
DRAWING NO. w10493-CONCEPT SKETCH			REV P00

Appendix 11.1.9 – Maintenance Schedules

Operation and Maintenance Requirements for Filter Drains

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet / outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (e.g. NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Ref. Table 16.1, CIRIA C753 'The SuDS Manual'

The maintenance requirements detailed above are to be undertaken by the site owner.

Name:

Position:

Date:

**Signed on behalf
Of the site owner**

Operation and Maintenance Requirements for Ponds and Wetlands

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season), or as required
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage, and / or physical damage.	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options.	Half yearly
	Check any mechanical devices e.g. penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1m above water level	Annually
	Remove sediment from any forebay	Every 1 – 5 years, or as required
Occasional maintenance	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays	Every 5 years, or as required
	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, e.g. 25-50 years
Remedial actions	Repair erosion or other damage	As required
	Replant where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair/rehabilitate of inlets, outlets and overflows	As required

Ref. Table 23.1 CIRIA C753 'The SuDS Manual'

The maintenance requirements detailed above are to be undertaken by the site owner

Name:

Position:

Date:

**Signed on behalf
of site owner**