Drainage Strategy

Holiday Park Lodge, Rhuddlan, Denbighshire

Presented to: EHPI Ltd

Issued: July 2023

Delta-Simons Project No: 97109.578224

Protecting people and planet

Report Details

Client	EHPI Ltd
Report Title	Drainage Strategy
Site Address	Holiday Park Lodge, Rhuddlan, Denbighshire, LL18 5RS
Project No.	97109.578224
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Quality Assurance

Issue No.	Status	Issue Date	Comments	Author	Technical Review	Authorised
1	Final	11th July 2023	Updated to account for new red line boundary		A. Perryman pp	A. Perryman
				Oliver Eglington Graduate	Joshua Rigby Associate	Alex Perryman Associate Director

About us

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As part of Lucion Services, our combined team of 500 in the UK has a range of specialist skill sets in over 50 environmental consultancy specialisms including asbestos, hazardous materials, ecology, air and water services, geo-environmental and sustainability amongst others.

Delta-Simons is proud to be a founder member of the Inogen Environmental Alliance, enabling us to efficiently deliver customer projects worldwide by calling upon over 5000 resources in our global network of consultants, each committed to providing superior EH&S and sustainability consulting expertise to our customers. Through Inogen we can offer our Clients more consultants, with more expertise in more countries than traditional multinational consultancy.

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Appendices

1.0 Introduction

1.1 Appointment

1.1.1 Delta-Simons Limited ("Delta-Simons") was instructed by EHPI Ltd (the "Client") to carry out updates to an existing Drainage Strategy for a planning application for a holiday park lodge in Rhuddlan, Denbighshire, LL18 5RS (the "Site"), for which the proposed development plan has been amended.

1.2 Project Understanding

1.2.1 New legislation (introduced with Schedule 3 of the Flood & Water Management Act) in Wales requires new development to have Sustainable Drainage Systems (SuDS) approval by the SuDS Approval Body (SAB) in conjunction with the planning process. Therefore, the Client has requested a DS in line with the above guidance to identify water management measures, including SuDS, to provide surface water runoff reduction and treatment.

1.3 Scope of Works

1.3.1 The proposed development will increase impermeable area and risk of surface water flooding to downstream receptors. Therefore, a Drainage Strategy with appropriate consideration for SuDS in line with CIRIA SuDS (C753) Guidance is required. The DS would include the following:

- Review existing conditions including sewer plans, British Geological Survey information and topographical information;
- Review Lead Local Flood Authority (LLFA) (Denbighshire County Council) drainage policies;
- Submit developer enquiry to LLFA and Dŵr Cymru (Welsh Water) (where required);
- Analyse existing and proposed impermeable areas;
- Calculate existing runoff rates (excluding existing drainage system modelling);
- Assess method of surface water runoff disposal (soakaway/watercourse/sewer);
- Establish surface water discharge rate in consultation with the LLFA/sewerage undertaker;
- Estimate required attenuation volume using MicroDrainage or similar;
- Assess and Advise on suitable forms of SUDS;
- Advise on drainage system maintenance measures;
- Advise on surface water treatment methods;
- Establish method of foul water drainage;
- Prepare concept drainage sketch (where development plan is available as dwg. format); and
- Prepare Drainage Strategy report;

1.3.2 This report considers the following national and local policies:

- Denbighshire County Council Local Development Plan (2006 – 2021)[1]
- Schedule 3 Surface Water Management Act (2010)[2]

1 https://www.denbighshire.gov.uk/en/resident/planning-and-building-regulations/local-development-plan/ldp-adopted-ldp/ldp-adopted-ldp.aspx
2 https://gweddill.gov.wales/docs/desh/publications/190108-suds-statutory-guidance-en.pdf

- CIRIA Guidance: The SuDS Manual (C753) (2017)[3]; and
- National Planning Policy Framework (NPPF) (2019)[4].

1.4 Sources of Information

1.4.1 The following sources of information have been reviewed and assessed for the purpose of this DS:

- British Geological Society (BGS) Interactive Map[5]; and
- MAGIC Interactive Map[6].

1.5 Project Limitations

1.5.1 The wider Delta-Simons limitations are contained within Appendix A.

3 https://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx
4 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/779764/NPPF_Feb_2019_web.pdf
5 http://mapapps.bgs.ac.uk/geologyofbritain/home.html
6 http://www.magic.gov.uk/

2.0 Site Description

2.1.1 The aim of this section of the report is to outline key environmental information associated with the baseline environment.

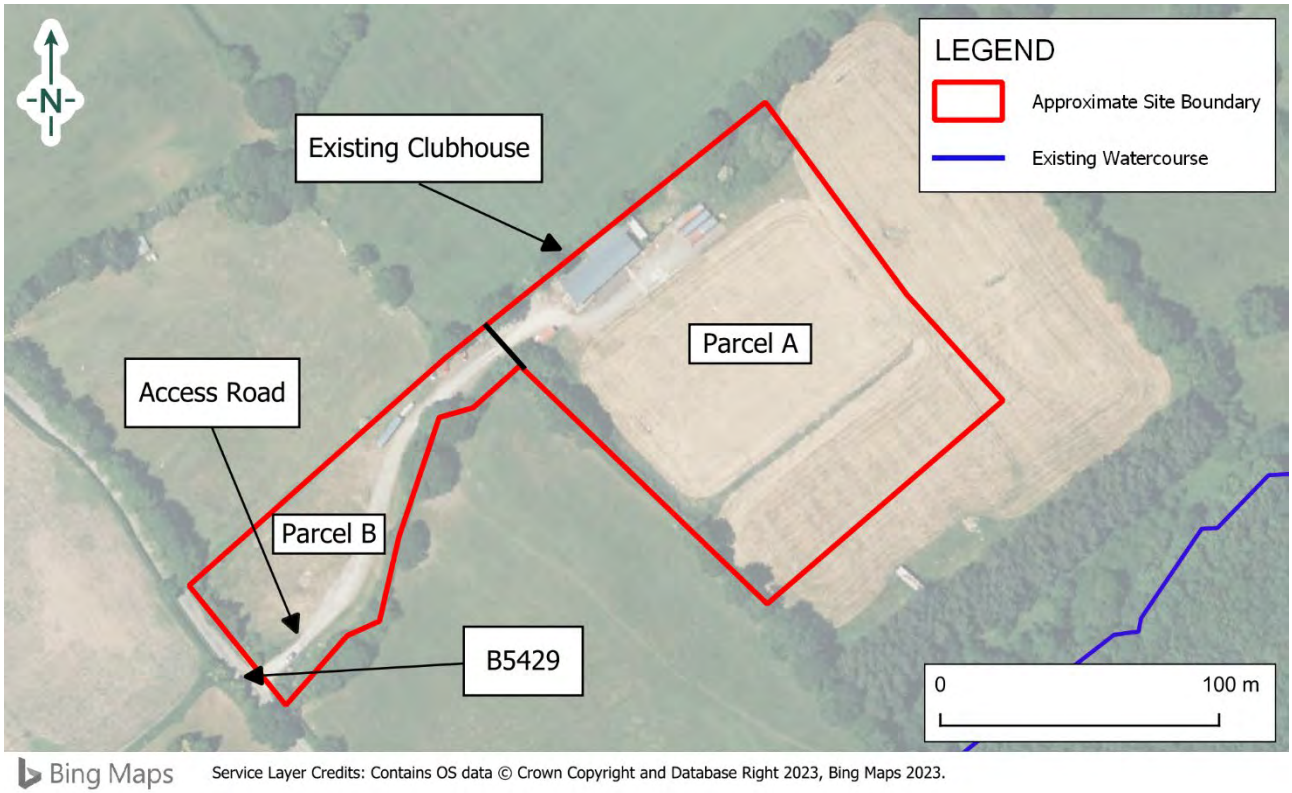


Figure 1: Site Location Plan

Co-ordinates	Centred approximately at National Grid Reference (NGR) 304760, 376800	**Area**	2.0947 Ha
Site Location	The Site is located approximately 2.5 km south-east from the town of Rhuddlan and comprises part of the former Rhyl Rugby Club sports ground. The Site is bound to the north by open agricultural fields, to the east by an existing rugby field beyond which is more agricultural land, to the south by another rugby field, beyond which lies the wider Tir-Hwch woodland and to the west by the B5429 with agricultural fields beyond.		
Existing Site Conditions	The Site includes one rugby pitch with associated club house, gravel access road, the Tir-Hwch Wood to the south and a pond to the north within an existing vegetated/woodland area north east of the club house. For the purposes of this assessment the Site is considered entirely greenfield in nature and has been split into two parcels based upon topography and existing drainage conveyance. The boundary of each parcel can be found in Figure 1. Parcel A occupies an area of approximately 1.605 ha, and Parcel B occupies approximately 0.49 ha.		
Topography	A topographical survey has been undertaken by Curvasure Professional Construction in December 2018 and is included in Appendix B. The topographical survey shows that the Site slopes from 35.79 metres Above Ordnance Datum (m AOD) in the north-east to 28.07 m AOD in the south-west.		

	Topographic levels to metres Above Ordnance Datum (m AOD) have also been derived from a 1 m resolution Environment Agency (EA) composite 'Light Detecting and Ranging' (LiDAR) Digital Terrain Model (DTM). A review of LiDAR ground elevation data shows that the Site slopes from approximately 35 m AOD in the north-east to approximately 29 m AOD in the south-west. [A LiDAR extract is included in Appendix C].
Hydrology	The nearest Ordinary Watercourse (under the jurisdiction of the LLFA) is the unnamed watercourse which is located approximately 90 m south-west of the Site. The watercourse flows in a generally east to westerly direction. The watercourse is culverted beneath the B5429 before discharging into the River Clwyd approximately 860 m west of the Site. A Drainage Ditch is also highlighted on the topographic survey, draining north to south adjacent to the B5429 to the west of the Site. The flow path of this drainage ditch has not been confirmed; however it is believed the ditch roughly follows the route of the B road before discharging into the Watercourse where the Watercourse intersects the road.
Geology	Reference to the British Geological Survey (BGS) online mapping (1:50,000 scale) indicates that the east of the site is underlain by superficial Devensian Till deposits whilst the western extent is underlain by Glaciofluvial Sand and Gravel deposits. The superficial deposits are identified as being underlain by Warwickshire Group Mudstone bedrock generally consisting of Mudstone, Siltstone and Sandstone. *The geological mapping is only available at a scale of 1:50,000 and therefore may not be a true reflection of the underlying ground conditions.* There are no historical BGS borehole records within close proximity of the Site.
Hydrogeology	According to the EA's Aquifer Designation data, obtained from MAGIC Map's online mapping [accessed 18/05/2023] indicates that the superficial deposits are classified as unproductive strata, which are 'rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow'. The Warwickshire Group Mudstone bedrock is classified as a Secondary A Aquifer. Secondary A Aquifers are 'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers;' Delta-Simons completed soakaway testing on Site to the BRE365 specification to establish infiltration rates and the suitability of infiltration as a surface water discharge method for the Site. During the site investigation dark brown Clay was encountered to depth (bottom of trial pit) in all test locations and was overlain by dark brown slightly sand clayey topsoil. The soakaway testing failed to produce viable infiltration results due to the relatively impermeable nature of the underlying geology. Soakaway test results have been made available in Appendix D. The EA's 'Source Protection Zones' data, obtained from MAGIC Map's online mapping [accessed 18/05/2023], indicates that the Site is not located within a Source Protection Zone (SPZ) or a Groundwater Vulnerability Zone (GVZ).
Local Drainage	Dŵr Cymru Welsh Water were contacted to provide public sewer plans within the vicinity of the Site. Dŵr Cymru Welsh Water confirm they hold no sewer assets in the area and therefore did not provide a sewer asset plan.
Proposed Site Conditions	Within Parcel A, the proposed development comprises the following: • 7 no. one bed units measuring 35 sqm each;

	• 7 no. two bed units measuring 51 sqm each; and • 5 no. three bed units measuring 64 sqm each. The former rugby club house is to be refurbished into a reception area, café and shop, and a pond is proposed to be located to the north-east within an existing vegetated/woodland area. Within Parcel B, the proposed development comprises the following: • 3 no. one bed units measuring 35 sqm each; and • 3 no. two bed units measuring 51 sqm each. Amenity space is to be provided within both Parcel A and B, and the Tir-Hwch Wood to the south is to be retained. There will be further hardstanding within both parcels associated with access roads and carparking. Proposed development plans can be found in Appendix E. Based upon the proposed development plan, the development will introduce approximately 1.13 ha of hardstanding in Parcel A. The existing club house roof area has also been incorporated within this calculation for completeness. Approximately 0.1 ha of new hardstanding will be introduced to Parcel B. In total, the proposed development will result in an increase in hardstanding of approximately 1.23 ha.

3.0 Relevant Planning Policy and Guidance

3.1 Introduction

3.1.1 The aim of this section of the report is to discuss the main aspects of the local and national planning policies that are relevant to any proposed development on the Site and relevant guidance and legislation.

3.2 Local policy

3.2.1 The Denbighshire County Council Local Development Plan (LDP) sets out the proposals and policies for future development and use of land in Denbighshire. The LDP was adopted in June 2013, and the following policies relate to SuDS:

Policy VOE 6 – Water Management

3.2.2 "All development will be required to incorporate water conservation measures, where practicable. Major development proposals (greater than 1,000 sqm floorspace or 10 dwellings) should be accompanied by a Water Conservation Statement".

3.2.3 "All development will be required to eliminate or reduce surface water run-off from the site, where practicable. The run-off rates from the site should maintain or reduce pre-development rates."

3.3 Consultation

3.3.1 Dŵr Cymru Welsh Water were contacted and confirm they hold no records of public foul, combined or surface water sewers within the vicinity of the proposed development.

4.0 Drainage Strategy

4.1 Introduction

4.1.1 The Site currently comprises undeveloped sports fields considered to be 100% permeable. An existing club house and access road along the northern periphery are considered hardstanding, but not formally drained. For the purposes of this assessment the entirety of the application Site is to be considered greenfield, and the proposed drainage system including the flow control has been preliminarily designer with this in mind.

4.1.2 The Site has been split into two parcels based upon natural drainage and topography. Parcel A is approximately 1.605 ha in size, whilst Parcel B is approximately 0.49 ha.

4.1.3 The proposed development will introduce 1.13 ha of hardstanding in parcel A in the form of buildings and access, and 0.1 ha of hardstanding in Parcel B, for a total of 1.23 ha of hardstanding introduced across the Site.

4.1.4 The increase in 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.

4.2 Drainage Hierarchy

4.2.1 The recommended surface water drainage hierarchy (Standard S1 of the Welsh Government: 'Recommended non-statutory standards for sustainable drainage (SuDS) in Wales (2018) sets out the following hierarchy of drainage options:

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

Priority Level 1: Surface Water Collected for Use

4.2.2 There is a limited foreseeable requirement for non-potable surface water at the Site, however the general maintenance and watering of soft landscaping and private garden areas along with the bicycle wash area proposed within Parcel B could benefit from the collection and reuse of a small proportion of the surface water generated on Site. Grey water reuse will therefore be included where possible on the site.

4.2.3 It must be noted that section G1.6 of the 'Recommended non-statutory standards for sustainable drainage (SuDS) in Wales' states that; *"in most cases, rainwater harvesting alone will not be adequate to deal with the site drainage and provision will be required for an overflow to a Level 2 or lower priority runoff destination."* As downstream provision of attenuation storage will be required to accommodate for rainwater harvesting system overflows, rainwater harvesting is not considered a cost-effective solution for managing surface water runoff as a whole, beyond the basic gardening operations detailed above.

Priority Level 2: Surface Water Infiltration

4.2.4 As detailed in Section 2.0, soakaway testing was completed by Delta-Simons in September 2019 to the BRE365 specification. Three tests were completed, and all tests failed to produce viable infiltration results. Considering this, infiltration solutions are not deemed feasible at this Site.

Priority Level 3: Surface Water Discharge to Watercourse

4.2.5 As soakaways are determined not to be suitable a connection to a watercourse is the next consideration.

4.2.6 The nearest watercourse is located to the south of Parcel A. The topographic survey does not extend to the watercourse itself, however it is clear that the topography of Parcel A slopes south, continuing this trend towards the watercourse (see Appendix B). The lowest point of the Parcel is the south west corner at 28.07 m AOD, and therefore it is considered feasible to discharge surface water from Parcel A into the Watercourse to the south of the parcel, ensuring a gravity fed connection. The Client has confirmed that their ownership runs up to the watercourse and therefore there are no third party land ownership issues. Surface water from this parcel is predicted to naturally flow into this Watercourse in the current scenario, and therefore discharging into the Watercourse is deemed to maintain the existing runoff regime.

4.2.7 Parcel B slopes east to west from a maximum elevation of approximately 33.00 m AOD to 29.10 m AOD towards the B5429. The topographic survey has identified a ditch along this road whereby surface water from this parcel may discharge into. The ditch is identified as having an invert level of 28.47m AOD. It is estimated that this ditch follows the B road southwards and discharges into the Watercourse identified above at its intersection with the road, however this has not been confirmed at the time of writing. Irrespective of the ditch outfall, surface water from Parcel B is currently predicted to flow into this ditch naturally. Therefore, the preferred option for discharge is to maintain the runoff regime as existing and discharge into the ditch at a controlled rate via a gravity fed connection.

4.2.8 It is recommended that a drainage survey is carried out at the ditch to identify its ultimate outfall, and its suitability for a formal connection from Parcel B of the proposed development.

Priority Level 4: Surface Water Discharge to Surface Water Sewer or Highway Drain

4.2.9 Consultation with Dŵr Cymru Welsh Water has confirmed no public utilities within the vicinity of the Site and therefore this option has not been considered further.

Priority Level 5: Surface Water Discharge to a Combined Sewer

4.2.10 As above, consultation with Dŵr Cymru Welsh Water has confirmed no public utilities within the vicinity of the Site.

4.3 Surface Water Discharge

4.3.1 In this instance, the preferred strategy is to discharge surface water from Parcel A into the Watercourse flowing east to west to the south of the Site. The outfall should be located to the south west of the parcel where levels are lowest facilitating gravity fed discharge. Surface water from Parcel B should discharge into the ditch to the west of the Site adjacent to the main access gate and the B5429 via a gravity fed connection. This ditch is likely to flow southwards adjacent to the B5429 before discharging into the Watercourse detailed above, however a drainage survey is recommended to confirm this.

4.3.2 The existing greenfield runoff rates have been estimated using the Interim Code of Practice for Sustainable Drainage Systems (ICP SuDS) Method, Summarised in Table 2 below. ICP SuDS calculations are included as Appendix F.

Table 2: Greenfield Runoff Rates

Return Period	Entire Site	Parcel A	Parcel B
	Runoff Rates (l/s)		
1 in 2	5.1	4.7	0.4
QBAR	5.4	5.0	0.4
1 in 30	9.7	8.9	0.8
1 in 100	12.0	11.0	1.0

4.3.3 A flow rate of 5.0 l/s is proposed for Parcel A, discharging into the watercourse to the south of the Site.

4.3.4 A flow rate of 2 l/s is proposed for Parcel B as the QBAR rate is very low. This is to ensure that the HydroBrake is self-cleansing. Surface water from Parcel B will discharge into the existing drainage ditch located adjacent to the Site access.

4.3.5 These flow rates ensure that the risk to downstream receptors will not be exacerbated and for events above the 1 in 2 year rainfall event, betterment will be achieved.

4.4 Attenuation Storage

4.4.1 The upper end allowance on peak rainfall intensity of 40% has been applied to storage calculations to commensurate to the lifespan of the proposed development.

4.4.2 In order to achieve a discharge rate of 5.0 l/s for Parcel A, and 2.0 l/s for Parcel B, attenuation storage will be required. Storage estimates have been provided using MicroDrainage and are included in Appendix G and summarised in Table 3 below.

Table 4: Attenuation Storage Volume Requirements

Storm Event	Parcel A	Parcel B
	Attenuation Volume (m^3)	
1 in 30 year +20% CC	624 - 824	28 – 44
1 in 100 year +40% CC	1051 - 1291	55 - 77

4.4.3 The attenuation volumes are provided for indicative purposes only and should be verified at the detailed design stage.

4.5 Sustainable Drainage Systems

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

Soakaways

4.5.2 As described above, soakaway testing was completed by Delta-Simons in September 2019 to the BRE365 specification. Three tests were completed, and all tests failed to produce viable infiltration results. Considering this, infiltration solutions are not deemed feasible at this Site.

Swales, Detention Basins and Ponds

4.5.3 Sufficient space is available on site to utilise ponds, basins or swales as above ground attenuation features. In order to facilitate gravity drainage, attenuation features should be located at the lower extents of each Parcel. MicroDrainage calculations are included as Appendix H.

Parcel A

4.5.4 Runoff from Parcel A may be attenuated via a storage pond in the southern extent of the parcel. The location of the pond is shown in the concept drainage sketch included in Appendix I. Proposed development plans (Appendix E) show an attenuation pond situated in the north-eastern extent of the Parcel. This area is unsuitable for an attenuation feature as it is a topographic high point. Therefore, it is recommended to direct surface water runoff to an attenuation pond in the southern extent of the Site. MicroDrainage calculations (included in Appendix H) indicate that 1100.7 m^3 of storage will be required to attenuate up to the 1 in 100 year event +40% CC. The proposed pond will have a base area of 930 m^2, a surface area of 1469 m^2, a depth of 1 m, and a 0.3 m freeboard. The 1 m design head of the pond will encompass 1101.6 m^3 of storage, enough to attenuate up to the 1 in 100 year event +40%CC. The 0.3 m freeboard also allows an additional 422 m^3 of storage that could be realised during a residual risk event. The natural topographic gradient within Parcel A will allow surface water runoff generated on-Site to be directed to the proposed attenuation pond via a gravity fed system, before ultimately discharging into the watercourse to the south of the Site at a controlled rate of 5 l/s.

Parcel B

4.5.5 Sufficient space is available on Site to utilise a pond and a system of swales as above ground attenuation features. In order to facilitate gravity drainage, attenuation features should be situated in the western area of Parcel B.

4.5.6 A swale located along the main access road with an area of approximately 22.57 m^2, a cross sectional width of 1 m and an average depth of 0.7 m may accommodate approximately 15.8 m^3 of attenuation storage within Parcel B. The remaining 61.2 m^3 of required storage may be provided with a combination of permeable paving within the access road (see below) and a small pond structure with a surface area of 90 m^2, a slope ratio of 1:3, a depth of 1.0 m with a 0.3 m freeboard located on the area of soft landscaping to the north of the access road and to the west of the parcel in general (see Appendix I for a Concept Drainage Sketch), allowing surface water to flow via gravity to the pond and in to the drainage channel to the south west.

4.5.7 The detail of the final proposed open surface water attenuation features will need to consider the site gradient and may require check damming to ensure adequate storage provision.

4.5.8 An open surface water attenuation feature such as a pond, basin or a swale in a residential area presents a safety risk; the hazards and appropriate mitigation should be considered at the detailed design stage.

Rainwater Harvesting

4.5.9 The attenuation benefits provided through the use of rainwater harvesting are considered to be limited and would only be realised when the tanks were not full. However, rainwater harvesting techniques could be incorporated within the final design.

Green Roofs

4.5.10 Green roofs are not identified on development plans. Given the nature of the proposed development, the significant additional cost involved in installing and maintaining green roofs and the additional works required to allow for the additional loading on the building, green roofs are not considered a practical option. The benefits achieved through installing a green roof would be disproportionate to the significant ongoing maintenance and construction costs involved.

Porous/Permeable Paving

4.5.11 As detailed above, permeable paving could be incorporated within private roads and driveways. Storage would be provided within the sub-grade material prior to controlled release to the receiving watercourse. The amount of storage offered by permeable paving is subject to sub-grade depth and Site gradient. Based upon the proposed development plan (Appendix E), private parking spaces in Parcel A considered suitable for permeable paving cover approximately 253.44 m^2. Within Parcel B, permeable paving could be incorporated in the proposed access road that runs through the centre of the Parcel. The access road in Parcel B occupies approximately 717.3 m^2.

4.5.12 Within Parcel A, based on an external paved area of private car parking spaces of approximately 253.44 m^2, a sub-grade depth of 0.3m and a void ratio of 30%, there is potential to accommodate 22.8 m^3 of attenuation storage within the sub-grade of permeable paving (assuming the base of the sub-grade will be formed at a level gradient).

4.5.13 Within Parcel B, based on an external paved area of approximately 717.3 m^2, a sub-grade depth of 0.3m and a void ratio of 30%, there is potential to accommodate 64.56 m^3 of attenuation storage within the sub-grade of permeable paving (assuming the base of the sub-grade will be formed at a level gradient).

Underground Attenuation Tanks

4.5.14 Storage for Parcels A and B could be provided within underground attenuation tanks or within oversized pipes. Sufficient space for an underground tank is provided within the POS and road network of each respective parcel.

4.6 Preferred Drainage Scheme

4.6.1 Surface water runoff up to the 1 in 100 year + 40% CC allowance event will be attenuated on Site. A total attenuation volume of 1100.7 m^3 within Parcel A, and 61.2 m^3 within Parcel B will be required to achieve the proposed discharge rates. Within Parcel A, storage will be provided by an attenuation pond located in the southern extent of the Site to maximise gravity fed discharge, and permeable paving within the private parking. Within Parcel B, storage may be provided by a swale running adjacent to the main access road running through the parcel, permeable paving within the access road and a small pond to the south west of the parcel within an area of soft landscaping again to maximise gravity fed discharge.

4.6.2 Surface water from Parcel A may discharge directly into the Watercourse flowing east to west to the south of the Site. The outfall should be located to the south west of the parcel where levels are lowest. Surface water from Parcel B should discharge into the ditch to the west of the Site adjacent to the main access gate and the B5429. The ditch is predicted to flow southwards adjacent to the B5429 before discharging into the Watercourse detailed above.

4.6.3 Surface water may be collected and reused at a volume commensurate for the general maintenance and watering of planters and garden areas, and for use within the proposed bicycle wash down area within Parcel B

4.6.4 An Indicative Drainage Sketch has been produced and made available in Appendix I to highlight the proposed storage and discharge locations.

4.6.5 As greenfield runoff rates are to be maintained, the proposed surface water drainage scheme will ensure no increase in runoff over the lifetime of the development.

4.7 Event Exceedance

4.7.1 Storage will be provided for the 1 in 100 year plus 40% CC event. Storm events in excess of the 1 in 100 year plus 40% CC event should be permitted to produce temporary shallow depth flooding within Low vulnerability POS and soft landscaped areas of the Site. Furthermore, the 0.3 m freeboard in the proposed attenuation pond in Parcel A will allow for an additional storage volume of 422.4 m^3 of attenuation which will allow for additional flood storage during a residual risk event. Finished floor levels will be set at a minimum of 150 mm above surrounding ground levels ensuring exceedance flooding will not affect the buildings.

4.8 Surface Water Treatment

4.8.1 In accordance with the CIRIA C753 publication 'The SuDS Manual' (2015), residential roofs have a 'very low' pollution hazard level, with low traffic roads classified as having a 'low' pollution hazard level. Table 1 below 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
Residential Roofs	Very Low	0.2*	0.2	0.05
Low Traffic 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.

** up to 0.8 where there is potential for metals to leach from the roof

4.8.2 Where practical, runoff from roofs and roads will be directed to permeable paving, ponds and swale systems. Table 2 below demonstrates that permeable paving, ponds and swales provide sufficient treatment.

Table 2: SuDS Mitigation Indices

	Mitigation Indices		
Type of SuDS	**Total Suspended Solids (TSS)**	**Metals**	**Hydrocarbons**
Permeable Pavement	0.7	0.6	0.7
Swale	0.5	0.6	0.6
Pond	0.7	0.7	0.5

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

4.8.3 It can be concluded that the inclusion of permeable paving, ponds and swales will provide sufficient treatment. Where attenuation is provided in a below ground system (tank storage), treatment will need to be provided by a suitably sized separator.

4.9 Maintenance

4.9.1 Maintenance of communal drainage features such as permeable paving or an attenuation tank will be the responsibility of the Site owner. Maintenance of shared surface water drainage systems can be arranged through appointment of a Site management company.

4.9.2 Maintenance schedules for an attenuation tank and permeable paving are included in Appendix J. Maintenance of the separator will be as per the manufacturer's guidance.

4.10 Foul Water Discharge

4.10.1 Consultation with Dŵr Cymru Welsh Water has confirmed no public foul or combined utilities within the vicinity of the Site. Therefore, Suitably sized biodisc treatment plants (or similar) within each parcel would be a feasible option and would provide sufficient treatment for foul flows. Treated effluent from Parcel A should be discharged to the Watercourse located to the south of the Site, and treatment water from Parcel B should be discharged to the ditch to the west. The sewerage treatment plants should be placed a minimum of 7m from habitable buildings and a minimum of 10m from watercourses. The treatment plants should be sized appropriately and maintained to the manufacturer's specification.

4.11 Water Conservation Statement

4.11.1 The following sustainable water systems will be considered for inclusion within the proposed holiday lodges and recreational building and will be incorporated should they be deemed feasible;

- Reduced Water Urinal Systems;
- Flow Restrictors;
- Spray Taps;
- Dual Flush WCs;
- Eco Showerheads; and
- Leak Detection.

5.0 Conclusions and Recommendations

5.1 Conclusions

5.1.1 Delta-Simons Limited ("Delta-Simons") was instructed by EHPI Ltd (the "Client") to carry out updates to an existing Drainage Strategy for a planning application for a holiday park lodge in Rhuddlan, Denbighshire, LL18 5RS (the "Site"), for which the proposed development plan has been amended.

- The Site currently comprises the former Rhyl Rugby Club sports ground considered entirely greenfield in nature. The Site is split into two parcels based upon topography and natural drainage. Parcel A occupies an area of approximately 1.605 ha, and Parcel B approximately 0.49 ha.
- Surface water runoff and storage calculations have been undertaken for each development parcel using ICP SuDS and MicroDrainage with a 40% allowance for Climate Change. Surface water runoff will be attenuated within each respective parcel, utilising a combination of pond structures, a swale running adjacent to the access road in Parcel B, and permeable paving within the proposed car parking areas and western access road in Parcel B.
- Surface water from Parcel A will discharge into the Watercourse flowing along the southern periphery at a controlled rate of 5 l/s, matching the QBAR greenfield rate. Surface water from Parcel B will discharge into the drainage ditch to the west of Parcel B at 2 l/s, to ensure the HydroBrake is self-cleansing.
- Restricting runoff to greenfield rates will ensure no increase in flood risk to downstream receptors post-development.
- Surface water may be collected and reused at a volume commensurate for the general maintenance and watering of planters and garden areas, and for use within the proposed bicycle wash down area.
- Pond and swale systems may provide habitat for nesting birds, waterfowl, invertebrates and reptiles, facilitate a level of water quality treatment and enhance the aesthetic value of the proposed development.
- Foul flows should be treated directly on Site within an appropriately sized biodisc treatment plant (or similar) within each parcel. Treated effluent from Parcel A should be discharged to the Watercourse located along the southern periphery of the Site, and treatment water from Parcel B should be discharged to the ditch to the west.

5.2 Recommendations

- Verify the attenuation volumes included in this report when undertaking detailed drainage design;
- Make provision for the sustainable drainage features highlighted within this report; and
- Survey the drainage ditch along the western periphery of Parcel B to confirm its outfall location, and to assess the suitability of the ditch for discharging surface water from Parcel B.

Appendix A – Limitations

Limitations

The recommendations contained in this Report represent Delta-Simons professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant. Delta-Simons does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

Delta-Simons obtained, reviewed and evaluated information in preparing this Report from the Client and others. Delta-Simons conclusions, opinions and recommendations has been determined using this information. Delta-Simons does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which Delta-Simons has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by Delta-Simons for the sole and exclusive use of the Client and for the specific purpose for which Delta-Simons was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Delta-Simons, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, Delta-Simons does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Delta-Simons from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by the Consultant.

Appendix B – Topographical Survey

Legend

Symbols

- Bollard
- Survey Station
- Electricity Pole
- Iron Water Gully
- Osbm
- Road Sign
- Shrubs
- Slope
- Stop Kerb
- Telegraph Pole
- Tree (Spread to scale)
- Tree Stump
- Ufills Marker Post
- Air Valve
- Flower Bed
- Bore Hole
- Bollard
- British Telecom Inspection Chamber
- Bus Stop
- Telegraph Pole
- British Telecom Inspection Chamber
- CCTV Closed Circuit Television Furniture
- Control Electricity Box (Above ground)
- Earth Rod
- Electricity Pole
- Fire Hydrant
- Gully
- Inspection Chamber
- Letter Box
- Manhole
- Ufills Marker Post
- Road Sign
- Rodding Eye
- Roan Water Gully
- Setting Out Point
- Stop Valve
- Stop Top
- Telephone Call Box
- Traffic Light
- Water Meter
- Boarded Wire Fence
- Close Boarded Fence
- Chain Link Fence
- Chestnut Paling
- Corrugated Iron Fence
- Iron Railing
- Larchlap Fence Panel
- Post & Chain
- Post & Wire Fence
- Retaining Wall
- Stell Palisade Fence
- Stock Proof Fence
- Wire Mesh Fence

Abbreviations

AV, BED, BH, BOL, BS, BT, CCTV, CES, DK, EK, EP, FH, GU, IC, LP, LB, MH, MP, P, RS, RE, RWG, SOP, ST, SV, TC, TL, WM

Boundary Abbreviations

B/W, C/B, C/E/, C/H, C/P, C/L, C/I, I/L, I/F, P/W, R/W, P/C, S/PAL, S/P, W/M

Title:
TOPOGRAPHIC SURVEY
RHYL RUGBY CLUB
CWM
RHYL
LL18 5RU

Client:
North Wales Construction Limited
C/o Landlock North Wales
Guilden Sutton Lane, Chester CH3 7EX

Notes:
1. Grid - Nad 83 to OS grid using OSGB 36
2. Datum - Nad 83 to OS datum using OSGB 36
3. Contour vertical interval = 1m
4. Survey orientated to grid north

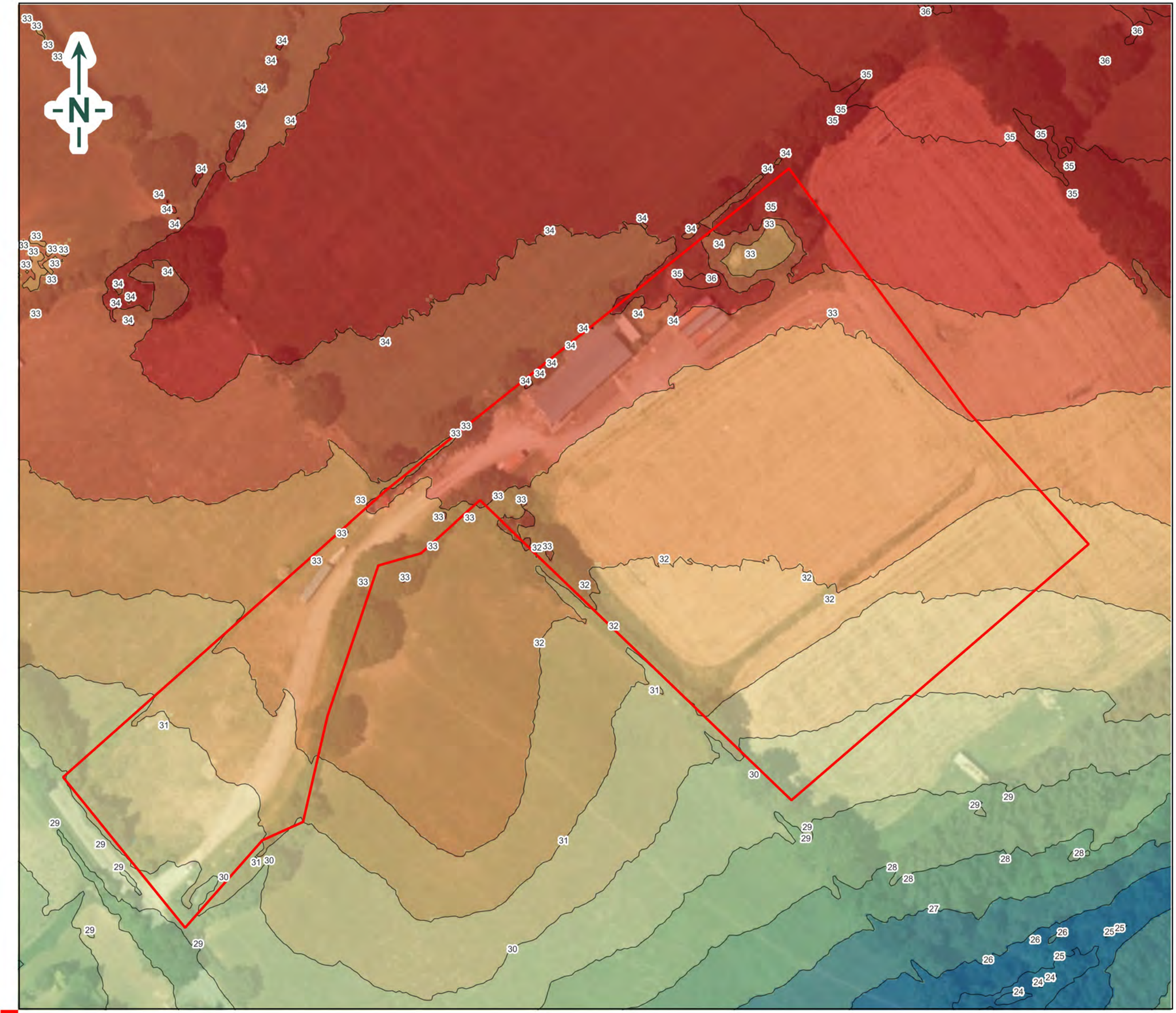
SCALE: 1:500@A0 DATE: 11/02/19 CHECKED: SR DWG NO. 18_Z20/01

Survey data and drawings produced by:

CURVASURE
PROFESSIONAL CONSTRUCTION

Curvasure limited a company registered in England and Wales. Company No. 4830137
Registered Office: 23 Princes Drive, Colwyn Bay, Conwy, LL29 8HT
t: 01492 532400 m: 07970 499236 f: 01492 532400 e: adam@curvasure.co.uk
www.curvasure.co.uk

Appendix C – LiDAR Plan



Legend

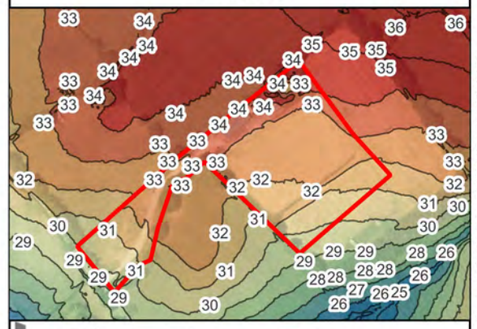
- Approximate Site Boundary
- Contours

Elevation (m AOD)

- <= 26
- 26 - 27
- 27 - 28
- 28 - 29
- 29 - 30
- 30 - 31
- 31 - 32
- 32 - 33
- 33 - 34
- > 34

0 10 20 30 40 50 m

Figure: LiDAR Plan		
Job: Holiday Lodge Park, Rhuddlan, Denbighshire, LL18 5RS		
Client: EHPI Ltd		
Appendix: C	Revision: A	Date: 11 July 2023
Drawn by: OE	Checked by: AP	Scale: 1:1,000
Job No.: 97109.5782		



Bing Maps | DeltaSimons

Site Plan Provided by Client.

C:\QGIS\22-1907.01 Holiday Park Denbighshire\prj\97109.578224 Holiday Park Rhuddlan.qgz

Appendix D – Soakaway Testing Results

deltasimons

DRILLERS BOREHOLE RECORD

Type of Drilling	Depth reached	Casing Diameter	Each Drive/Sample Diameter	Run length	% Recovery
TP	3				

LOCATION ID: SA 101

HAND PITS

Time Spent		
Depth		
Dimensions		

Project Name: Holiday Lodge Park, Denbighshire	Lead Driller: RA		
Project No: 19-1430.01	Assistant Driller:		
Client: North Wales Construction Ltd	Logged By: RA		
Plant Used: 4CX	Date:	Sheet: of	

GROUND CONDITIONS

Top	Base	Description	Recovery (%)
0.	0.05	Topsoil Dark brown Slightly Sandy clay	
0.05	0.1	Made ground crushed concrete brick slate gravelly made ground	
0.1	1.1	dark brown soft to Firm clay	
1.1	1.3	Dark brown Firm Slightly gravelly clay gravel is Fine to coarse	

SPT TEST

Test Depth	Seating Blows	Test	N Value	Remarks
1.3		Dark brown and grey/d mottled Firm to Stiff clay with occasional cobble		
1.9	3.0	Stiff Dark brown grey/d mottled clay		
		groundwater 2.4		

SPT CALIBRATION CERTIFICATE NO.

SAMPLES

Type	Ref	Top	Base

DRILLERS BOREHOLE RECORD

Location ID	SA007
Site	**Holiday Lodge park, Denbighshire**

WATER		
Strike depth:		Strike depth:
Rest depth:		Rest depth:
Rate of flow		Rate of flow
Observations		Observations
Water added from:		Water added from:
Water added to:		Water added to:

DIP DATA	Time	DTW	Time	DTW

NOTES: (delays, other tests taken, etc)

INSTALLS	Plain (m)		Slotted (m)		Bentonite pellets (m)		Gravel		Grout/ cement (m)		Arisings (m)		Sock (m)		Tap	Cover	Diameter	Base cap	Notes (e.g. Hole collapsed, pipe left out of ground etc)
	from	to	from	to	from	to	from	to	from	to	from	to	from	to					
			3																

INSTALLS	Plain (m)		Slotted (m)		Bentonite pellets (m)		Gravel		Grout/cement (m)		Arisings (m)		Sock (m)		Tap	Cover	Diameter	Base cap	Notes (e.g. Hole collapsed, pipe left out of ground etc)
	from	to	from	to	from	to	from	to	from	to	from	to	from	to					
			3																

Ground Conditions (Cont.)

Top	Base	Description	Recovery (%)
		depth 3m length 3.4 width 600 ground pole 3 to 2.4	

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DRILLERS BOREHOLE RECORD

Project Name: Holiday Lodge Park, Denbighshire	Lead Driller: RA
Project No: 19-1430.01	Assistant Driller:
Client: North Wales Construction Ltd	Logged By: RA
Plant Used: 4CX	Date: 19/09/ Sheet: of

Type of Drilling	Depth reached	Casing Diameter	Each Drive/Sample		
			Diameter	Run length	% Recovery
TP	2.8				

LOCATION ID	SA 102	
HAND PITS		
Time Spent		
Depth		
Dimensions		

GROUND CONDITIONS

Top	Base	Description	Recovery (%)
0	0.2	Dark brown clayey Topsoil with occasional gravel	
0.2	1.1	Dark brow Firm Clay with occasional Gravel	
1.1	2.1	Dark brown Firm to Stiff greyish mottled clay with cobbles pressent	
2.1	2.8	Very Stiff Dark brown greyish Mottled Clay	

Gravel to 2.3

SPT TEST

Test Depth	Seating Blows	Test	N Value	Remarks

SPT CALIBRATION CERTIFICATE NO.

SAMPLES

Type	Ref	Top	Base

DRILLERS BOREHOLE RECORD

Location ID	SA108
Site	Holiday Lodge park, Denbighshire

WATER		DIP DATA	Time	DTW	Time	DTW	NOTES: (delays, other tests taken, etc)
Strike depth:	Strike depth:						
Rest depth:	Rest depth:						
Rate of flow	Rate of flow						
Observations	Observations						
Water added from:	Water added from:						
Water added to:	Water added to:						

INSTALLS	Plain (m)		Slotted (m)		Bentonite pellets (m)		Gravel		Grout/ cement (m)		Arisings (m)		Sock (m)		Tap	Cover	Diameter	Base cap	Notes (e.g. Hole collapsed, pipe left out of ground etc)
	from	to	from	to	from	to	from	to	from	to	from	to	from	to					
			3																

INSTALLS	Plain (m)		Slotted (m)		Bentonite pellets (m)		Gravel		Grout/cement (m)		Arisings (m)		Sock (m)		Tap	Cover	Diameter	Base cap	Notes (e.g. Hole collapsed, pipe left out of ground etc)
	from	to	from	to	from	to	from	to	from	to	from	to	from	to					
			3																

Ground Conditions (Cont.)

Top	Base	Description	Recovery (%)
		3.4 Length	
		↕ Goo width	
		↕	
		2.8 in depth	
		Gravel pack 0.5	
		2.8 - 2.5	

deltasimons

DRILLERS BOREHOLE RECORD

Project Name: Holiday Lodge Park, Denbighshire	Lead Driller: RA
Project No: 19-1430.01	Assistant Driller:
Client: North Wales Construction Ltd	Logged By: RA
Plant Used: 4 CX	Date: 19/09 Sheet: of

Type of Drilling	Depth reached	Casing Diameter	Each Drive/Sample Diameter	Each Drive/Sample Run length	Each Drive/Sample % Recovery
TP	2.9				

LOCATION ID	SA103	
HAND PITS		
Time Spent		
Depth		
Dimensions		

GROUND CONDITIONS

Top	Base	Description	Recovery (%)
0	0.3	Topsoil Dark brown slightly clayey	
0.3	0.5	Dark brow soft to firm clay	
0.5	1.7	Firm dark brown greyish mottled clay with ocasional cobble & gravel	
1.7	2.9	Very stiff Dark brown ~~dark~~ greish mottled clay	

SPT TEST

Test Depth	Seating Blows	Test	N Value	Remarks

SPT CALIBRATION CERTIFICATE NO.

SAMPLES

Type	Ref	Top	Base

2.9 - 2.4

DRILLERS BOREHOLE RECORD

Location ID	BH3
Site	Holiday Lodge park, Denbighshire

WATER		
	Strike depth:	Strike depth:
	Rest depth:	Rest depth:
	Rate of flow	Rate of flow
	Observations	Observations
	Water added from:	Water added from:
	Water added to:	Water added to:

DIP DATA	Time	DTW	Time	DTW

NOTES: (delays, other tests taken, etc)

INSTALLS	Plain (m)		Slotted (m)		Bentonite pellets (m)		Gravel		Grout/ cement (m)		Arisings (m)		Sock (m)		Tap	Cover	Diameter	Base cap	Notes (e.g. Hole collapsed, pipe left out of ground etc)
	from	to	from	to	from	to	from	to	from	to	from	to	from	to					
			3																

INSTALLS	Plain (m)		Slotted (m)		Bentonite pellets (m)		Gravel		Grout/cement (m)		Arisings (m)		Sock (m)		Tap	Cover	Diameter	Base cap	Notes (e.g. Hole collapsed, pipe left out of ground etc)
	from	to	from	to	from	to	from	to	from	to	from	to	from	to					
			3																

Ground Conditions (Cont.)

Top	Base	Description	Recovery (%)
		depth 2.9	
		width 600	
		length 3.4	
		0.5 Gravel 2.9 to 2.4	

deltasimons

PERMABILITY TESTING

Address: 3 Henley Office Park, Doddington Road, Lincoln, LN6 3QR			
Tel: 01522 882 555	Fax: 01522 698393	Mobile: 07879 490 330	
Client	North Wales Construction Ltd	Date	19/9/19
Site	Holiday Lodge Par, Denbighshire	Job/Order Number	19-1430.01

Trial pit No	SA107	Water level prior to test			2.42
Trial Pit Dimensions		Trial pit topped up to			330
Trial pit width	600	Approximate quantity of water added			
Trial pit length	3.4	Gravel pack installed:	From 3	To:	2.4
Trial pit depth	3	Page number	1 Of:		2

Test 1			Test 2			Test 3		
Time	Time (min/sec)	Water level	Time	Time (min/sec)	Water level	Time	Time (min/sec)	Water level
12 10	0	2.42						
1210	30	2.40						
1211	1	2.39						
1212	2	2.39						
1213	3	2.39						
1214	4	2.39						
1215	5	2.39						
1225	15	2.37						
1255	45	2.36						
1325	1hr15	2.35						
1410	2hr	2.34						
1510	3hr	2.34						
1610	4hr	2.34						
Test 1 continued over page			Test 2 continued over page			Test 3 continued over page		

SA101

deltasimons

PERMABILITY TESTING

Test 1 continued...			Test 2 continued...			Test 3 continued...		
Time	Time (min/sec)	Water level	Time	Time (min/sec)	Water level	Time	Time (min/sec)	Water level

Notes

Lizzy asked to do a 5hr test only

deltasimons

PERMABILITY TESTING

Address: 3 Henley Office Park, Doddington Road, Lincoln, LN6 3QR			
Tel: 01522 882 555	Fax: 01522 698393	Mobile: 07879 490 330	
Client	North Wales Construction Ltd	Date	19/9/19
Site	Holiday Lodge Par, Denbighshire	Job/Order Number	19-1430.01

Trial pit No	SA102	Water level prior to test			—
Trial Pit Dimensions		Trial pit topped up to			2.45
Trial pit width	600	Approximate quantity of water added			330
Trial pit length	3.4	Gravel pack installed:	From	2.8	To: 2.3
Trial pit depth	2.8	Page number	1	Of:	2

Test 1			Test 2			Test 3		
Time	Time (min/sec)	Water level	Time	Time (min/sec)	Water level	Time	Time (min/sec)	Water level
1086	0	2.45						
1026	30	2.43						
1027	1	2.43						
1028	2	2.42						
1029	3	2.41						
1030	4	2.40						
1031	5	2.40						
1036	10	2.38						
1041	15	2.37						
1106	40	2.35						
1140	1hr15	2.34						
1211	1hr55	2.34						
1226	2hr	2.33						
1526	3hr	2.33						
1426	4hr	2.33						
1526	5hr	2.32						
Test 1 continued over page			Test 2 continued over page			Test 3 continued over page		

SA102

deltasimons

PERMABILITY TESTING

Test 1 continued...			Test 2 continued...			Test 3 continued...		
Time	Time (min/sec)	Water level	Time	Time (min/sec)	Water level	Time	Time (min/sec)	Water level

Notes

Cold Morning, dry weather, Moist ground

Lizzy asked to do 5 hr test only

deltasimons

PERMABILITY TESTING

Address: 3 Henley Office Park, Doddington Road, Lincoln, LN6 3QR			
Tel: 01522 882 555	Fax: 01522 698393	Mobile: 07879 490 330	
Client	North Wales Construction Ltd	Date	19/9/19
Site	Holiday Lodge Par, Denbighshire	Job/Order Number	19-1430.01

Trial pit No	SA 107	Water level prior to test			2.42
Trial Pit Dimensions		Trial pit topped up to			
Trial pit width	600	Approximate quantity of water added			270
Trial pit length	3.4	Gravel pack installed:	From 2.9	To:	2.4
Trial pit depth	2.9	Page number	1 Of:		2

Test 1			Test 2			Test 3		
Time	Time (min/sec)	Water level	Time	Time (min/sec)	Water level	Time	Time (min/sec)	Water level
1152	0.	2.42						
1152	30	2.45						
1153	1	2.41						
1154	2	2.40						
1155	3	2.39						
1156	4	2.38						
1157	5	2.37						
1202	10	2.34						
1217	25	2.30						
1252	1hr	2.28						
1322	1 30	2.27						
1352	2hr	2.26						
1452	3hr	2.25						
1552	4hr	2.24						
Test 1 continued over page			Test 2 continued over page			Test 3 continued over page		

SA103

deltasimons

PERMABILITY TESTING

Test 1 continued...			Test 2 continued...			Test 3 continued...		
Time	Time (min/sec)	Water level	Time	Time (min/sec)	Water level	Time	Time (min/sec)	Water level

Notes

Cold mornings / moist ground / Dry weather

Lizzy asked to do a 5 hr test only

Appendix E – Proposed Development Plans

Drawing Key

- Site Boundary (18,861m²)
- Ownership Boundary
- Existing Buildings
- Existing Highway
- Existing Recreation Site
- Existing Track
- Inland Water Source
- Existing Tree/Hedge
- Existing Fence/Gate
- Existing RPA Area

1.22m RH

29.1m

Path (um)

N

PARC FFORDD Y WAEN

RHUDDLAN, NORTH WALES

Project. Former Rhyl & District Rugby Club, Waen, Rhuddlan

Drawing No. 21Y.A001 | Revision. P03

Scale. 1:1000 | Paper Size. A3 | Date. 24.08.22

Existing Site Location Plan

Drawing Key

- Site Boundary (18,861m²)
- Ownership Boundary
- Existing Buildings
- Existing Highway
- Existing Recreation Site
- Existing Track
- Inland Water Source
- Existing Tree/Hedge
- Existing Fence/Gate
- Existing RPA Area
- +m Existing Site Level

Drawing Label Key

01/ Existing brownfield land (formerly rugby pitches).
02/ Vacant club house building.
03/ Existing vehicular access from highway (B5429).
04/ Existing access road within the site.
05/ Existing parking and turning area.
06/ Existing pathways and railings.
07/ Existing trees and hedgerows to the perimiter of the site.
08/ Existing secure and gated storage area.
09/ Existing pond within dense vegetation.

PARC FFORDD Y WAEN

RHUDDLAN, NORTH WALES

Project. Former Rhyl & District Rugby Club, Waen, Rhuddlan

Drawing No. 21Y.A002 | Revision. P03

Scale. 1:500 | Paper Size. A3 | Date. 24.08.22

Existing Site Plan (1 of 2)

Drawing Key

- Site Boundary (18,861m²)
- Ownership Boundary
- Existing Buildings
- Existing Highway
- Existing Recreation Site
- Existing Track
- Inland Water Source
- Existing Tree/Hedge
- Existing Fence/Gate
- Existing RPA Area
- ⊕ +m Existing Site Level

Drawing Label Key

01/ Existing brownfield land (formerly rugby pitches).
02/ Vacant club house building.
03/ Existing vehicular access from highway (B5429).
04/ Existing access road within the site.
05/ Existing parking and turning area.
06/ Existing pathways and railings.
07/ Existing trees and hedgerows to the perimiter of the site.
08/ Existing secure and gated storage area.
09/ Existing pond within dense vegetation.

N

PARC FFORDD Y WAEN

RHUDDLAN, NORTH WALES

Project. Former Rhyl & District Rugby Club, Waen, Rhuddlan

Drawing No. 21Y.A003 | Revision. P03

Scale. 1:500 | Paper Size. A3 | Date. 24.08.22

Existing Site Plan (2 of 2)

Schedule of Accommodation

25 no. leisure units of three typologies.

40 no. guest & 12 no. staff/visitor parking spaces.

Unit Type 1/ 3 Bedroom Unit

Units 14, 15, 16, 18 & 19 (5 units).
All units inclusive of 2 no. parking spaces (10 total).

Unit Type 2/ 2 Bedroom Unit

Properties 1, 2, 4, 11, 12, 13, 21, 22, 23 & 24 (10 units).
All units inclusive of 2 no. parking spaces (20 total).

Unit Type 3/ 1 Bedroom Unit

Properties 3, 5, 6, 7, 8, 9, 10, 17, 20 & 25 (10 units).
All units inclusive of 1 no. parking spaces (10 total).

Drawing Key

- Site Boundary (18,861m²)
- Ownership Boundary
- Existing Buildings
- Existing Highway
- Existing Recreation Site
- Existing Track
- Inland Water Source
- Existing Tree/Hedge
- Existing Fence/Gate
- Existing RPA Area
- Proposed Leisure Unit (1)
- Proposed Landscape Area
- Proposed Leisure Unit (2)
- Proposed Decking
- Proposed Leisure Unit (3)
- Proposed Planting
- Proposed Guest Parking
- Proposed Pathway

29.1m

Path (um)

N

PARC FFORDD Y WAEN

RHUDDLAN, NORTH WALES

Project. Former Rhyl & District Rugby Club, Waen, Rhuddlan

Drawing No. 21Y.A004 | Revision. P04

Scale. 1:1000 | Paper Size. A3 | Date. 24.08.22

Proposed Site Location Plan

Drawing Key

- Site Boundary (18,861m²)
- Ownership Boundary
- Existing Buildings
- Existing Highway
- Existing Recreation Site
- Existing Track
- Inland Water Source
- Existing Tree/Hedge
- Existing Fence/Gate
- Existing RPA Area
- Existing Site Level
- Proposed Site Level
- Proposed Leisure Unit (1)
- Proposed Landscape Area
- Proposed Leisure Unit (2)
- Proposed Guest Parking
- Proposed Leisure Unit (3)
- Proposed Planting
- Proposed Access Road
- Proposed Pathway
- Proposed Visibility Splay

Drawing Label Key

01/ Proposed leisure development on brownfield land.
02/ Refurbishment of existing club house into guest facilities.
03/ Relocation of existing vehicular access from highway.
04/ Proposed 4.8m wide access road throughout the site.
05/ Proposed visitor and staff parking area.
06/ Proposed outdoor entertainment play area.
07/ Existing trees and hedgerows to the perimeter of the site.
08/ Proposed facility maintenance and bulk bin storage.
09/ Existing pond within dense vegetation.
10/ Parking area for units 21, 22, 23, 24 and 25.
11/ Proposed boundary hedgerow.

Schedule of Accommodation

25 no. leisure units of three typologies.

40 no. guest & 12 no. staff/visitor parking spaces.

Unit Type 1/ 3 Bedroom Unit
Units 14, 15, 16, 18 & 19 (5 units).
All units inclusive of 2 no. parking spaces (10 total).

Unit Type 2/ 2 Bedroom Unit
Properties 1, 2, 4, 11, 12, 13, 21, 22, 23 & 24 (10 units).
All units inclusive of 2 no. parking spaces (20 total).

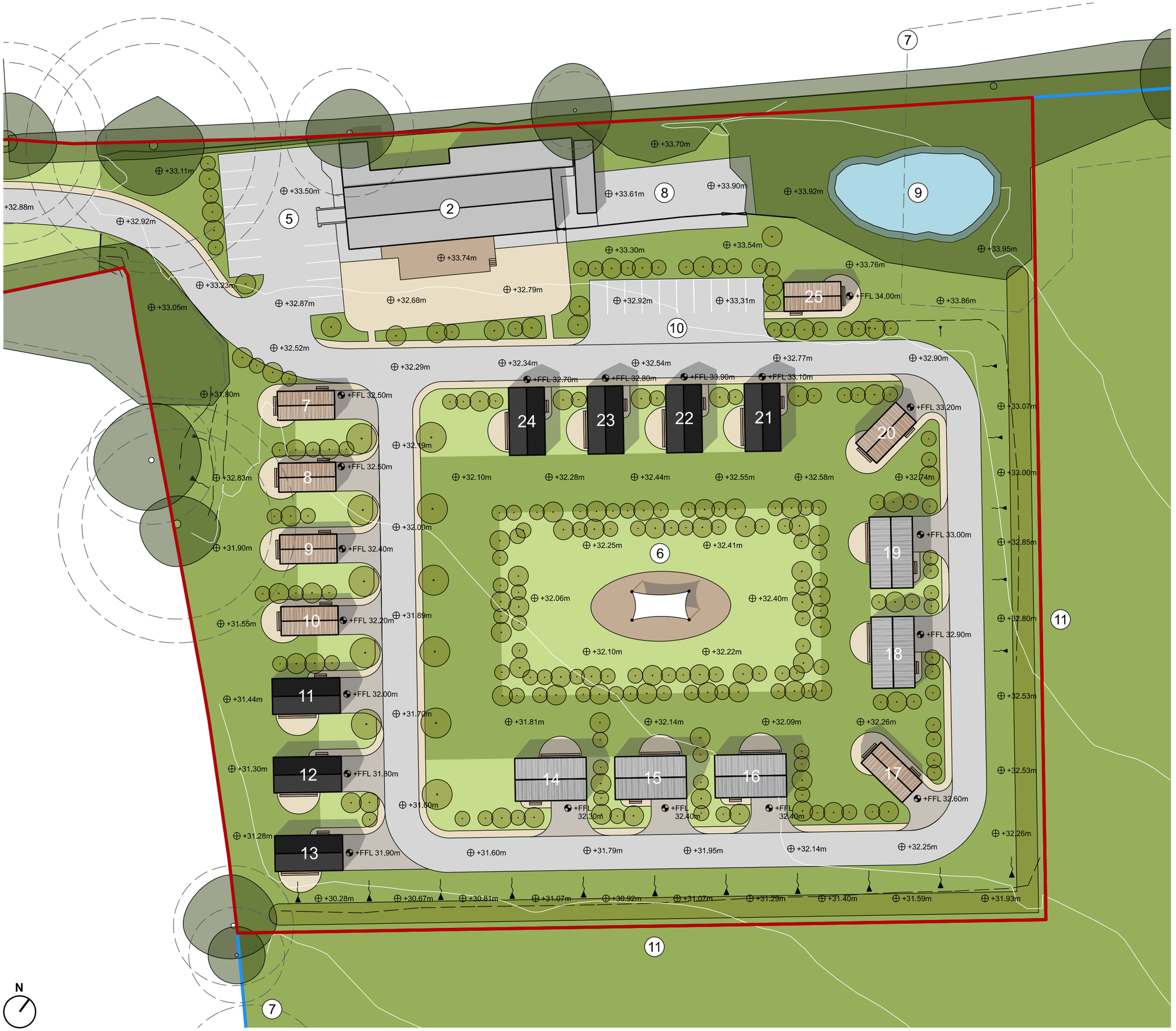
Unit Type 3/ 1 Bedroom Unit
Properties 3, 5, 6, 7, 8, 9, 10, 17, 20 & 25 (10 units).
All units inclusive of 1 no. parking spaces (10 total).

PARC FFORDD Y WAEN

RHUDDLAN, NORTH WALES

Project. Former Rhyl & District Rugby Club, Waen, Rhuddlan
Drawing No. 21Y.A005 | Revision. P04
Scale. 1:500 | Paper Size. A3 | Date. 24.08.22

Proposed Site Plan (1 of 2)



Drawing Key

- Site Boundary (18,861m²)
- Ownership Boundary
- Existing Buildings
- Existing Highway
- Existing Recreation Site
- Existing Track
- Inland Water Source
- Existing Tree/Hedge
- Existing Fence/Gate
- Existing RPA Area
- Existing Site Level
- Proposed Site Level
- Proposed Leisure Unit (1)
- Proposed Landscape Area
- Proposed Leisure Unit (2)
- Proposed Guest Parking
- Proposed Leisure Unit (3)
- Proposed Planting
- Proposed Access Road
- Proposed Pathway
- Proposed Visibility Splay

Drawing Label Key

01/ Proposed leisure development on brownfield land.
02/ Refurbishment of existing club house into guest facilities.
03/ Relocation of existing vehicular access from highway.
04/ Proposed 4.8m wide access road throughout the site.
05/ Proposed visitor and staff parking area.
06/ Proposed outdoor entertainment play area.
07/ Existing trees and hedgerows to the perimeter of the site.
08/ Proposed facility maintenance and bulk bin storage.
09/ Existing pond within dense vegetation.
10/ Parking area for units 21, 22, 23, 24 and 25.
11/ Proposed boundary hedgerow.

Schedule of Accommodation

25 no. leisure units of three typologies.

40 no. guest & 12 no. staff/visitor parking spaces.

Unit Type 1/ 3 Bedroom Unit
Units 14, 15, 16, 18 & 19 (5 units).
All units inclusive of 2 no. parking spaces (10 total).

Unit Type 2/ 2 Bedroom Unit
Properties 1, 2, 4, 11, 12, 13, 21, 22, 23 & 24 (10 units).
All units inclusive of 2 no. parking spaces (20 total).

Unit Type 3/ 1 Bedroom Unit
Properties 3, 5, 6, 7, 8, 9, 10, 17, 20 & 25 (10 units).
All units inclusive of 1 no. parking spaces (10 total).

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RHUDDLAN, NORTH WALES

Project. Former Rhyl & District Rugby Club, Waen, Rhuddlan
Drawing No. 21Y.A006 | Revision. P04
Scale. 1:500 | Paper Size. A3 | Date. 24.08.22

Proposed Site Plan (2 of 2)

Drawing Key

- Site Boundary (18,861m²)
- Ownership Boundary
- Existing Buildings
- Existing Highway
- Existing Recreation Site
- Existing Track
- Inland Water Source
- Existing Tree/Hedge
- Existing Fence/Gate
- Existing RPA Area
- Existing Site Level
- Proposed Site Level
- Proposed Leisure Unit (1)
- Proposed Landscape Area
- Proposed Leisure Unit (2)
- Proposed Guest Parking
- Proposed Leisure Unit (3)
- Proposed Planting
- Proposed Access Road
- Proposed Pathway
- Proposed Visibility Splay

Proposed Landscape Plan

Trees

PT1/ Proposed boulevard tree planting: Betula Pendula, Pyrus Calleryana 'Chanticleer', Prunus Avium and Tilia Cordata 'Streetwise'

PT2/ Proposed native tree planting to leisure units: Acer Campestre, Alnus Incana, Crataegus Monogyna, Malus Sylvestris, Prunus Avium, Prunus Padus, Quercus Robur, Sorbus Aucuparia and Tilia Cordata

Hedgerow

PH1/ Proposed native hedgerow to site perimeter: Acer Campestre, Corylus Avellana, Crataegus Monogyna, Prunus Padus, Prunus Spinosa and Rosa Canina.

Shrubs/Flowers

PS1/ Proposed decorative shrubs to entrance and ground cover planting: Acer Campestre, Corylus Avellana, Crataegus Monogyna, Ilex Aquifolium, Prunus Avium, Sorbus Aucuparia and Sorbus Torminalis

PF1/ Proposed wild flower meadow.

PF2/ Proposed communal grass area for games and barbecues.

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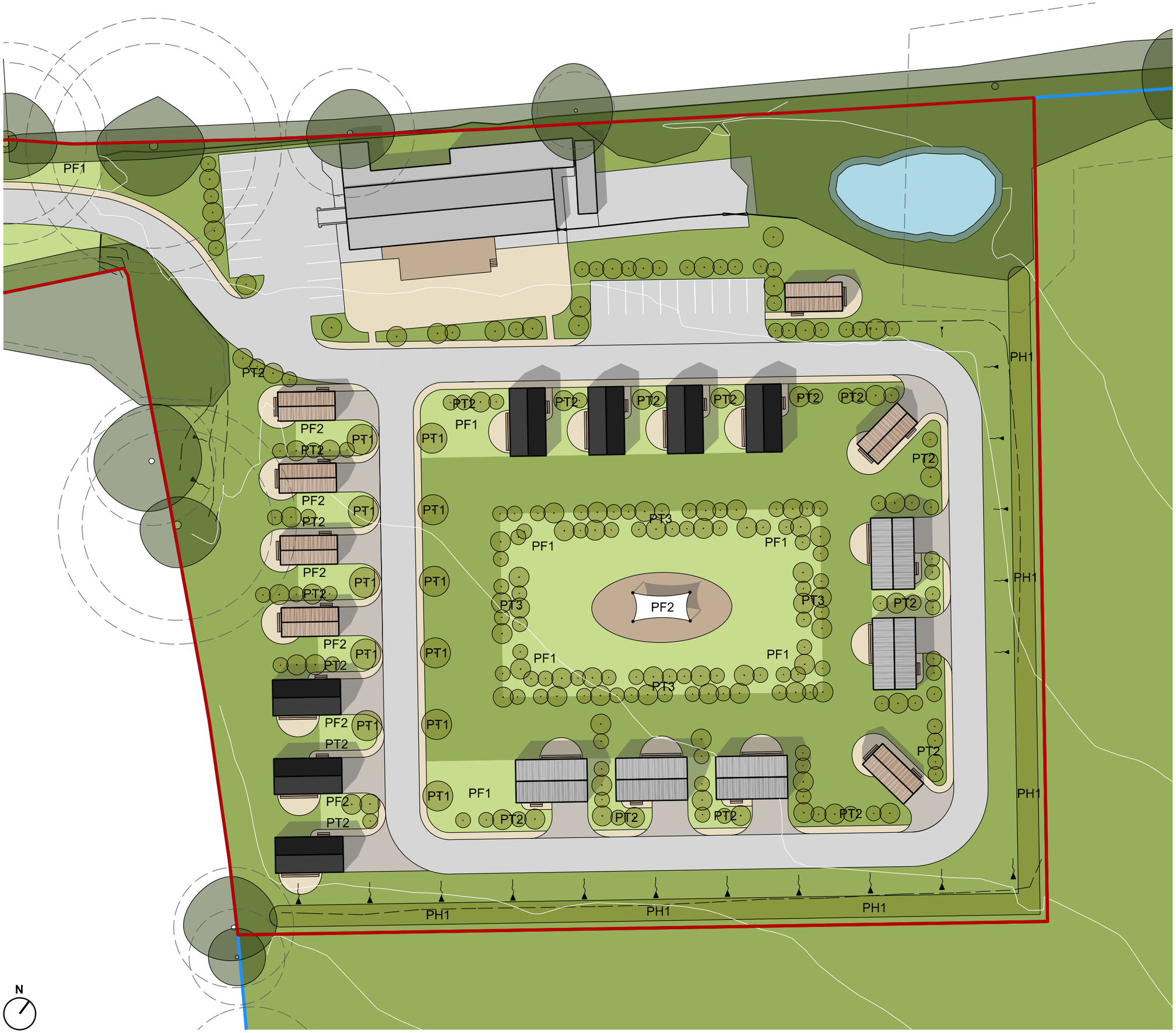
RHUDDLAN, NORTH WALES

Project. Former Rhyl & District Rugby Club, Waen, Rhuddlan

Drawing No. 21Y.A007 | Revision. P01

Scale. 1:500 | Paper Size. A3 | Date. 24.08.22

Proposed Landscape Plan (1 of 2)



Drawing Key

- Site Boundary (18,861m²)
- Ownership Boundary
- Existing Buildings
- Existing Highway
- Existing Recreation Site
- Existing Track
- Inland Water Source
- Existing Tree/Hedge
- Existing Fence/Gate
- Existing RPA Area
- Existing Site Level
- Proposed Site Level
- Proposed Leisure Unit (1)
- Proposed Landscape Area
- Proposed Leisure Unit (2)
- Proposed Guest Parking
- Proposed Leisure Unit (3)
- Proposed Planting
- Proposed Access Road
- Proposed Pathway
- Proposed Visibility Splay

Proposed Landscape Plan

Trees

PT1/ Proposed boulevard tree planting: Betula Pendula, Pyrus Calleryana 'Chanticleer', Prunus Avium and Tilia Cordata 'Streetwise'

PT2/ Proposed native tree planting to leisure units: Acer Campestre, Alnus Incana, Crataegus Monogyna, Malus Sylvestris, Prunus Avium, Prunus Padus, Quercus Robur, Sorbus Aucuparia and Tilia Cordata

Hedgerow

PH1/ Proposed native hedgerow to site perimeter: Acer Campestre, Corylus Avellana, Crataegus Monogyna, Prunus Padus, Prunus Spinosa and Rosa Canina.

Shrubs/Flowers

PS1/ Proposed decorative shrubs to entrance and ground cover planting: Acer Campestre, Corylus Avellana, Crataegus Monogyna, Ilex Aquifolium, Prunus Avium, Sorbus Aucuparia and Sorbus Torminalis

PF1/ Proposed wild flower meadow.

PF2/ Proposed communal grass area for games and barbecues.

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RHUDDLAN, NORTH WALES

Project. Former Rhyl & District Rugby Club, Waen, Rhuddlan

Drawing No. 21Y.A008 | Revision. P01

Scale. 1:500 | Paper Size. A3 | Date. 24.08.22

Proposed Landscape Plan (2 of 2)

Drawing Key

- Site Boundary (18,861m²)
- Existing Buildings
- Existing Recreation Site
- Inland Water Source
- Existing Fence/Gate
- Proposed Leisure Unit (1)
- Proposed Leisure Unit (2)
- Proposed Guest Parking
- Proposed Pathway
- Ownership Boundary
- Existing Highway
- Existing Track
- Existing Tree/Hedge
- Existing RPA Area
- Proposed Landscape Area
- Proposed Decking
- Proposed Planting

Drawing Label Key

01/ Proposed leisure development on brownfield land.
02/ Refurbishment of existing club house into guest facilities.
03/ Relocation of existing vehicular access from highway.
04/ Proposed 4.8m wide access road throughout the site.
05/ Proposed visitor and staff parking area.
06/ Proposed outdoor entertainment play area.
07/ Existing trees and hedgerows to the perimeter of the site.
08/ Proposed facility maintenance and bulk bin storage.
09/ Existing pond within dense vegetation.
10/ Parking area for units 21, 22, 23, 24 and 25.
11/ Proposed boundary hedgerow.

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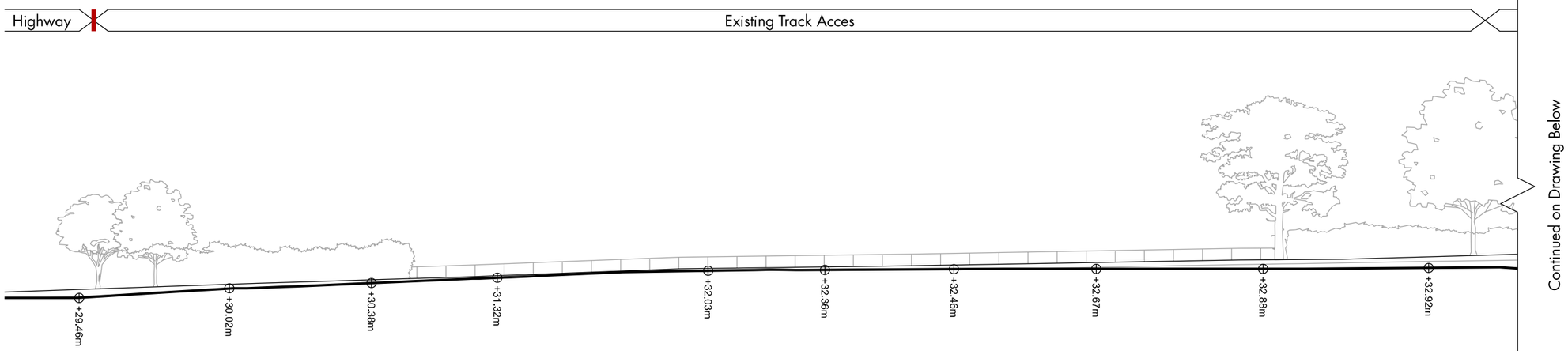
RHUDDLAN, NORTH WALES

Project. Former Rhyl & District Rugby Club, Waen, Rhuddlan

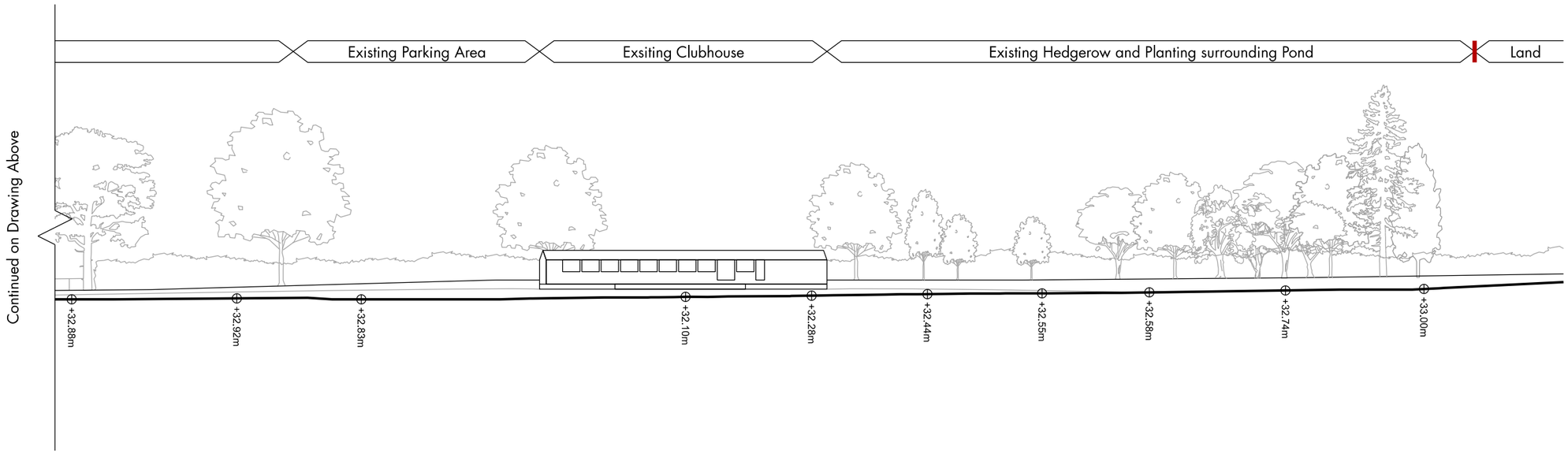
Drawing No. 21Y.A009 | Revision. P01

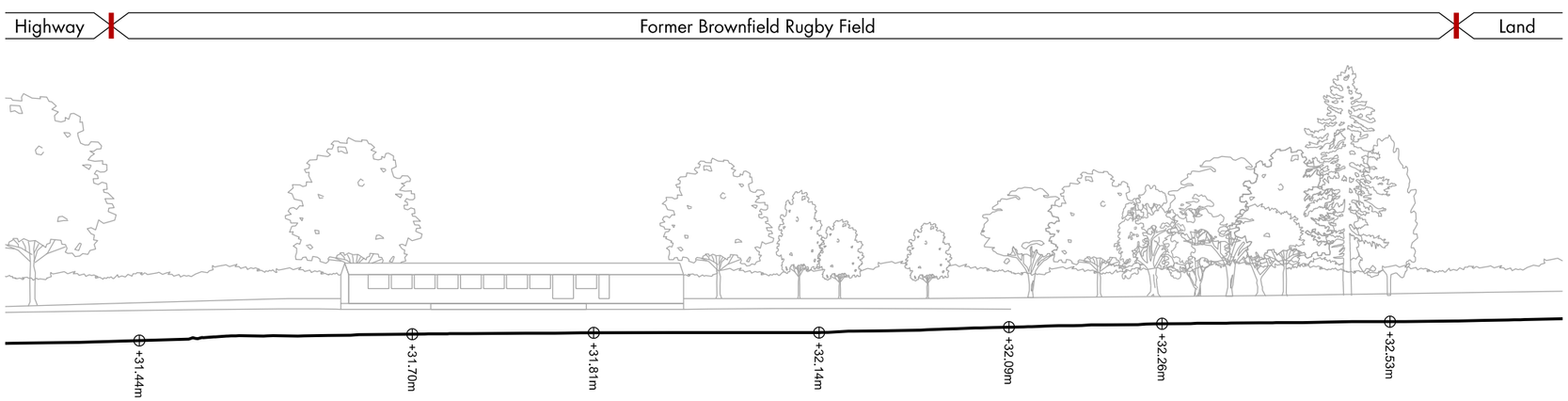
Scale. 1:500 | Paper Size. A3 | Date. 24.08.22

Proposed Access Plan



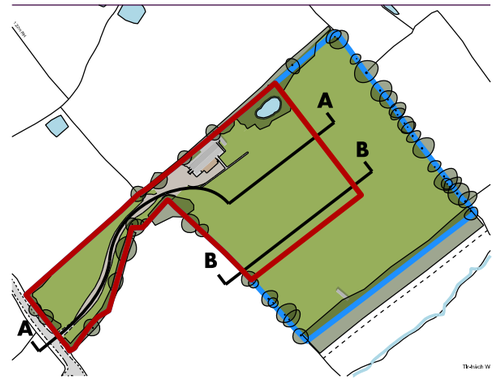
Existing Site Section AA





Existing Site Section BB

Existing Site Location Plan 1:5000



Drawing Key

Site Boundary (18,861m²) ⊕+m Existing Site Level

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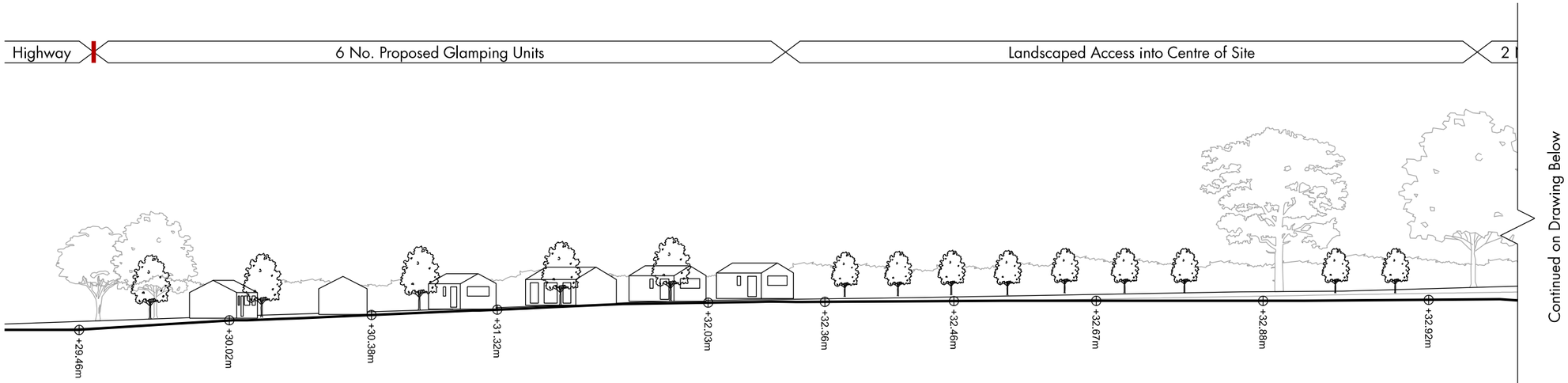
RHUDDLAN, NORTH WALES

Project. Former Rhyl & District Rugby Club, Waen, Rhuddlan

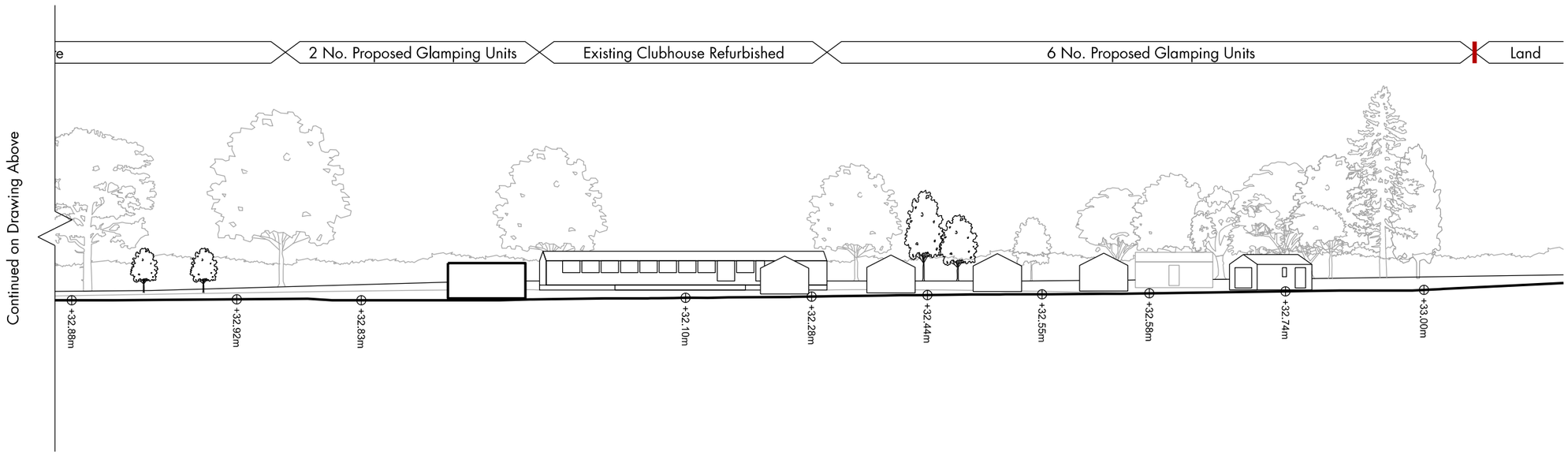
Drawing No. 21Y.A010 | Revision. P01

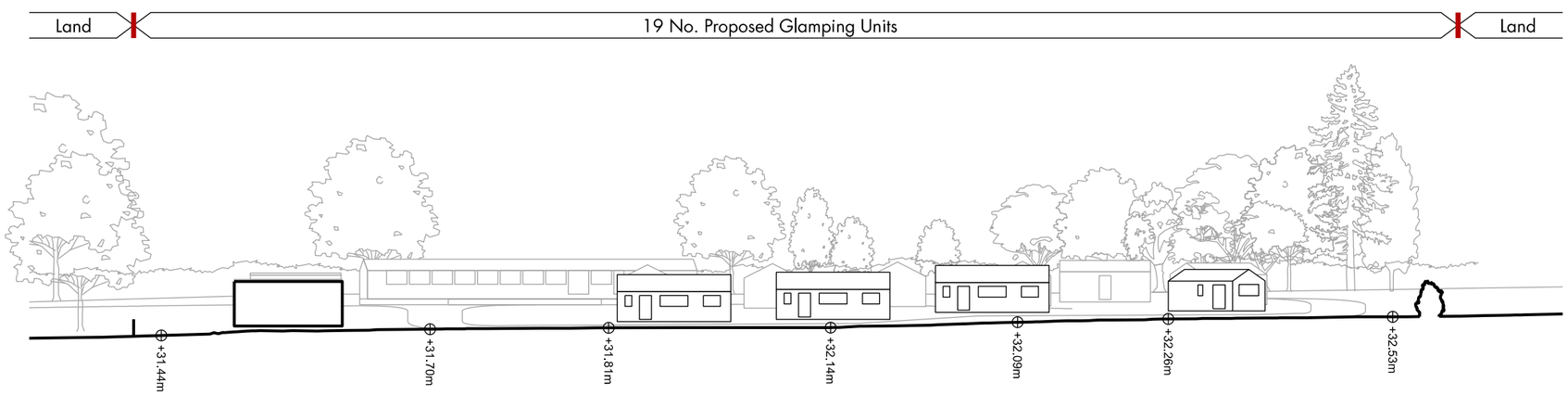
Scale. 1:500 | Paper Size. A3 | Date. 24.08.22

Existing Site Sections



Proposed Site Section AA





Proposed Site Section BB

Proposed Site Location Plan 1:5000

Drawing Key

Site Boundary (18,861m²) ⊕+m Existing Site Level

PARC FFORDD Y WAEN

RHUDDLAN, NORTH WALES

Project. Former Rhyl & District Rugby Club, Waen, Rhuddlan

Drawing No. 21Y.A010 | Revision. P01

Scale. 1:500 | Paper Size. A3 | Date. 24.08.22

Proposed Site Sections

Appendix F – ICP SuDS Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	Soil	0.450
Area (ha)	1.119	Urban	0.000
SAAR (mm)	716	Region Number	Region 9

Results l/s

QBAR Rural	5.0
QBAR Urban	5.0
Q2 years	4.7
Q1 year	4.4
Q30 years	8.9
Q100 years	11.0

ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	Soil	0.450
Area (ha)	0.099	Urban	0.000
SAAR (mm)	716	Region Number	Region 9

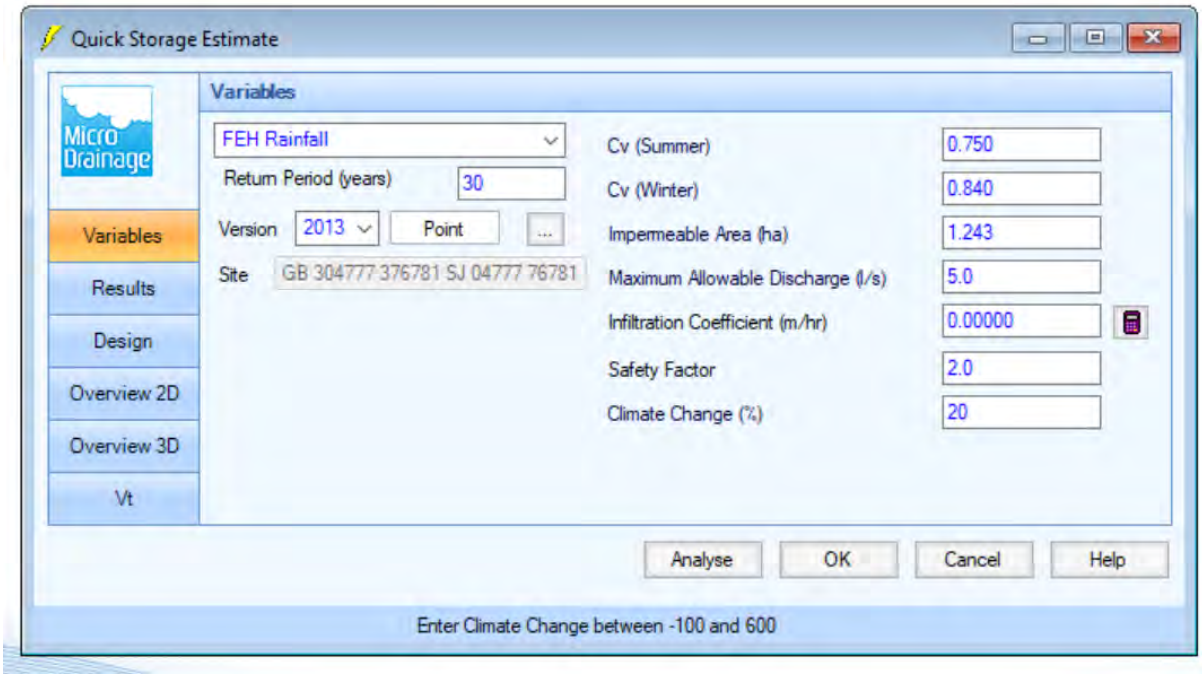
Results l/s

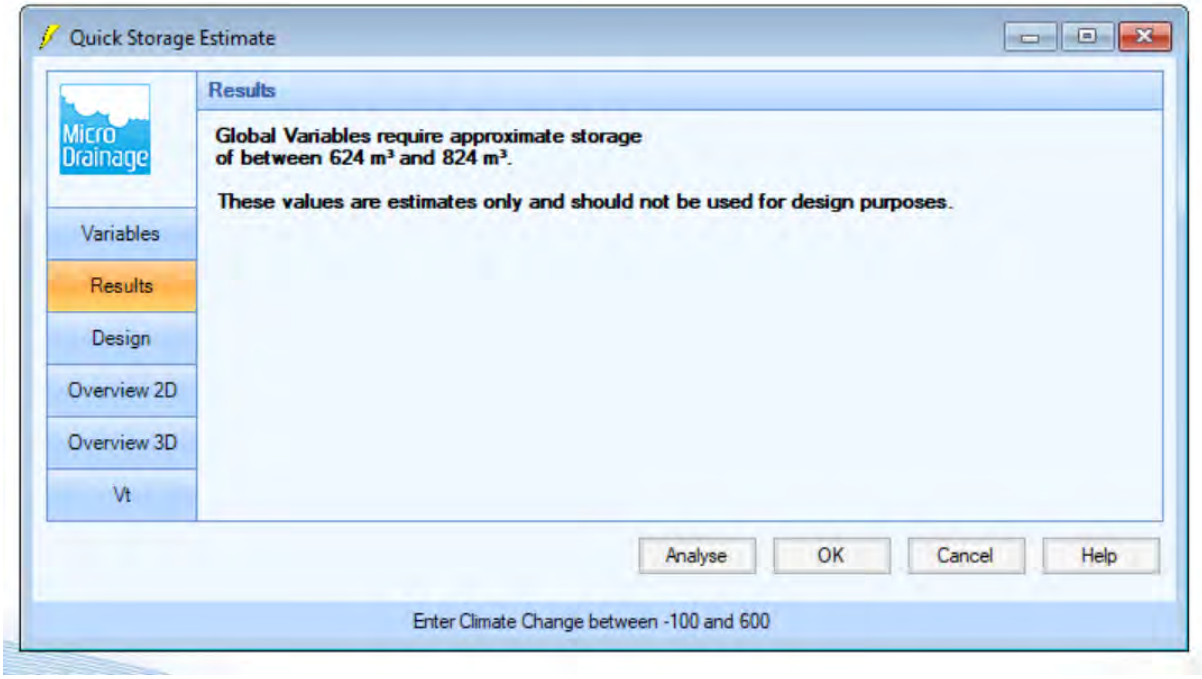
QBAR Rural	0.4
QBAR Urban	0.4
Q2 years	0.4
Q1 year	0.4
Q30 years	0.8
Q100 years	1.0

Appendix G – Quick Storage Estimates

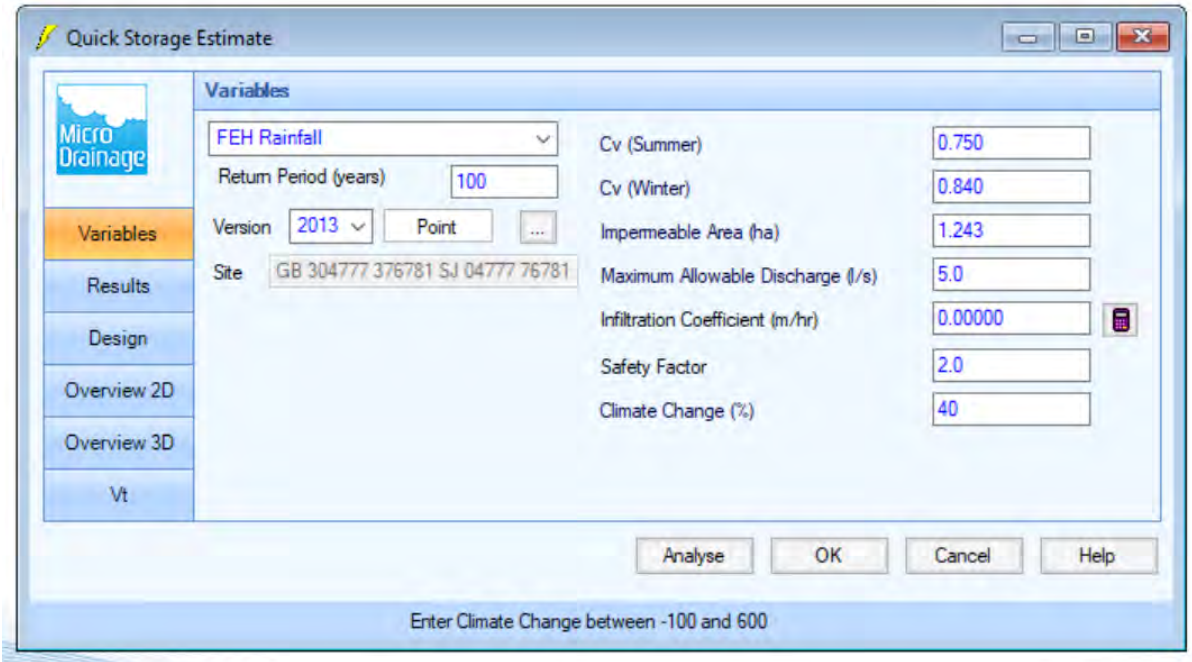
MicroDrainage Quick Storage Estimates

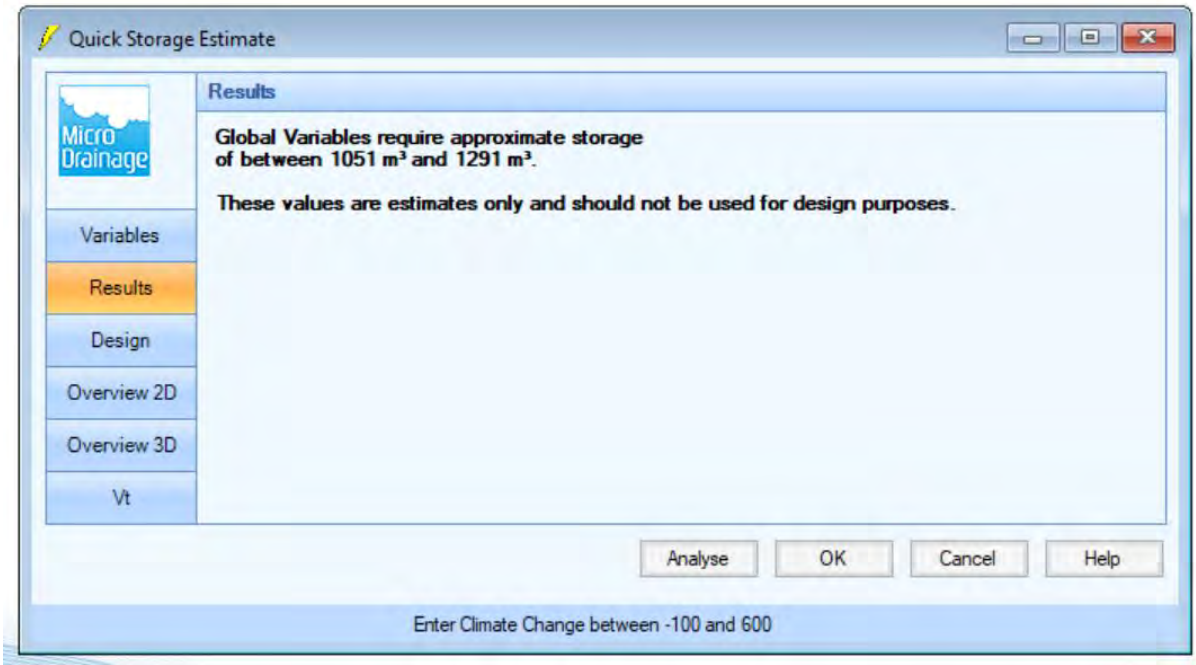
1 in 30 Year + 20% CC





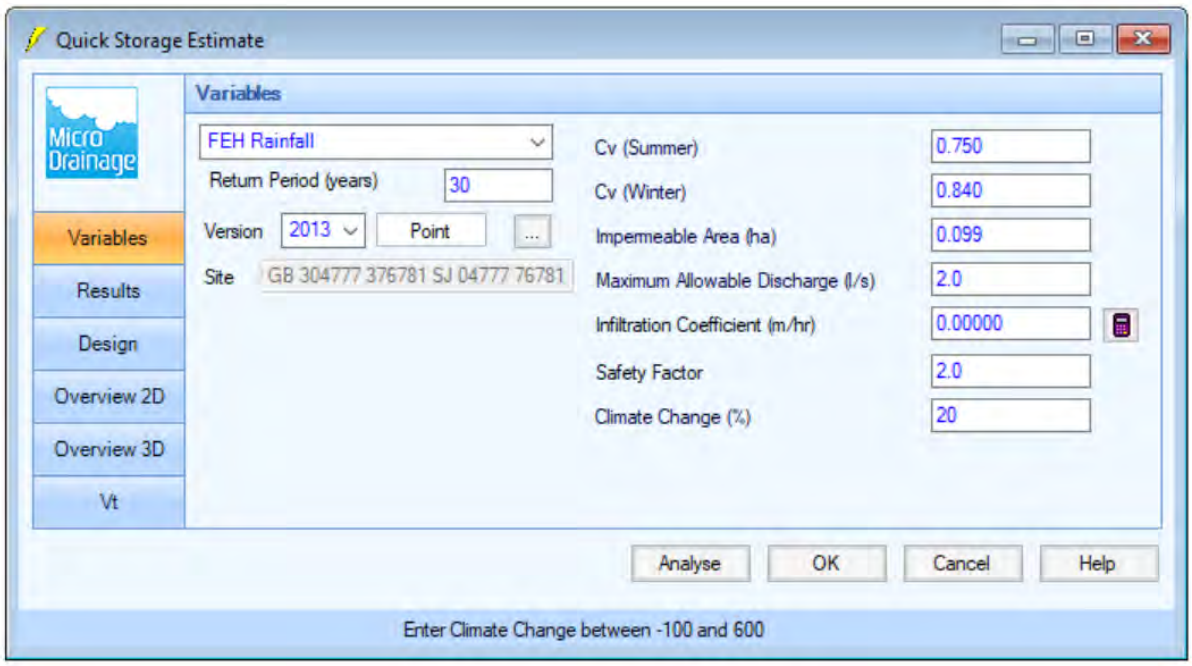
1 in 100 + 40% CC

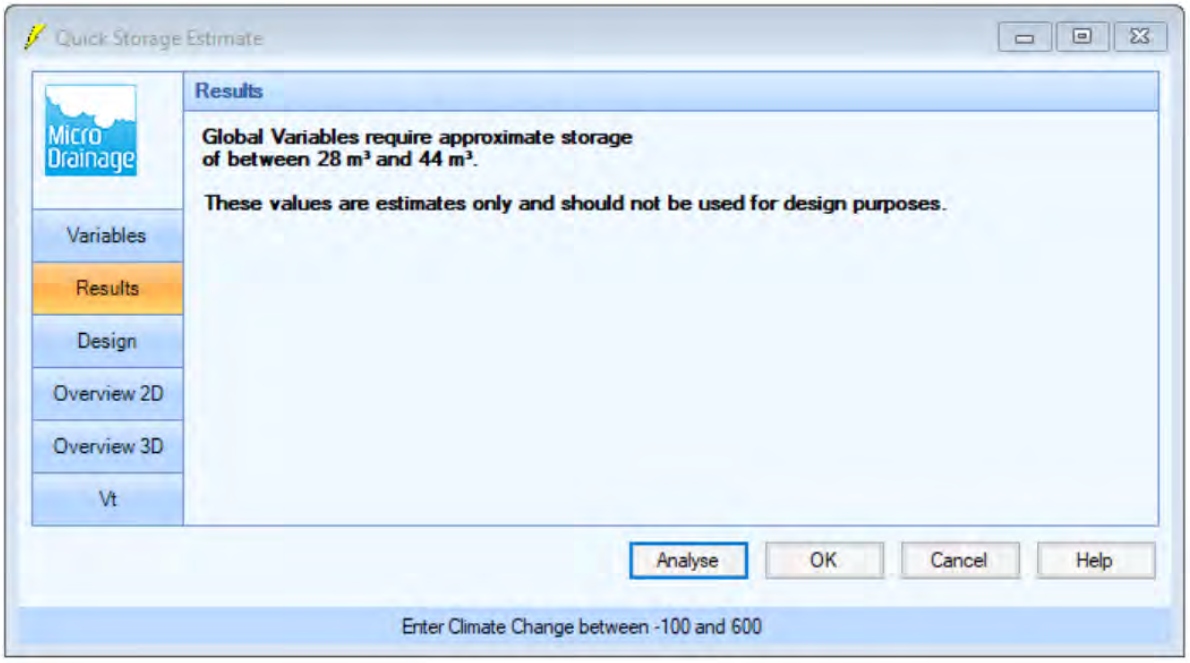

Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Variables
FEH Rainfall
Return Period (years) 100
Version 2013
Point
...
Site GB 304777 376781 SJ 04777 76781
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 1.243
Maximum Allowable Discharge (l/s) 5.0
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 40
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Results
Global Variables require approximate storage
of between 1051 m³ and 1291 m³.
These values are estimates only and should not be used for design purposes.
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600

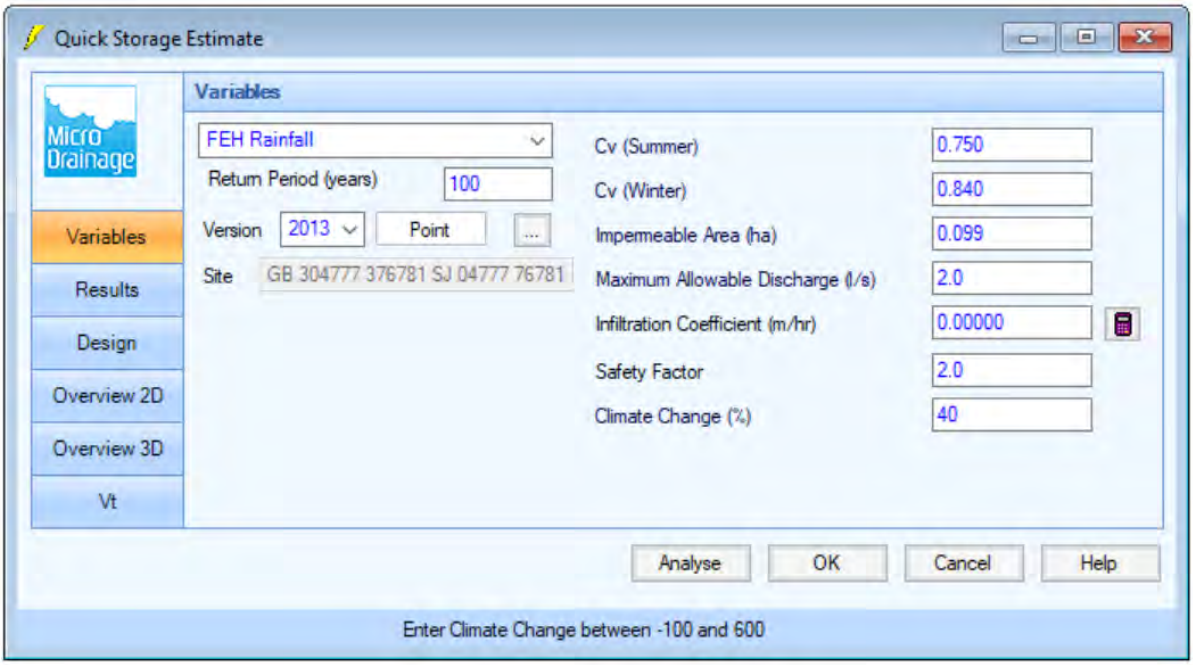
Parcel B Quick Storage Estimates

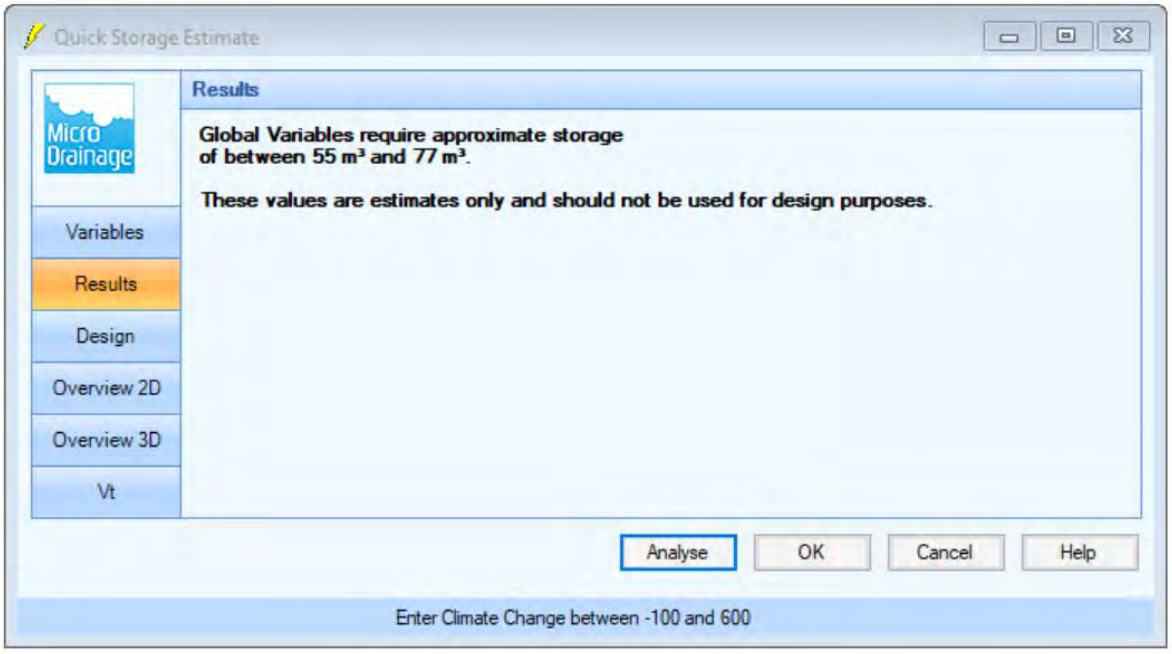
1 in 30 year + 20% CC





1 in 100 year + 40% CC





Appendix H – MicroDrainage Calculations

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.069	0.369	5.0	365.4	O K
30 min Summer	99.183	0.483	5.0	487.6	O K
60 min Summer	99.300	0.600	5.0	618.1	O K
120 min Summer	99.407	0.707	5.0	742.3	O K
180 min Summer	99.466	0.766	5.0	812.1	O K
240 min Summer	99.504	0.804	5.0	857.8	O K
360 min Summer	99.549	0.849	5.0	912.2	O K
480 min Summer	99.573	0.873	5.0	941.5	O K
600 min Summer	99.586	0.886	5.0	957.2	O K
720 min Summer	99.591	0.891	5.0	964.5	O K
960 min Summer	99.591	0.891	5.0	963.8	O K
1440 min Summer	99.563	0.863	5.0	929.3	O K
2160 min Summer	99.510	0.810	5.0	864.3	O K
2880 min Summer	99.462	0.762	5.0	807.3	O K
4320 min Summer	99.375	0.675	5.0	704.0	O K
5760 min Summer	99.291	0.591	5.0	608.7	O K
7200 min Summer	99.229	0.529	5.0	538.8	O K
8640 min Summer	99.180	0.480	5.0	485.1	O K
10080 min Summer	99.142	0.442	5.0	443.9	O K
15 min Winter	99.111	0.411	5.0	409.8	O K
30 min Winter	99.237	0.537	5.0	547.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	159.018	0.0	331.0	27
30 min Summer	106.361	0.0	408.0	41
60 min Summer	67.832	0.0	609.6	72
120 min Summer	41.228	0.0	726.0	130
180 min Summer	30.462	0.0	774.1	190
240 min Summer	24.441	0.0	781.3	250
360 min Summer	17.764	0.0	772.9	368
480 min Summer	14.092	0.0	763.6	488
600 min Summer	11.743	0.0	755.1	606
720 min Summer	10.101	0.0	747.3	726
960 min Summer	7.942	0.0	732.7	964
1440 min Summer	5.620	0.0	704.4	1436
2160 min Summer	3.954	0.0	1301.8	1760
2880 min Summer	3.075	0.0	1337.3	2136
4320 min Summer	2.147	0.0	1300.6	2944
5760 min Summer	1.672	0.0	1491.7	3696
7200 min Summer	1.396	0.0	1555.7	4472
8640 min Summer	1.215	0.0	1623.9	5264
10080 min Summer	1.091	0.0	1696.1	5960
15 min Winter	159.018	0.0	365.1	26
30 min Winter	106.361	0.0	415.9	41

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.366	0.666	5.0	694.2	O K
120 min Winter	99.484	0.784	5.0	833.8	O K
180 min Winter	99.550	0.850	5.0	913.3	O K
240 min Winter	99.592	0.892	5.0	965.8	O K
360 min Winter	99.643	0.943	5.0	1029.4	O K
480 min Winter	99.671	0.971	5.0	1064.9	O K
600 min Winter	99.687	0.987	5.0	1085.3	O K
720 min Winter	99.696	0.996	5.0	1096.1	O K
960 min Winter	99.699	0.999	5.0	1100.7	O K
1440 min Winter	99.678	0.978	5.0	1072.9	O K
2160 min Winter	99.618	0.918	5.0	997.8	O K
2880 min Winter	99.561	0.861	5.0	927.2	O K
4320 min Winter	99.451	0.751	5.0	794.0	O K
5760 min Winter	99.345	0.645	5.0	670.3	O K
7200 min Winter	99.243	0.543	5.0	554.7	O K
8640 min Winter	99.165	0.465	5.0	468.9	O K
10080 min Winter	99.104	0.404	5.0	402.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.832	0.0	677.4	70
120 min Winter	41.228	0.0	779.5	128
180 min Winter	30.462	0.0	785.1	186
240 min Winter	24.441	0.0	779.9	246
360 min Winter	17.764	0.0	771.0	362
480 min Winter	14.092	0.0	764.7	478
600 min Winter	11.743	0.0	759.5	596
720 min Winter	10.101	0.0	754.8	712
960 min Winter	7.942	0.0	746.5	940
1440 min Winter	5.620	0.0	732.8	1386
2160 min Winter	3.954	0.0	1441.4	1996
2880 min Winter	3.075	0.0	1449.4	2252
4320 min Winter	2.147	0.0	1335.5	3164
5760 min Winter	1.672	0.0	1670.8	4096
7200 min Winter	1.396	0.0	1742.6	4832
8640 min Winter	1.215	0.0	1819.7	5616
10080 min Winter	1.091	0.0	1901.8	6352

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 304777 376781 SJ 04777 76781
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.243

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.414	4	8	0.414	8	12	0.414

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	930.0	1.000	1282.6	1.001	1350.0	1.300	1469.4

Hydro-Brake® Optimum Outflow Control

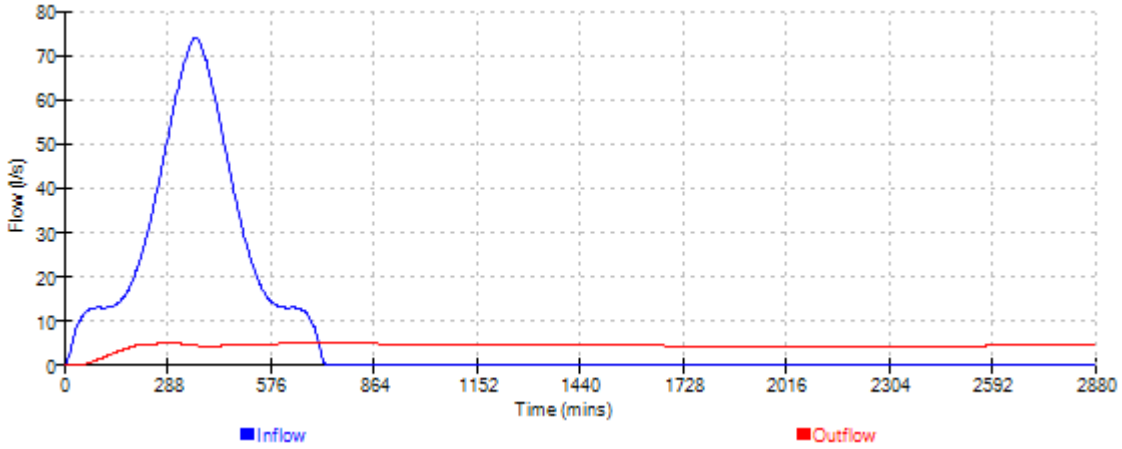
Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	105
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

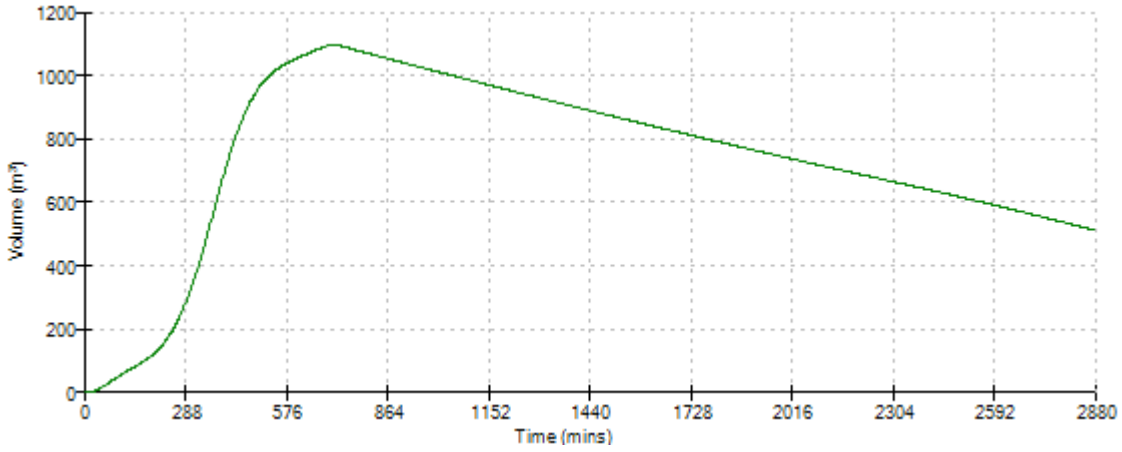
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0
Flush-Flo™	0.296	5.0
Kick-Flo®	0.637	4.1
Mean Flow over Head Range	-	4.3

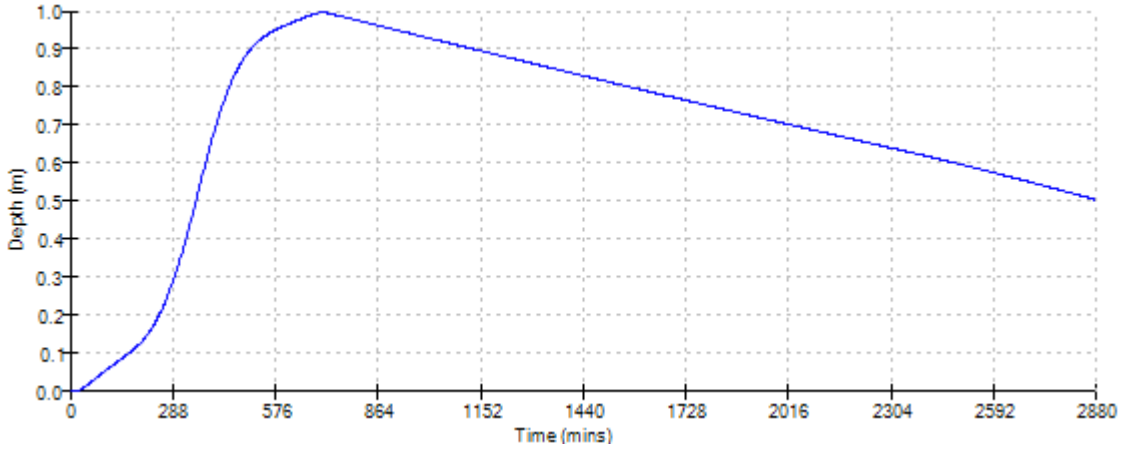
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.4	3.000	8.4	7.000	12.5
0.200	4.8	1.400	5.8	3.500	9.0	7.500	12.9
0.300	5.0	1.600	6.2	4.000	9.6	8.000	13.3
0.400	4.9	1.800	6.6	4.500	10.1	8.500	13.7
0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.1
0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.5
0.800	4.5	2.400	7.5	6.000	11.6		
1.000	5.0	2.600	7.8	6.500	12.1		

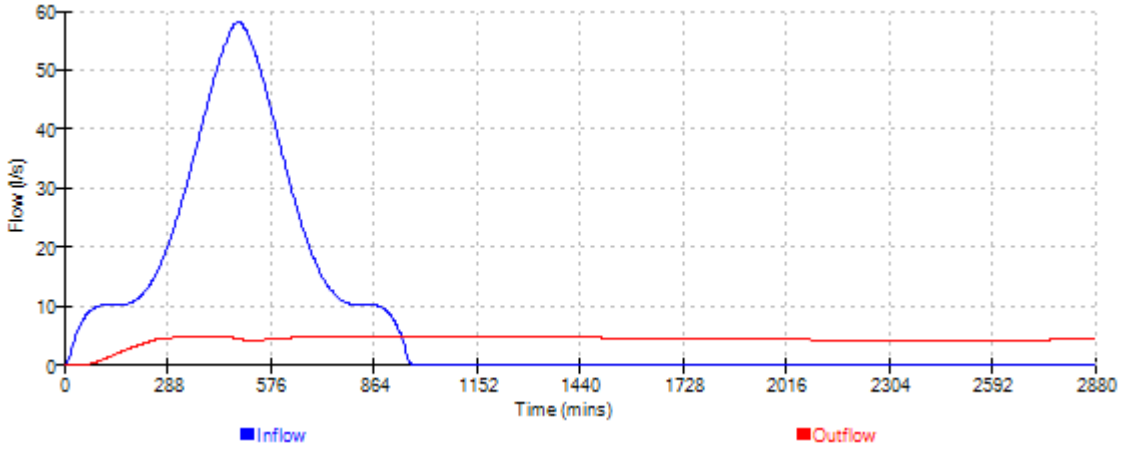
Event: 720 min Winter

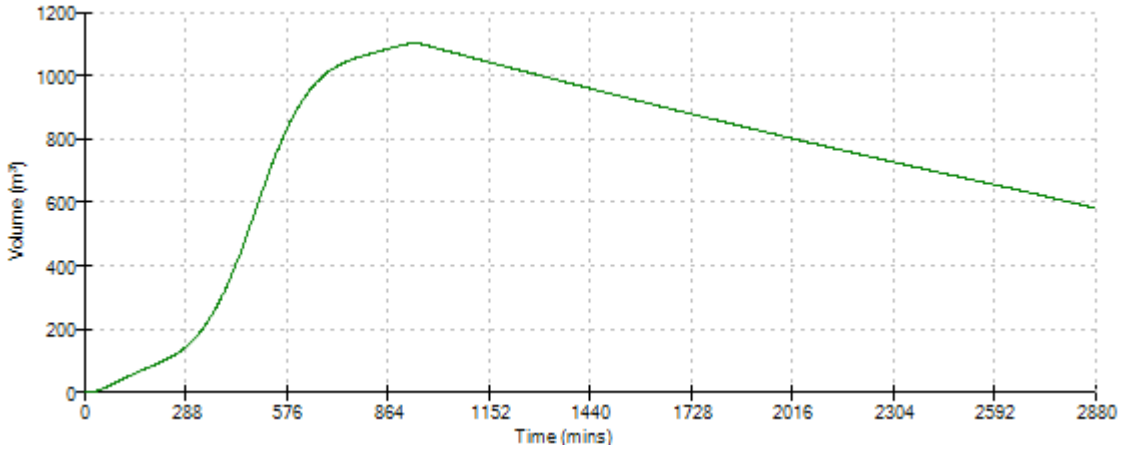


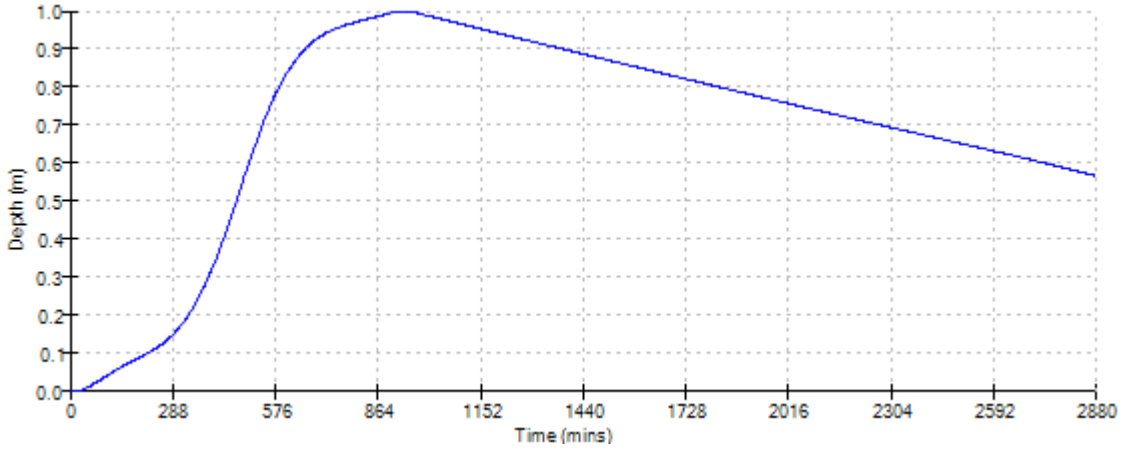




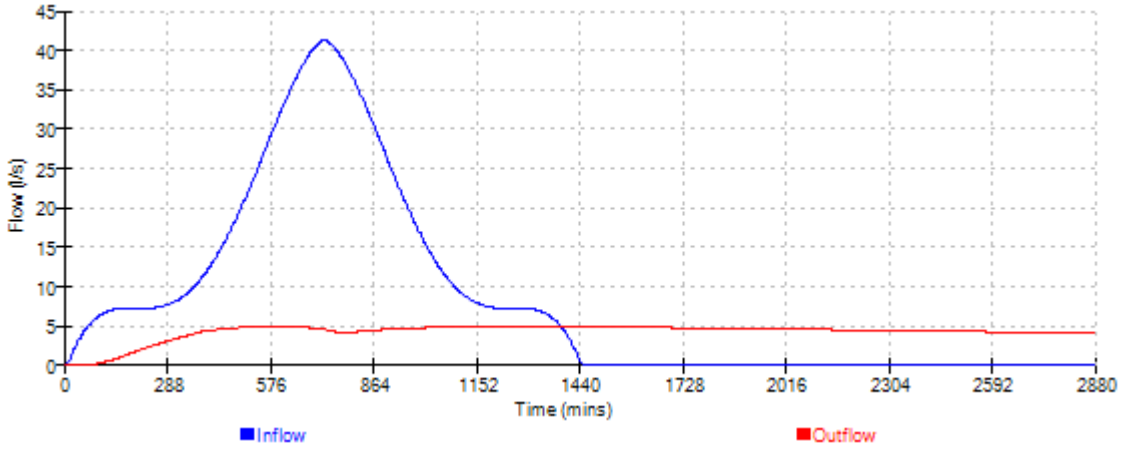
Event: 960 min Winter

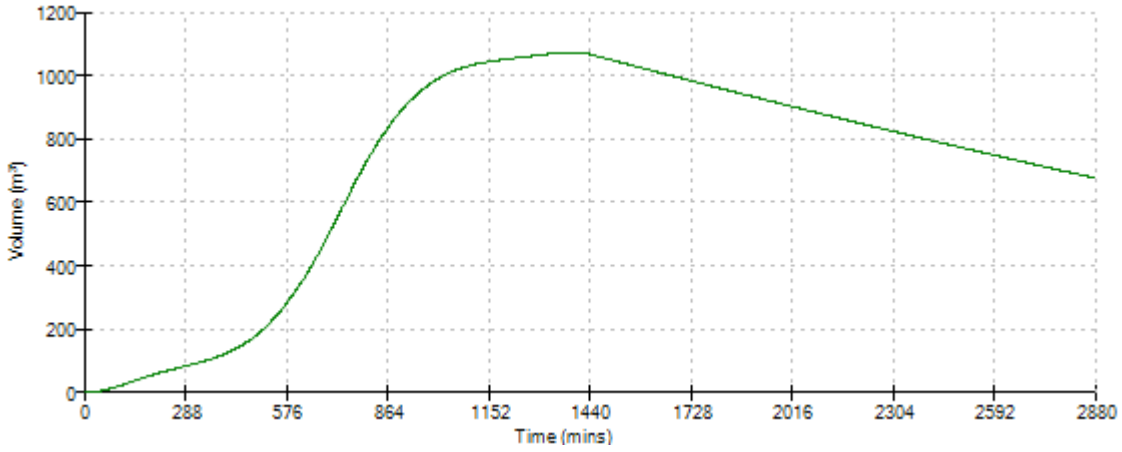


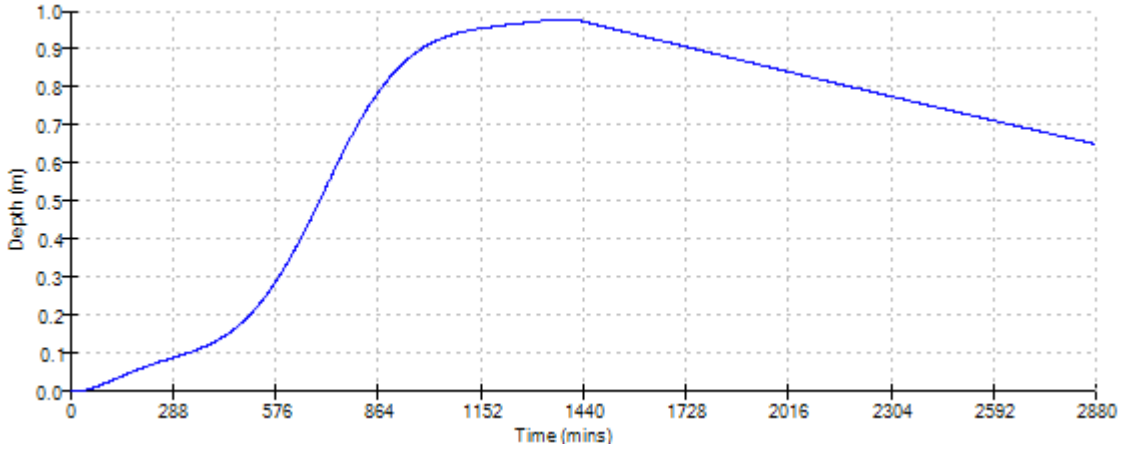




Event: 1440 min Winter







Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.306	0.306	1.9	27.6	O K
30 min Summer	9.404	0.404	1.9	36.4	O K
60 min Summer	9.498	0.498	1.9	44.8	O K
120 min Summer	9.565	0.565	1.9	50.9	O K
180 min Summer	9.586	0.586	1.9	52.7	O K
240 min Summer	9.585	0.585	1.9	52.6	O K
360 min Summer	9.561	0.561	1.9	50.5	O K
480 min Summer	9.532	0.532	1.9	47.9	O K
600 min Summer	9.503	0.503	1.9	45.3	O K
720 min Summer	9.474	0.474	1.9	42.7	O K
960 min Summer	9.419	0.419	1.9	37.7	O K
1440 min Summer	9.324	0.324	1.9	29.1	O K
2160 min Summer	9.219	0.219	1.9	19.7	O K
2880 min Summer	9.155	0.155	1.8	13.9	O K
4320 min Summer	9.092	0.092	1.6	8.3	O K
5760 min Summer	9.072	0.072	1.3	6.5	O K
7200 min Summer	9.062	0.062	1.1	5.6	O K
8640 min Summer	9.056	0.056	1.0	5.0	O K
10080 min Summer	9.051	0.051	0.9	4.6	O K
15 min Winter	9.345	0.345	1.9	31.1	O K
30 min Winter	9.457	0.457	1.9	41.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	159.018	0.0	29.3	25
30 min Summer	106.361	0.0	39.2	39
60 min Summer	67.832	0.0	50.2	68
120 min Summer	41.228	0.0	61.1	124
180 min Summer	30.462	0.0	67.7	182
240 min Summer	24.441	0.0	72.5	240
360 min Summer	17.764	0.0	79.0	292
480 min Summer	14.092	0.0	83.6	350
600 min Summer	11.743	0.0	87.1	414
720 min Summer	10.101	0.0	89.9	480
960 min Summer	7.942	0.0	94.2	610
1440 min Summer	5.620	0.0	100.0	866
2160 min Summer	3.954	0.0	105.6	1216
2880 min Summer	3.075	0.0	109.5	1560
4320 min Summer	2.147	0.0	114.6	2216
5760 min Summer	1.672	0.0	119.1	2944
7200 min Summer	1.396	0.0	124.3	3672
8640 min Summer	1.215	0.0	129.8	4400
10080 min Summer	1.091	0.0	135.9	5136
15 min Winter	159.018	0.0	32.8	25
30 min Winter	106.361	0.0	44.0	39

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	9.566	0.566	1.9	50.9	O K
120 min Winter	9.649	0.649	1.9	58.4	O K
180 min Winter	9.676	0.676	1.9	60.9	O K
240 min Winter	9.680	0.680	1.9	61.2	O K
360 min Winter	9.657	0.657	1.9	59.1	O K
480 min Winter	9.620	0.620	1.9	55.8	O K
600 min Winter	9.578	0.578	1.9	52.0	O K
720 min Winter	9.534	0.534	1.9	48.0	O K
960 min Winter	9.450	0.450	1.9	40.5	O K
1440 min Winter	9.308	0.308	1.9	27.8	O K
2160 min Winter	9.173	0.173	1.9	15.5	O K
2880 min Winter	9.106	0.106	1.7	9.6	O K
4320 min Winter	9.069	0.069	1.2	6.2	O K
5760 min Winter	9.055	0.055	1.0	5.0	O K
7200 min Winter	9.049	0.049	0.8	4.4	O K
8640 min Winter	9.045	0.045	0.7	4.0	O K
10080 min Winter	9.042	0.042	0.6	3.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.832	0.0	56.3	68
120 min Winter	41.228	0.0	68.4	124
180 min Winter	30.462	0.0	75.9	180
240 min Winter	24.441	0.0	81.2	236
360 min Winter	17.764	0.0	88.5	340
480 min Winter	14.092	0.0	93.6	386
600 min Winter	11.743	0.0	97.5	458
720 min Winter	10.101	0.0	100.6	528
960 min Winter	7.942	0.0	105.5	664
1440 min Winter	5.620	0.0	112.0	916
2160 min Winter	3.954	0.0	118.3	1256
2880 min Winter	3.075	0.0	122.6	1564
4320 min Winter	2.147	0.0	128.4	2244
5760 min Winter	1.672	0.0	133.4	2944
7200 min Winter	1.396	0.0	139.2	3680
8640 min Winter	1.215	0.0	145.4	4312
10080 min Winter	1.091	0.0	152.3	5200

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 304777 376781 SJ 04777 76781
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.099

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.033	4	8	0.033	8	12	0.033

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)
0.000	90.0

Hydro-Brake® Optimum Outflow Control

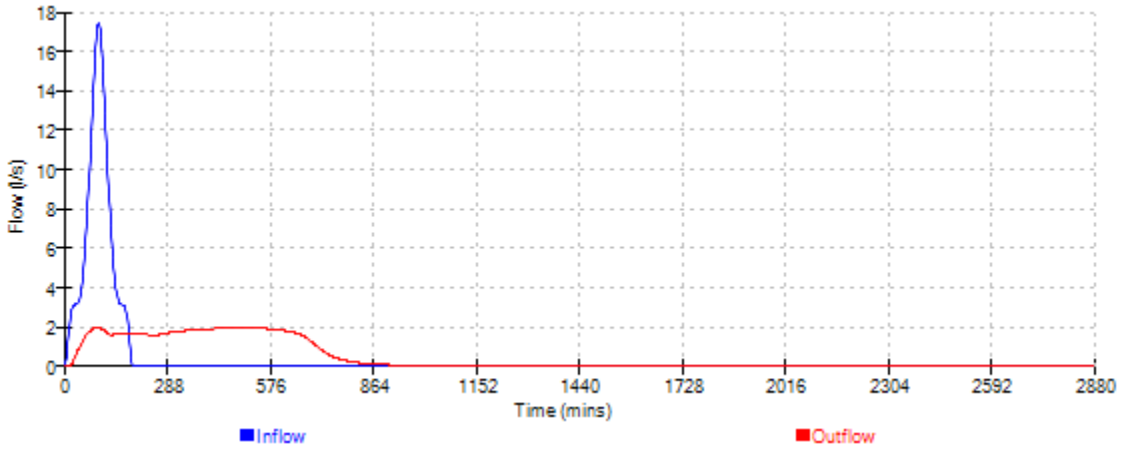
Unit Reference	MD-SHE-0067-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	9.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

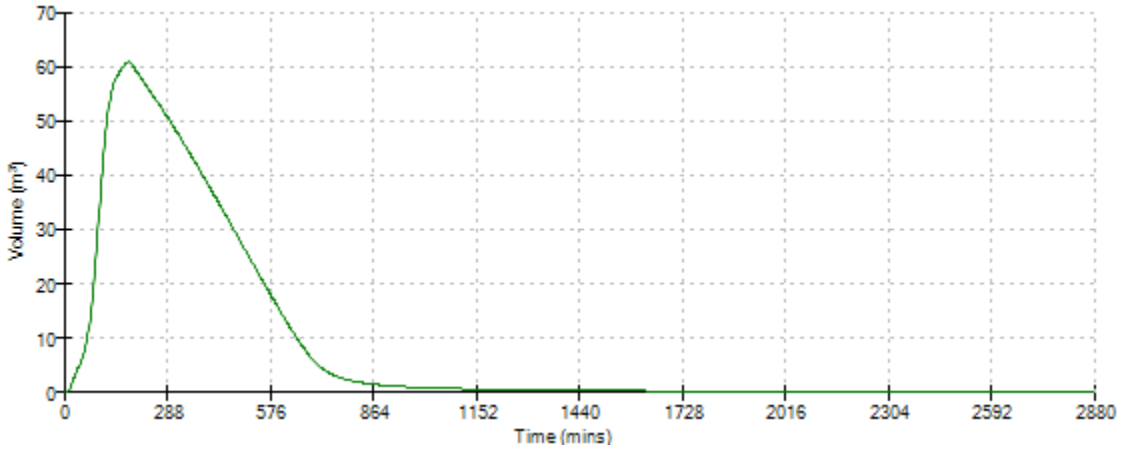
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0
Flush-Flo™	0.296	1.9
Kick-Flo®	0.599	1.6
Mean Flow over Head Range	-	1.7

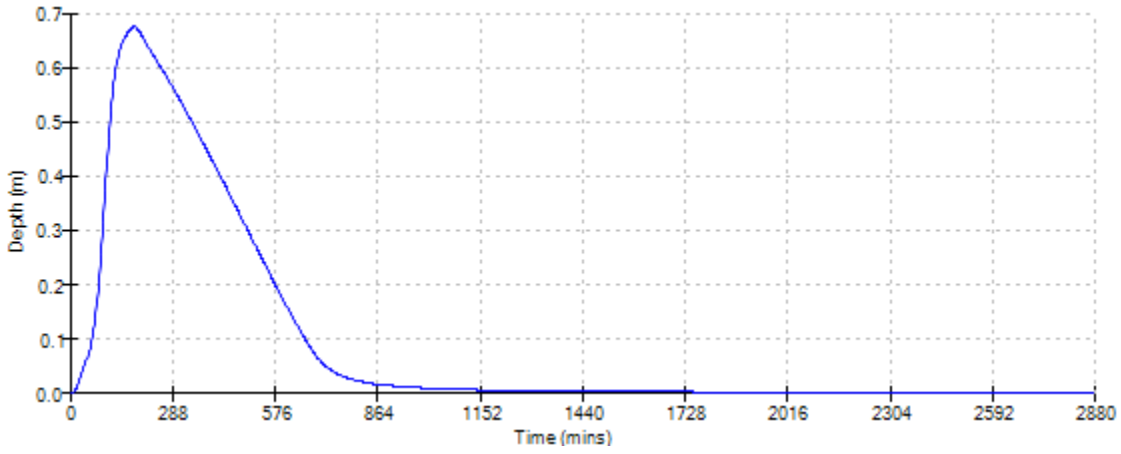
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.6	1.200	2.2	3.000	3.3	7.000	4.9
0.200	1.9	1.400	2.3	3.500	3.5	7.500	5.1
0.300	1.9	1.600	2.5	4.000	3.8	8.000	5.2
0.400	1.9	1.800	2.6	4.500	4.0	8.500	5.4
0.500	1.8	2.000	2.7	5.000	4.2	9.000	5.5
0.600	1.6	2.200	2.9	5.500	4.4	9.500	5.7
0.800	1.8	2.400	3.0	6.000	4.6		
1.000	2.0	2.600	3.1	6.500	4.7		

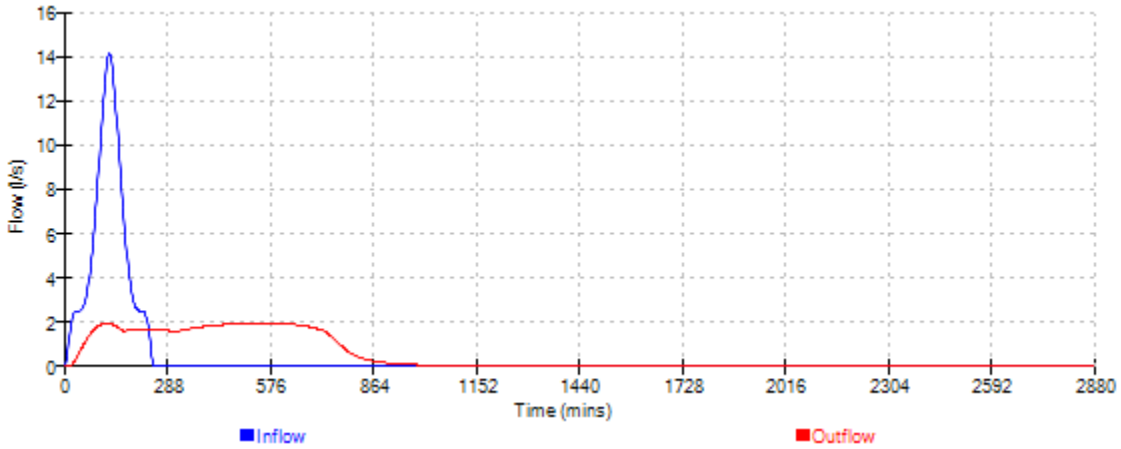
Event: 180 min Winter

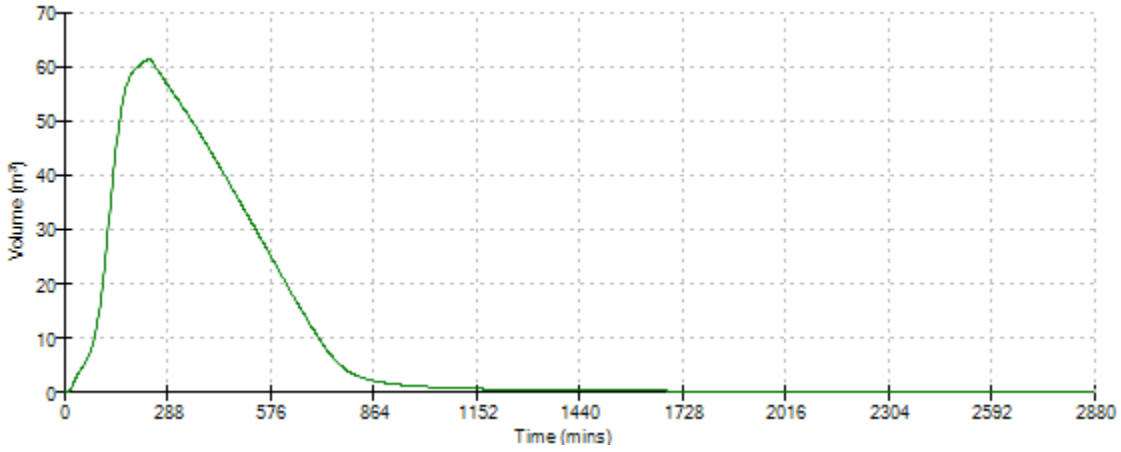


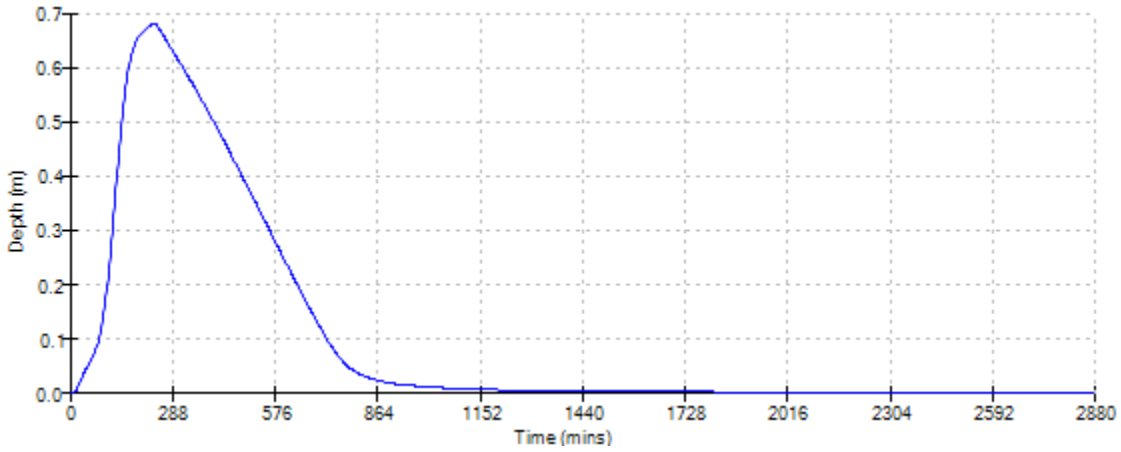




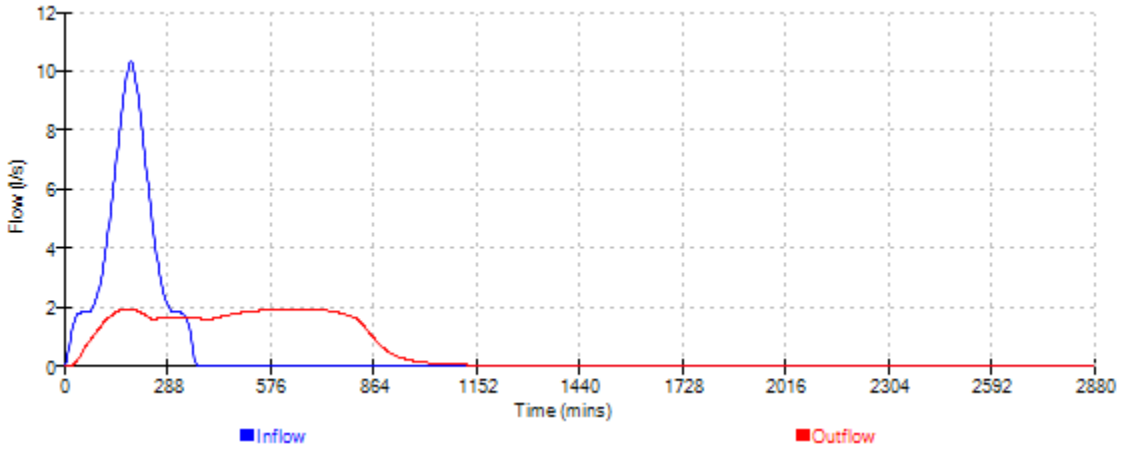
Event: 240 min Winter

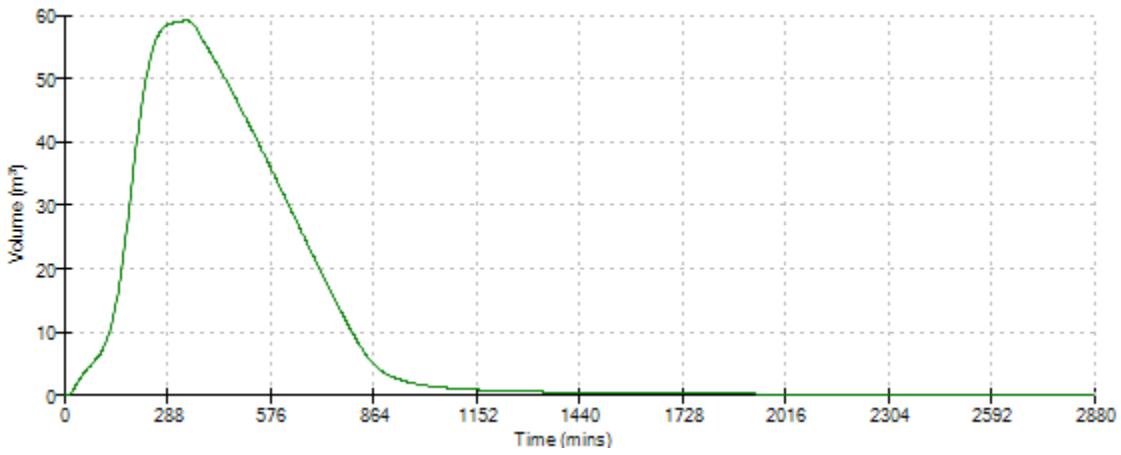


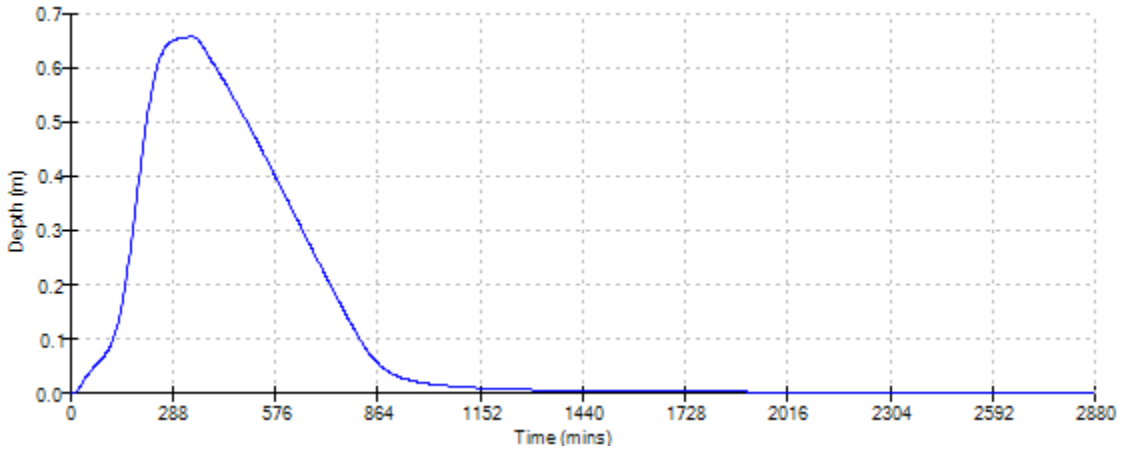




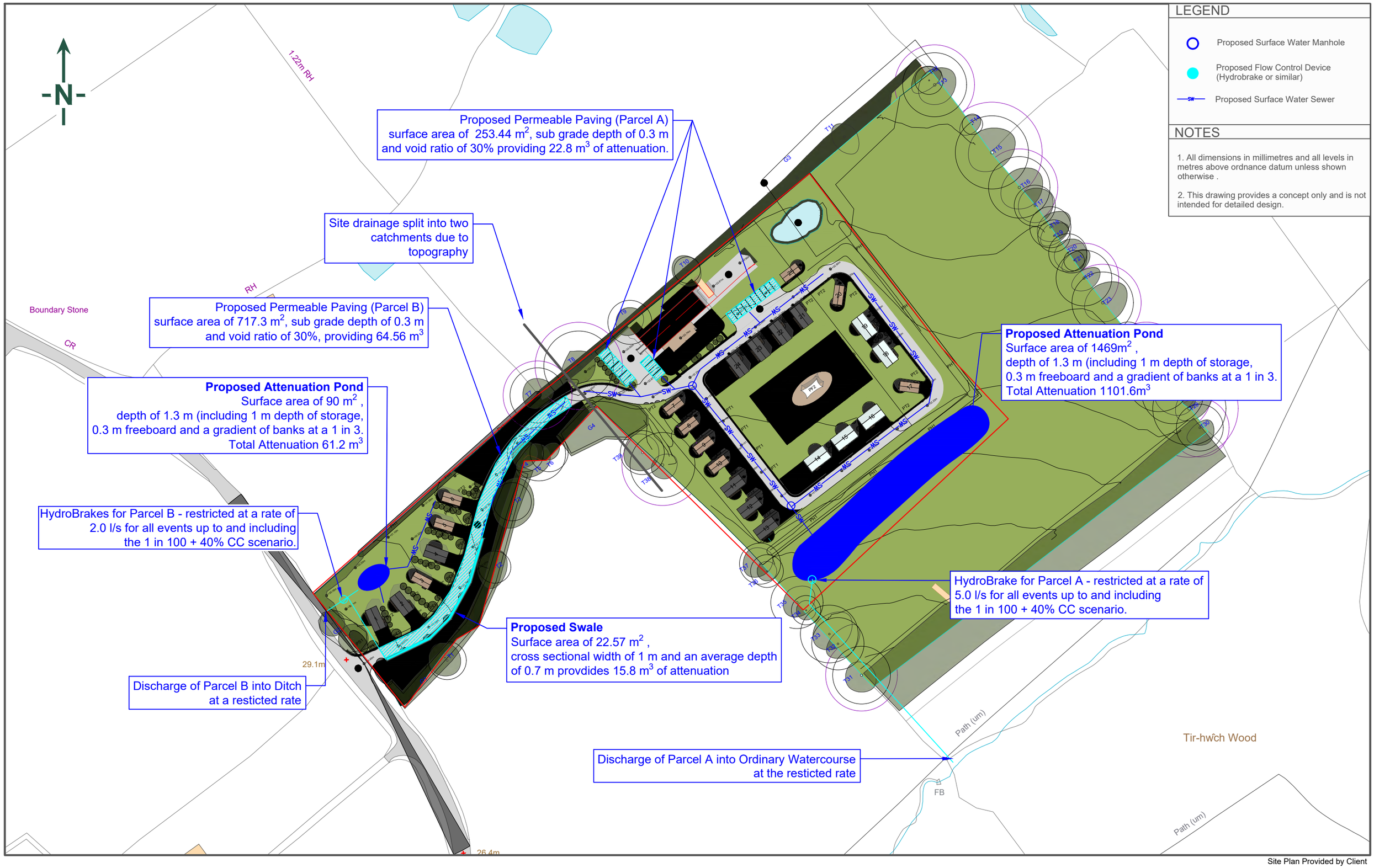
Event: 360 min Winter







Appendix I – Concept Drainage Sketch



Site Plan Provided by Client

DeltaSimons

TITLE:
Drainage Sketch
Holiday Lodge Park, Rhuddlan, Denbighshire, LL18 5RS

DRAWN BY: AR	SCALE: Not to Scale	PROEJCT NO: 97109.578224
CHECKED BY: OE	REVISION: 1	APPENDIX: I
DATE: 11-07-2023		

Appendix J – Maintenance Schedules

Swales Maintenance Schedule

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as Required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swales treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oil or petrol residues using safe standard practices	As required

Ref. Table 17.1 CIRIA C753 'The SuDS Manual'

Attenuation Storage Tank Maintenance Schedule

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove If necessary	Every 5 years or as required

Ref. Table 21.3, CIRIA C753 'The SuDS Manual'

Detention Basin Maintenance Schedule

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass-for spillways and access routes	Monthly (during growing season), or as required
	Cut grass - meadow grass in and around basin	Half yearly (spring - before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides. structures. pipework etc. for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebays	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed- areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years. or as required
	Remove sediment from inlets, outlets. forebays and main basin when required	Every 5 years. or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Ref. Table 22.1 CIRIA C753 'The SuDS Manual'

Rainwater Harvesting System Maintenance Schedule

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspection of the tank for debris and sediment build up, inlets/ outlets/ withdrawal devices, overflow areas, pumps, filters	Annually (and following poor performance)
	Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and other debris	Annually and following poor performance
Occasional maintenance	Cleaning and /or replacement of any filters	Three monthly (or as required)
Remedial actions	Repair of overflow erosion damage or damage to tank	As required
	Pump repairs	As required

Ref. Table 11.6, CIRIA C753 'The SuDS Manual'