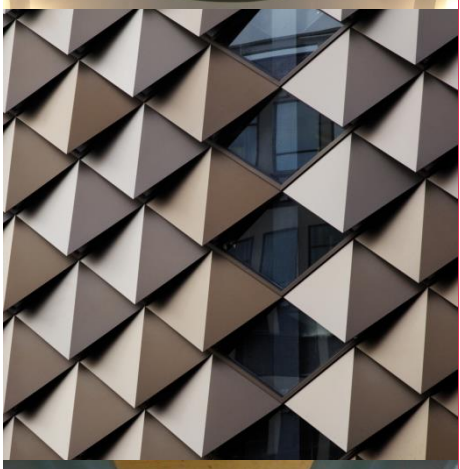

Ysgol Plas Brondyffryn

Flood Consequence Assessment

Curtins Ref: YPB-CUR-00-XX-RP-C-00001

Revision: P04

Issue Date: 13 September 2022

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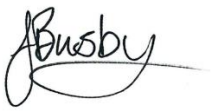
Author	Signature	Date
Jake Busby Senior Engineer		13/09/2022

Reviewed	Signature	Date
Alice Fearn Senior Engineer		13/09/2022

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1.0 Introduction

Curtins has been appointed by Wates Construction North West to prepare a Flood Consequence Assessment (FCA) in support of a planning application for the provision of a new Development at Ystrad Road, Denbigh.

The report is based on currently available information.

The FCA provides information on the nature of flood risk at the site and has been prepared in accordance with Technical Advice Note (TAN) 15 'Development and Flood Risk' from Planning Policy Wales (PPW). TAN 15 provides guidance on the requirements for a FCA and the nature of development or land use appropriate for flood risk areas (vulnerability classification).

The proposals for the surface water management strategy are based on the requirements of Denbighshire County Council in their role as the SuDS Approving Body (SAB).

Proposals contained or forming part of this report represent the design intent and may be subject to alteration or adjustment in completing the detailed design of this project. Where such adjustments are undertaken as part of the detailed design and are deemed a material deviation from the content contained in this document, prior approval shall be obtained from the relevant authority in advance of commencing such works.

Where the proposed works to which this report refers are undertaken more than twelve months following the issue of this report, Curtins shall reserve the right to re-validate the findings and conclusions by undertaking appropriate further investigations at no cost to Curtins.

1.1 Scope of the Flood Consequence Assessment

This assessment has been undertaken in accordance with the requirements of TAN 15 (2004) and the guidance documents Flood Consequence Assessment: Climate Change Allowances (2021)

The planning application site is approximately 2.6 (ha) in size and is shown as being predominantly within Flood Zone 1 with some areas of Zone 2 and 3 by the online Flood Map for Planning (FMP) provided by Natural Resource Waters (NRW). The source of this flooding is from the culverted watercourse within the site and defined as "Surface Water and Small Watercourses" by NRW.

Surface Water and Small Watercourses – Flood Zone 2

Areas with 0.1% to 1% (1 in 1000 to 1 in 100) chance of flooding from surface water and/or small watercourses in a given year, including the effects of climate change.

Surface Water and Small Watercourses – Flood Zone 3

Areas with more than 1% (1 in 100) chance of flooding from surface water and/or small watercourses in a given year, including the effects of climate change.

The Development Advice Map (DAM) shows that the areas of Flood Zone 2 and Flood Zone 3 identified above within the site boundary is designated as Flood Zone B. The data suggests this designation is due to historical flooding. TAN 15 outlines that there is a need to assess the site levels against the 0.1% (1 in 1000 year) flood level.

The FCA will:

- Investigate all potential risks of flooding to the site;
- Summarise the requirements of the FCA for the overall development;
- Consider the impact the development may have elsewhere with regards to flooding;
- Consider proposals to mitigate any potential risk of flooding determined to be present;
- Considered the requirements of the Welsh Government's Statutory Standards for Sustainable Drainage Systems and the SuDS Approving Body (SAB) guidance;
- Considered the impacts of climate change;
- Considered the receiving public sewer capacity issues;
- Provide guidance on the proposed foul water strategy;
- Prepare a Drainage Strategy for the surface water systems on the site, making recommendations for outfall, discharge rates, attenuation and forms of SuDS; and,
- Make recommendations as to how surface water drainage features are to be operated and maintained.

The FCA has been based on the following information:

- The online Development Advice Maps;
- Denbighshire County Council's Preliminary Flood Risk Assessment (PFRA), dated June 2011;
- Denbighshire County Council's Strategic Flood Consequence Assessment (SFCA), dated January 2018;
- Welsh Water public sewer records;
- Denbighshire County Council's Local Development Plan (adopted June 2013).

In January 2019, the Welsh Assembly Government (WAG) implemented Schedule 3 of the Flood and Water Management Act (2010) and establishes County Councils as the SuDS Approving Bodies (SABs) which requires SuDS measures to be implemented for the management of surface water. All new developments greater than 1 dwelling or where construction is greater than 100m^2 will require SuDS and will need to demonstrate compliance with the statutory SuDS standards.

2.0 Development and Flood Risk

This FCA has been prepared in accordance with the relevant national, regional and local planning policy and statutory authority guidance as follows.

2.1 Planning Policy Wales and TAN 15 Guidance

Planning Policy Wales (PPW) Edition 11, February 2021 details the current national planning policy for flood risk in Wales. The Welsh Government's objectives require action through the planning system and moves towards a more positive avoidance of development in areas defined as being at risk of flooding. Section 6.6 of the PPW focuses on flood risk and water management, with a specific emphasis on the climate emergency and the impacts of more intense rainfall.

"…Development should reduce, and must not increase, flood risk arising from river and/or coastal flooding on and off the development site itself."

Technical Advice Note 15 (TAN 15) provides technical guidance which supplements the policy set out in PPW in relation to development and flooding. TAN 15 provides guidance on the requirements for a FCA and the nature of development or land use appropriate for flood risk areas (vulnerability classification).

Climate change specific guidance 'Flood Consequence Assessments: Climate Change Allowances' released in September 2021 updates previous climate change allowances in support of TAN 15.

2.2 Local Policy

Planning policy for Denbigh is contained in the Denbighshire County Council's Local Development Plan, adopted in June 2013. The local planning policy makes specific reference to flood risk within objective 14. The local plan advises the requirements for the Planning Policy Wales and TAN 15 are followed.

2.3 Proposed Development

Erection of a new Ysgol Plas Brondyffryn Special Educational Needs (SEN) School for ages 3-19, including formation of Multi Use Games Areas (2no.), external plant / services area, new 118 space car parking area (including 14 electric charging bays), minibus parking (4no.), cycle parking (60no.), designated drop off area, new vehicular access off Ystrad Road, extension / improvements to existing active travel route, community café, landscaping works and all other associated works.

2.4 Site Specific Flood Risk Classification

The online DAM has a section of the site within Flood Zone B meaning further consideration is required against the 0.1% event flood level. In this circumstance the flood risk is from surface water and small watercourses. It is evident that the source of the flood risk is from the existing culverted watercourse. The risk appears to be due to the potential for a blockage at the entrance to the culvert which would

result in overland flow through the site towards an open watercourse to the north where the culvert ultimately discharges.

This overland flow results in the site being designated as Flood Zone 2 and Flood Zone 3 (Surface Water and Small Watercourses).

2.5 Flood Risk Vulnerability

TAN 15 follows a risk based approach in determining the suitability of land for development in areas at risk of flooding, with the intention of steering all new development to the lowest flood risk areas. Particular flooding consequences may not be acceptable for particular types of development.

According to the online Development Advice Map, the site is located within Flood Zone A and B. Zone B is localised to the west of the site and does not impact on the building. The risk is due to a preventable overland flow. The scheme is considered as highly vulnerable.

The site is located within FZB and FZA, and as such the Justification Test is not required.

3.0 Existing Site Details

3.1 Site Description

The site is located to the east of Denbigh Town Centre at LL16 3HE, National Grid Reference SJ 06114 66072. The site is approximately 2.6ha and is currently used as playing fields for the local leisure centre and adjacent schools. Ystrad Road is to the south of the site, and the existing leisure centre to the north. The site is greenfield and undeveloped. Figure 3.1 shows the site in the local context.

Figure 3.1 – Site Location Plan

3.2 Topography

A topographical survey was completed in January 2022 by Survey Operations. The survey is included within Appendix B. The site falls generally from the southeast to the north west on a fairly constant gradient. The high point is 53.300 and the low point 50.000. There is a small retaining wall adjacent to Ystrad Road and a mound to the west of the existing MUGA. The mound is outside of the site boundary.

3.3 Hydrological Setting

There is a watercourse to the south and north of the site, they are connected via a culverted watercourse flowing towards the north. The watercourse was culverted as part of works by Denbighshire County Council to reduce flood risk to properties within Denbigh. The watercourse captures run-off from the surrounding land, there does not appear to be any development directly associated with discharge to this feature.

The watercourse goes below ground to the southeast of the site via a large headwall with trash and debris screens. The diameter of the culvert is not currently known, and further survey is required to confirm. The culvert entrance appears to be the source of the overland flow shown as flood risk on NRW data.

3.4 Existing Geology

BGS mapping indicates the site is underlain by Glacial Till superficial deposits and Alluvium deposits to the very west of the site, the superficial deposits are underlain by bedrock of the Kinnerton Sandstone Formation.

Topsoil/Made Ground was encountered in all exploratory holes from ground level to depths between 0.15m and 0.25m bgl. Topsoil typically comprised brown slightly sandy slightly gravelly clay with frequent rootlets. Till was encountered underlying the Topsoil/Made Ground in all exploratory hole locations. The glacial till deposits encountered predominantly comprised firm (occasionally soft) to stiff brown slightly gravelly to very gravelly, slightly silty to silty clay.

During return monitoring visits, groundwater levels were recorded between 0.44m and 8.82m bgl (51.37 and 43.36m AOD) within the Glacial Till Deposits.

Infiltration tests were attempted within Trial Pits, however the high groundwater level means these have not yet been successful. Falling Head tests were undertaken within three window sample locations, the results of which are given in table 3.1 below. Figure 3.2 shows the locations of the investigations.

Falling Head Test Results		
Exploratory Hole Location	**Length of Test (minutes)**	**Permeability Coefficient (k)**
WS01	60	1.17×10^{-6} m/s

Falling Head Test Results		
WS04	60	1.83 x 10 $^{-6}$ m/s
WS13	60	9.34 x 10 $^{-7}$ m/s

Table 3.1 – Falling Head Test Results

Figure 3.2 – Exploratory Hole Location Plan

The locations were chosen based on the indicative drainage strategy.

3.5 Hydrogeological Setting

NRW has classified the solid geology as a Principal Aquifer (The Kinnerton Sandstone Formation) and the superficial geology as a Secondary Undifferentiated Aquifer. The Alluvium Deposits are associated with a Secondary A Aquifer. This is defined as 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.

3.6 Existing Drainage

3.6.1 Public Drainage

Public sewer records have been obtained for the development site from Welsh Water.

There is an existing 200mm VC foul sewer within Ystrad Road to the east, there is also a 225mm VC foul sewer in Clwyd Avenue which is north of the site. The closest surface water sewer is to the north in the highway beyond the leisure centre. This is noted as having a 450mm diameter.

3.6.2 Private Drainage

As the site is greenfield there is unlikely to be anything present which provides existing connections to any sewers. A GPR survey was completed which did not identify any below ground drains. The culverted watercourse within the site is classed as an “Ordinary Watercourse” and therefore falls under the ownership and management of the local authority in their role as LLFA.

3.7 Culverted Watercourse

The ordinary watercourse was culverted to manage flood risk within Denbigh. Further information has been requested to understand the route of the culvert and the design capacities. Surveys of the culvert confirm it is a 900mm diameter concrete pipe at approximately 1.5m depth along its length. It is likely to experience surcharge up to 1m and therefore the appropriate outfall settings should be used in the hydraulic calculations.

4.0 Assessment of Flood Risk

4.1 Sources of Flood Risk

This study assesses the risk from different types of flooding to the development and the risk of flooding from the development, taking climate change into consideration, as well as how flood risk should be managed. The approach to the assessment of flood risk at the development site has been informed by the requirements of PPW/TAN 15 in conjunction with the client and NRW/SAB requirements.

4.2 Fluvial Flooding

The online Development Advice Map indicates the site is located mostly within Flood Zone A, defined as having little or no risk of flooding from rivers or the sea and an isolated area of Flood Zone B, defined Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. Flood Zone B may indicate evidence of a previous flood, however discussions with the LLFA have confirmed that this has not been the case since the culvert was installed.

An extract from the DAM is given in figure 4.1.

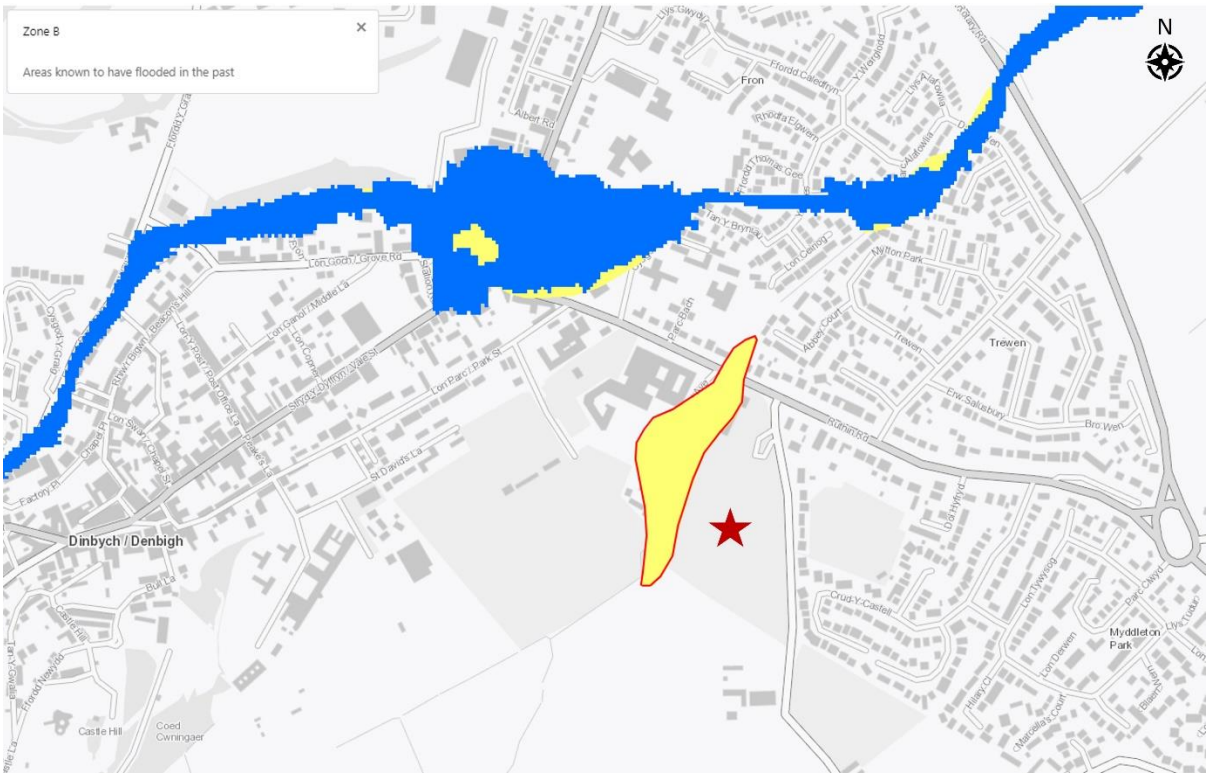


Figure 4.1 – Exploratory Hole Location Plan

The cause of the Flood Zone B definition is not from a fluvial source, the closest fluvial risk is to the north and significantly lower than the site. The risk from Fluvial sources is considered very low.

4.3 Pluvial Flooding (to the site)

The NRW Flood Map for Planning shows that the site is located within Flood Zone 2 and Flood Zone 3 when considering surface water and small watercourses as the source. The evidence shows that the risk is in the event of a culvert blockage at the existing headwall to the south. Where the culvert is operating normally there is sufficient capacity to manage the flows from the watercourse. Using the available mapping data the 1 in 1,000 year water level has been plotted against the topographical survey. The findings are presented within the extract shown in figure 4.2. It is noted that the NRW mapping uses LiDAR data to determine land levels rather than detailed survey.

Figure 4.2 – 1 in 1,000 year Surface Water and Small Watercourse Flood Risk Levels

Using LiDAR data, the invert at the beginning of the culvert is approximately 50.400mAOD, the land quickly raises to circa 51.900mAOD before dropping into the site. Any overland flow would require waters to backup at the culvert to a depth of 1.5m before breaching the site boundary. The risk of overland flow is only in the event of a culvert failure.

As the site technically has a designation of Flood Zone B, the extent of the 1 in 1,000 year flood level should be considered against the proposed building FFL and site levels in accordance with TAN15.

The risk of pluvial flooding to the site is considered high.

4.4 Pluvial Flooding (from the site)

Developers are responsible for ensuring that new development does not increase flood risk elsewhere. The proposed surface water drainage network shall be designed to not flood in the critical 1 in 30 (3.3%) Annual Probability storm event. Flood water generated up to the critical 1 in 100 (1%) Annual Probability plus climate change event shall be constrained within areas on site to not cause damage to buildings, essential services or adjoining developments.

The risk of flood risk increasing off-site because of the development is considered very low.

4.5 Groundwater Flooding

Groundwater was found during the initial site investigations. During return monitoring visits, groundwater levels were recorded between 0.44m and 8.82m bgl (51.37 and 43.36m AOD) within the Glacial Till Deposits. The SFRA identifies the site may be at increased risk of groundwater flooding.

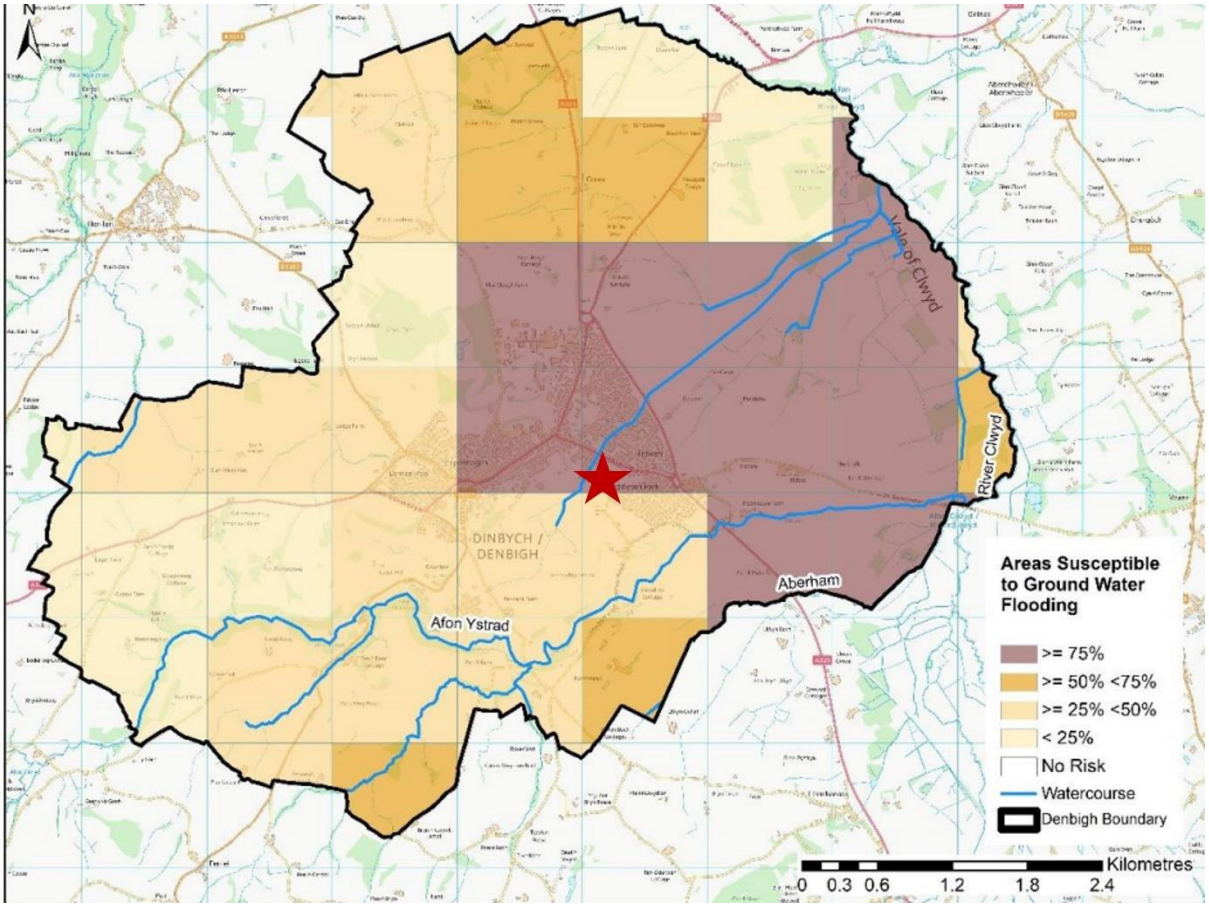


Figure 4.3 – Denbighshire SFCA Groundwater Flood Risk

Five rounds of groundwater monitoring have been undertaken to date, between 10th March and 28th April 2022.

Groundwater flooding tends to be more persistent than other sources of flooding, typically lasting for weeks or months rather than hours or days. Groundwater flooding does not generally pose a significant risk to life due to the slow rate at which the water level rises; however, it can cause significant risk to property. Floor levels proposed should be sufficiently above the maximum recorded groundwater level.

The risk of groundwater flooding is considered medium.

4.6 Public Sewers and Water Mains

There are foul sewers near the site, however they are situated lower than the current site levels. The assets are maintained by Welsh Water and are not noted as carrying surface water.

Additional flows to be discharged to the public sewer network have been subjected to an impact assessment by Welsh Water.

The PFRA and SFCA does not contain any information in relation to flood risk from water mains.

The risk of flooding from public sewers and water mains can be considered low.

4.7 Highway Drainage Flooding

There are road gullies located within the highways which bound the site. The highways fall away from the site towards the north. Providing Denbighshire County Council maintain their drainage assets in the vicinity of the site, the risk of flooding to the proposed development site from highway drainage is low.

4.8 Canals, Ponds and Artificial Watercourses

There are none of these features which would affect the site.

4.9 Summary of Flood Risk

- Fluvial Flooding – Very Low Risk
- Pluvial Flooding (to the site) – High Risk
- Pluvial Flooding (from the site) – Very Low Risk
- Groundwater Flooding – Medium Risk
- Public Sewers and Water Mains – Low Risk
- Highway Drainage Flooding – Low Risk
- Canals, Ponds and Artificial Watercourses – N/A

Mitigation proposals for Pluvial Flooding (to the site) and Groundwater Flooding are set out in section 5.0.

5.0 Mitigation

As identified in section 4, there are two flood risk sources which are above “low risk”, therefore the following mitigation measures are required within the design.

5.1 Pluvial Flooding (from the site) Mitigation

The maximum flood risk levels are shown below in figure 5.1, these are taken from the NRW Lle Database overlaid onto the detailed topographical survey. The lighter pink represents Flood Zone 2, and the darker shade is Flood Zone 3 (Surface Water and Small Watercourses). As above, the risk comes from a culvert blockage and would require a depth of 1.5m at the headwall.

The proposed building should be set above these levels to prevent overland flow reaching the threshold level. The proposed FFL is 51.600m which is safely above even the highest risk at the south.

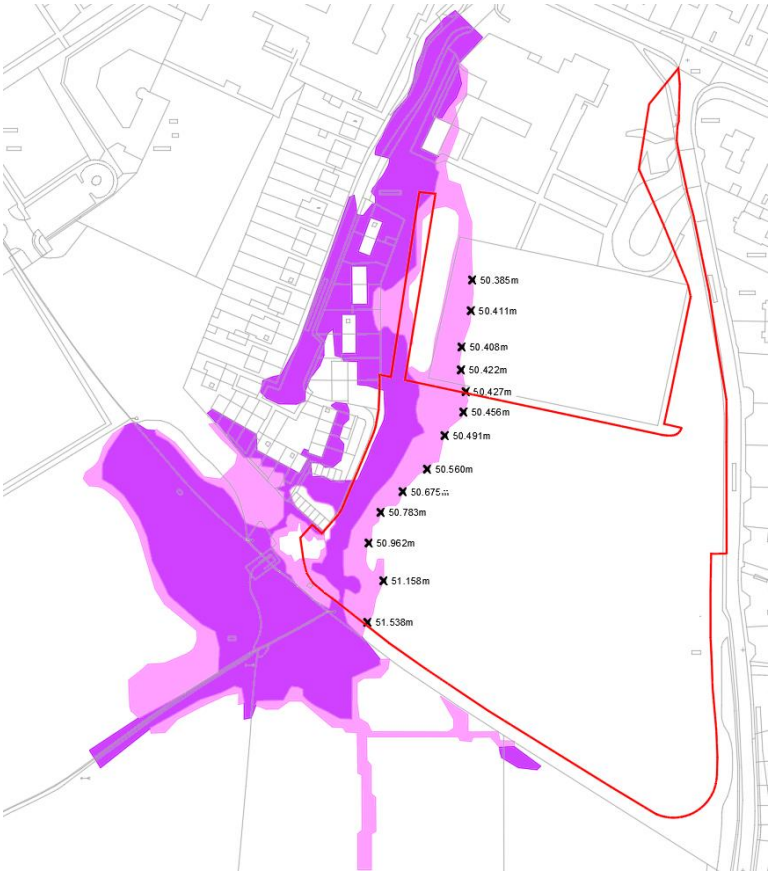


Figure 5.1 – 1 in 1,000 year Surface Water and Small Watercourse Flood Risk Levels

Land currently within Flood Zone 3 will be carefully considered as this could move the overland flow to the west which could increase the risk off site. Levels within this area should be maintained as they are or lowered to assist with channelling. The proposal for the scheme has included an area of wetland planting with lowered levels to assist in manging the low-risk event of overland flow. The lower levels are directed towards a drainage basin on site with a proposed discharge to the watercourse.

As the cause of the flood risk is a blocked or failed culvert entrance, the operation and maintenance manual for the proposed school will include a requirement to inspect the asset regularly. Regular inspections would identify any issues and prevent any flood risk impacting the site. Condition reports could be issued to the local authority for them to action. There will be no requirement on the school to maintain the asset.

Through these mitigation measures the risk of flooding to the site from pluvial sources is low.

5.2 Groundwater Flooding

The highest recorded groundwater level was 51.37mAOD within hole WS08 which is located towards the southeast of the site (see Appendix B). The building FFL is set at 51.600mAOD which is above the groundwater level. External ground levels across the site are to fall away from the proposed buildings and ensure that the creation of low points is avoided (other than those used intentionally for drainage features) in order that in the unlikely event of groundwater flooding, the flood water is safely routed away from the buildings on site. There are no below ground basements proposed within the scheme.

Providing the above mitigation measures are implemented, the flood risk to the development from groundwater is low.

6.0 Drainage Strategy

The following sets out the drainage strategy for the proposal against the requirements of the Local Authority as LLFA, the SuDS Approving Body (SAB) and TAN15.

6.1 Foul Drainage

The foul drainage from the proposed site will increase rates to the local sewer network as there is currently no connection. Dwr Cymru have been consulted and have confirmed that there is sufficient capacity in the network, and within the Wastewater Treatment Works (WwTW) to accept the proposed effluent flow at an unrestricted rate. Consultations are contained within Appendix C.

The enquiry confirms that the sewer discharges to Denbigh Eglwyswen WwTW which is located to the west of the site at SJ 07047 66482. The river discharge from Eglwyswen WwTW is to a small brook which goes to River Clwyd, this is not a Special Area of Conservation (SAC) in terms of phosphorus protection requirements. The WwTW appears to have been upgraded in 2019 / 2020 to manage changing phosphorus consents.

6.2 Surface Water Drainage

Any new development site drainage should be designed in accordance with current best practice to provide adequate capacity not to flood for the critical 1 in 30 (3.3%) Annual Probability storm event and flood water generated for the critical 1 in 100 (1%) Annual Probability plus climate change storm event shall be constrained within the site boundary and not cause damage to buildings, essential services or adjoining developments.

Surface water simulations are included within Appendix E and use FEH-13 data.

6.2.1 Standard S1 – Surface Water Run-Off Destination

The most appropriate method of surface water discharge has been determined based on the hierarchy of surface water disposal set out in the Statutory Standards for Sustainable Drainage Systems Standards for Wales, 2019.

Surface water re-use is unlikely to be suitable for this development, however as the M&E design develops it's possible that some rainwater could be collected from roof areas and used for maintenance around the public areas. This is to be confirmed and won't be included in the hydraulic modelling.

Falling Head tests were undertaken within three window sample locations, the results of which are given in table 3.1. The permeability coefficient is less than 10^{-6} m/s a full infiltration system is not preferred, however as some permeability is possible infiltration will not be restricted where possible. Permeable paving and other SuDS features will maximise infiltration potential and use

the main discharge point when this is exceeded. Groundwater needs to be considered when designing these systems.

Discharge to a watercourse is the main proposal for the scheme. The watercourse is culverted as identified above in section 3.7. This ultimately discharges to an ordinary watercourse to the north before finally discharging into the River Clwyd. Although there is no current positive connection the site levels fall towards the culvert and any greenfield run-off will become overland flow before entering highway drains in the area. Highway drains are generally directed to the local watercourses which then discharge into the River Clwyd. Therefore as long as a greenfield QBAR is targeted there will be no overall increase in flow to the local watercourses or the receiving river.

Priority 3 is achieved.

6.2.2 Standard S2 – Surface Water Runoff Hydraulic Control

The scheme incorporates permeable surfaces where possible and a series of raingardens, filter drains, tree pits, swales and a detention basin. In accordance with the statutory standards table G2.1 these methods can be assumed to be compliant for zero runoff for the first 5mm rainfall for 80% of events during the summer and 50% in winter.

The approach to the drainage strategy is to discharge at the QBAR equivalent rate for all storm events up to and including 1 in 100 year + 40% climate change. Based on the estimated greenfield runoff volume of 31m3 during the 6 hour 1 in 100 year storm it is not practical to limit discharge using volume control. The site will discharge at a maximum rate equivalent to QBAR for the 2.6ha in accordance with paragraph G2.30 in the statutory standards. The QBAR rate is 13.6 l/s as shown on the calculation within Appendix C.

Hydraulic calculations (included in Appendix E) have been completed for the site to assess overland flow and show routing for any exceedance during the peak storm event. The exceedance plan within Appendix D shows how overland flows will be routed and the areas required for temporary storage until the surcharge subsides.

In the event of a blockage / critical failure this will most likely be at the discharge chamber due to the requirement for a hydrobrake. In this event the water level within the basin will be the first sign of an issue with the network. Once the basin is exceeded the run-off will become overland flow and follow the existing routing identified on the flood risk maps for planning. The exceedance would likely enter the highway at Clwyd Avenue to the west. Any issues would be easily identifiable within the basin and remedial actions can be quickly implemented. The flow control will be fitted with a bypass option. The same consequence would occur in the event of a tank failure.

6.2.3 Standard S3 – Water Quality

There is a requirement to protect the receiving watercourse from contaminants or pollutants which may be produced as a result of the operational site. The Ciria SuDS manual classifies this site as low risk (chapter 4) as the parking is infrequent change within the school environment. The simple index approach (SIA) can be used to assess the risk and any mitigation requirements.

Referring to Table 26.2 within the SuDS manual (extracted to table 6.1 below) the site has a pollution hazard level of “low”.

Pollution hazard indices for different land use classifications				
Land Use	**Pollution Hazard Level**	**Total Suspended Solids (TSS)**	**Metals**	**Hydrocarbons**
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2	0.05
Non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4

Table 6.1 – Pollution Hazard Indices (Extract from Ciria SuDS Manual Table 26.2)

All roof drainage is collected by an internal siphonic system and discharged via the underground network to the detention basin. The detention basin is sufficient to mitigate the above indices for this purpose.

The external carparking is drained via permeable paving, tree pits, raingardens / bioretention areas prior to been discharged to the below ground network. The flows from the carparking and other external areas are also subject to a series of sumps to remove silts. Before discharge to the watercourse the run-off passes through the detention basin. This treatment train provides sufficient mitigation to the above indices for this purpose.

There are no proposed site uses which pose a risk to groundwaters.

6.2.4 Standard S4 – Amenity

The site incorporates a planting scheme which is coordinated with the drainage strategy. The design approach means that drainage forms part of the landscaping. Gullies and linear drainage channels are only used in essential areas meaning the majority of run-off is managed through the various landscaping features. The following amenity areas are part of the drainage strategy, these features can be used by the school as educational resources;

- Porous paving to carparking bays in contrasting finishes to the running aisles

- Raingarden planting to capture run off from carparking areas
- Swale areas which are accessible in controlled circumstances by students
- Permeable MUGA surfacing
- Basin can be used by students for various purposes in controlled sessions.

Although an attenuation tank is required, the system forms part of the MUGA construction allowing maximum surface area of amenity purposes. The drainage system required does not interrupt the landscaping proposal and all areas are accessible.

6.2.5 Standard S5 – Biodiversity

The scheme incorporates various planted drainage features, infiltration from these features is not prevented. Drainage systems that are on the surface and visible with vegetated components, comprising part of the local green infrastructure and ecosystem structure, are usually the greatest way to obtain biodiversity advantages. The landscaping proposal for the site incorporates the drainage within.

6.2.6 Standard S6 – Design of Drainage for Construction, Operation and Maintenance & Structural Integrity

The operational & maintenance (O&M) manual for the building operation will include the maintenance requirements for the drainage as set out in section 7 of this document. The planned maintenance is in accordance with the requirements of the Ciria SuDS manual, any proprietary products such as attenuation tanks shall be maintained in accordance with the manufacturer's specification.

The design of the attenuation tank is by a specialist manufacturer.

The design of the SuDS features as identified will be in line with the recommendations of the Ciria SuDS manual.

The design of pipes and manholes will be in accordance with the relevant British standards and building regulations to ensure maintenance can be performed safely. Efforts have been made to design a system that can be maintained without the requirement to enter chambers or confined spaces.

6.3 Discharge Rate

The drainage design permits a peak discharge of 13.6l/s during all storms up to and including 1 in 100 year + 40% climate change (CC). An allowance of 10% for urban creep (A) is included within the simulation. The 6 hour (winter) discharge volume is around 1,000m3 which is during the 1 in 100 year + 40% CC + 10% A.

6.4 Attenuation Requirements

Complying with the discharge rate set out in section 6.3 triggers the requirement for volumes of water above the allowable rate to be stored on site. The volume of this stored water depends on the rainfall event. In summary table 6.2 provides the total attenuated volume of water per return period.

Attenuation Requirements			
Attenuation Feature	**1 in 2 year**	**1 in 30 year + 10% A**	**1 in 100 year + 40%CC + 10%A**
Detention Basin	15m^3	37m^3	100m^3
Attenuation Tank	470m^3	740m^3	1,285m^3

Table 6.2 – Attenuation Volumes per Return Period

Permeable paving to the carparking bays is not included within the hydraulic calculations due to the gradient of the site, weir walls within the sub-base would be required which becomes a maintenance risk for the school. Failure to maintain permeable paving could also result in increased flood risk if required as part of the attenuation provision.

7.0 Maintenance

This section is intended to give an overview of the operation and maintenance for the drainage features included with the drainage strategy and in relation to typical details. Where proprietary products are specified, the manufacturer's instructions and recommendations should be followed in priority to this document unless specifically noted otherwise due to project constraints.

A management and maintenance plan for the lifetime of the development shall include the arrangements for an external contract where required to secure the operation of the sustainable urban drainage scheme throughout its lifetime.

The recommended operations and frequencies are typical only and should be more frequent initially to ensure that there are no unforeseen issues with the operation and then adjusted to suit the site requirements.

7.1 Off Site Maintenance

The existing culvert entrance should be inspected on a regular basis to ensure it is operational. The inspection should include the removal of any debris / litter trapped within the debris screen – any access to the headwall will be subject to safe methods of working been in place. It is recommended that prior to any predicted storm, the headwall is inspected to ensure no obstruction to flow. As set out in section 5.0, the regular inspection of the headwall decreases flood risk.

Existing Headwall		
Maintenance Activity	**Required Action**	**Frequency**
Monitoring	Inspect the headwall and remove any debris / litter trapped in the screening device	Monthly
Regular maintenance *(responsibility of Denbighshire Council)*	Inspect for evidence of poor operation via water level at headwall. If required, take remedial action.	Quarterly, 48 hours after large storms
	Check and remove large vegetation growth	Quarterly, 48 hours after large storms
	Check for excessive silt build-up or scouring to banks	Bi-annually

Table 7.1 – Existing Headwall Maintenance

7.2 On Site Maintenance

The school site will be managed by a suitable estates team. The drainage is subject to routine maintenance as with all assets. The following items are proposed within the strategy and will require maintaining and managing throughout the life cycle.

- Pipes
- Manholes
- Linear Drains
- Permeable Paving
- Detention Basin
- Bioretention / Raingardens
- Swales
- Flow Control.

No drainage is to be offered for adoption by the local authority or Dwr Cymru. It is recommended that the drainage system is inspected fully through surveys a minimum twice a year, with the system also being inspected after any major storm event. During the winter months, drainage features such as gullies and channels should be cleared of ice, snow, debris or litter.

Sediments and fills excavated from pre-treatment devices that received runoff from residential or standard road and roof areas are generally not toxic or hazardous materials and can therefore be safely disposed of either by land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate protocols.

7.2.1 Pipes

Pipes are proprietary products and the materials can vary across the site and as such where used the manufacture's recommendations should be followed. Regardless of the product used the pipes will be fully compliant with the Curtins drainage specification.

Pipes are intended to be the main conveyance across the development and where oversized they form the attenuation volume required by the limitation of the discharge rate. They are intended to be dry except for during rainfall events. These have been designed to be self-cleaning where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.

Access for maintenance is provided through access chambers and manholes.

Regular inspection and maintenance is important to identify areas which may have been obstructed/clogged and may not be drainage correctly thus exposing the development to a greater level of flood risk.

Pipes		
Maintenance Activity	**Required Action**	**Frequency**
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Initial Inspection should be provided as post construction CCTV survey	N/A
Regular maintenance / Inspection	Inspect for evidence of poor operation via water level in chambers. If required, take remedial action	Quarterly, 48 hours after large storms
	Check and remove large vegetation growth	Monthly (or as required)
Remedial Action	Rod through poorly performing runs as initial remediation	As required
	If continued poor performance jet and CCTV survey poorly performing runs	As required
	Seek advice as to remediation techniques suitable for the type of performance issue and location	As required if above actions are not effective

Table 7.2 – Pipework Maintenance

7.2.2 Manholes

Access points have been located at the head of each run, at a change in direction and at a change of pipe size in accordance with Building Regulations Part H.

The appropriate health and safety equipment must be used when accessing manholes. Confined space certificates must be held by any personnel entering a manhole and the appropriate permits should be obtained from the Maintenance Manager prior to any access.

7.2.3 Linear Drains

Channels should be inspected and cleaned in accordance with the manufacturer's details. Channel units can be cleaned through the use of a high-pressure hose; this can be fed into the channel system through access units strategically placed along the channel run. The throat section of channel units should be kept clear at all times to ensure uninterrupted flow of surface water into the drainage channel and any debris within the throat should be removed.

Locking bolts should be replaced and sufficiently tightened, taking care that the bolt heads do not stand above the top surface of the cover or grate. If covers are allowed to move within their frame, this may cause damage to the frame or seating.

Linear Drains		
Maintenance Activity	**Required Action**	**Frequency**
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Initial inspection including channel outlet boxes	Half yearly and after large storms
Regular maintenance / Inspection	Litter and debris removal	Monthly (or as required)
	Check and remove large vegetation growth	Monthly (or as required)
	Inspect silt accumulation rates and establish appropriate brushing frequencies. Silt can also be caused by adjacent landscaping areas which should be reprofiled to provide a flat area or berm adjacent to the drain	3-monthly, 48 hours after large storms
Remedial Action	Inspect access/outlet boxes and rod through poorly performing channels and outlets as initial remediation	As required

Table 7.3 – Linear Drains Maintenance

7.2.4 Permeable / Porous Paving

Paving used within the drainage network have been designed in accordance with Ciria and BS7533 guidance.

The pavements are intended to be water quality and attenuation storage features. These features are intended to be dry except during rainfall events. The pavements may also be utilised as an infiltration area or soakaway for other areas of the development.

The surface has been designed to be porous or to contain gaps where rain can flow through the upper construction layers into the voided stone which makes up the subbase.

Access for maintenance will only be via a rodding eye to the proposed underdrain. Maintenance & replacement requirements to the subbase will mean removal of the surfacing.

Permeable / Porous Paving		
Maintenance Activity	**Required Action**	**Frequency**
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect feature surface to identify evidence of erosion, compaction, ponding, and contamination. Record areas where water is ponding for >48 hours	Quarterly, immediately after large storms
	Check features surface for even gradients	Bi-annually
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect silt accumulation rates and establish appropriate removal frequencies	Bi-annually
	Inspect silt accumulation rates and establish appropriate brushing frequencies. Silt can also be caused by adjacent landscaping areas which should be reprofiled to provide a flat area or berm adjacent to the paving	Annually
Regular maintenance / Inspection	Litter and debris removal	Monthly (or as required)
	Check and remove large vegetation growth	Monthly (or as required)
	Brushing / vacuuming (if approved)	4-monthly; at the end of winter, the middle of summer and after the autumn leaf fall. Further assessment may be required if site specific observation
Remedial Action	Re-level uneven surfaces and reinstate design levels. This may be required as part of sediment removal	As required
Replacement of filter medium (25 years)	Assess filter medium below surfacing for condition and silt build-up. Replace as required	25 yearly

Table 7.4 – Permeable / Porous Paving Maintenance

7.2.5 Detention Basin

Regular inspection and maintenance is important for the effective operation of detention basins as designed.

Regular mowing in and around detention basins is required only along maintenance access routes, amenity areas (e.g. footpaths), and across some embankments. The remaining areas can be managed as “meadow”, unless additional management is required or desired for landscaping purposes.

Plant management, to achieve the required habitat/appearance, should be specified clearly in a maintenance schedule by the landscape architect planned to coincide with other site wide maintenance operations.

Sediment\material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols, especially where run-off is taken from potentially contaminated areas such as car parks/service yards.

Detention Basin		
Maintenance Activity	**Required Action**	**Frequency**
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Monitor water levels following heavy rainfall	As required
Regular maintenance / Inspection	Litter and debris removal	Monthly (or as required)
	Cut grass – meadow grass in and around basin	Bi-annually (spring before nesting season & autumn)
	Manage other vegetation and remove nuisance plants	Monthly (or as required)
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Remove sediment from inlets, outlet and forebay	Annually
Remedial Action	Reseed areas of poor vegetation growth	As required
	Repair erosion or other damage by reseeding or re-turfing	As required

Detention Basin		
	Relevel uneven surfaces and reinstate design levels	As required

Table 7.5 – Detention Maintenance

7.2.6 Raingardens / Bioretention Areas

Rainwater gardens will require regular maintenance to ensure continuing operation to design performance standards. The surface can become blocked with rubbish, debris and vegetation if incorrectly managed and maintained. The most intensive maintenance is required during the establishment period. Herbicides and pesticides (such as Roundup) and fertilizers should not be used on bioretention systems.

The maintenance of the planting and surface materials should be completed in accordance with the landscaping maintenance strategy.

Raingardens / Bioretention Areas		
Maintenance Activity	**Required Action**	**Frequency**
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Monitor surface following heavy rainfall	As required
Regular maintenance / Inspection	Litter and debris removal	Monthly (or as required)
	Inspect surfaces for silting and ponding, and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Manage other vegetation and remove nuisance plants	Monthly (or as required)
Remedial Action	Infill any holes or scour in the filter medium, improve erosion protection if required	Annually
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	Annually
Replacement of filter medium (25 years)	Assess filter medium below surfacing for condition and silt build-up. Replace as required	25 yearly

Table 7.6 – Raingardens / Bioretention Maintenance

7.2.7 Swales

The maintenance of swales is relatively straightforward and typically there should only be a small amount of extra work required for a swale over and above what is necessary for standard public open space.

The major maintenance requirement for dry swales is mowing. Mowing should ideally retain grass lengths of 75–150 mm across the main “treatment” surface, to assist in filtering pollutants and retaining sediments and to reduce the risk of flattening during runoff events. However, longer vegetation lengths, where appropriate, are not considered to pose a significant risk to functionality.

Swales		
Maintenance Activity	**Required Action**	**Frequency**
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Monitor surface following heavy rainfall	As required
Regular maintenance / Inspection	Litter and debris removal	Monthly (or as required)
	Cut grass – to retain grass height within specified design range	Monthly (during growing season)
	Manage other vegetation and remove nuisance plants	Monthly (or as required)
	Identify any ponding water on surface and smooth out ground as required	Bi-annually
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Bi-annually
Remedial Actions	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	Annually
	Relevel uneven surfaces and reinstate design levels	As required
Replacement of filter medium (25 years)	Assess filter medium below surfacing for condition and silt build-up. Replace as required	25 yearly

Table 7.7 – Swales Maintenance

7.2.8 Flow Control

The flow control units are intended for flood control and flow restriction.

The flow controls are specified as Hydro-brake or similar approved and are proprietary products; therefore, manufacturer's recommendations should also be taken in to consideration.

Access for maintenance has been provided by locating within manhole chambers.

Flow Control		
Maintenance Activity	**Required Action**	**Frequency**
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect the device for any signs of wear and tear, ensure the bypass is operational and wire is secured to MH opening.	Half yearly
Regular maintenance / Inspection	Removal sediment from sump within chamber	Bi-annually, 48 hours after large storms
	Inspect silt accumulation rates and establish appropriate brushing frequencies. Silt can also be caused by adjacent landscaping areas which should be reprofiled to provide a flat area or berm adjacent to the drain	Monthly
Remedial Action	If chamber remains surcharged 48 hours afters storm event, or detention basin is close to overtopping, the bypass cord should be pulled to drain down the system and investigations carried out.	As required

Table 7.8 – Flow Control Maintenance

8.0 Residual Risk

It is difficult to completely guard against flooding since extreme events greater than the design standard event are always possible, however it is practicable to minimise the risk by allowing a substantial freeboard (safety margin) and by using appropriate construction and management techniques.

For rainfall events in excess of the design standard of the proposed surface water management system, it is possible that the system capacity will be exceeded.

Site levels are designed to direct flows away from the building entrances where possible, and towards areas such as car parking or formal landscaping where temporarily shallow flooding may occur to mitigate the residual risk in the event of exceedance flows from the drainage system.

In addition, ongoing management and maintenance of the proposed surface water management systems and existing local drainage assets must be undertaken in accordance with the management schedules which will be defined at the detailed design stage.

Based on the above, the residual risk is considered to be acceptable for the lifetime of the development.

9.0 Conclusions and Recommendations

Curtins has been appointed by Wates Construction North West to prepare a Flood Consequence Assessment (FCA) in support of a planning application for the provision of a new Development at Ystrad Road, Denbigh.

The FCA provides information on the nature of flood risk at the site and follows Government guidance with regards to development and flood risk. The report is based on current available information and preliminary discussions.

The assessment has been undertaken in accordance with the standing advice and requirements of NRW as outlined in the Welsh Assemble Government PPW and accompanying TAN 15 guidance.

The surface water management strategy has been reviewed in relation to the Statutory Standards for Sustainable Drainage Systems in Wales and the SABs guidance with respect to surface water methods, SuDS provision and outfall options.

The report concludes that:

- The site is located mostly within Flood Zone A, defined as having a little or no risk of flooding from rivers or the sea.
- There is a small localised area of Flood Zone B that may have flooded in the past, however there is no evidence to suggest that this has occurred since the culverted watercourse was installed to alleviate flooding.
- In accordance with TAN 15, school uses are classified as ‘’Highly Vulnerable’ development. According to TAN 15, this land use is appropriate for Flood Zone A and B without the need to apply the Justification Test where mitigation factors are implemented.
- The site is considered as being at a low risk of flooding from all sources following the mitigation measures set out in section 5.0.
- Surface water discharge from the proposed development will be restricted to 13.6 l/s for all events up to and including the 1 in 100 (1%) Annual Probability plus climate change event. This represents the equivalent Qbar greenfield runoff rate for the site.
- Surface water attenuation will be provided for all events up to and including the 1 in 100 (1%) Annual Probability plus climate change event with exceedance flows managed on site so not to increase flood risk elsewhere.
- Foul flows from the site will be discharged at an unrestricted rate to the combined public sewer.

10.0 Appendices

Appendix A – Site Layouts

Appendix B – Topographical Survey

Exploratory Hole Plan

Appendix C – Consultations

Greenfield Run-off

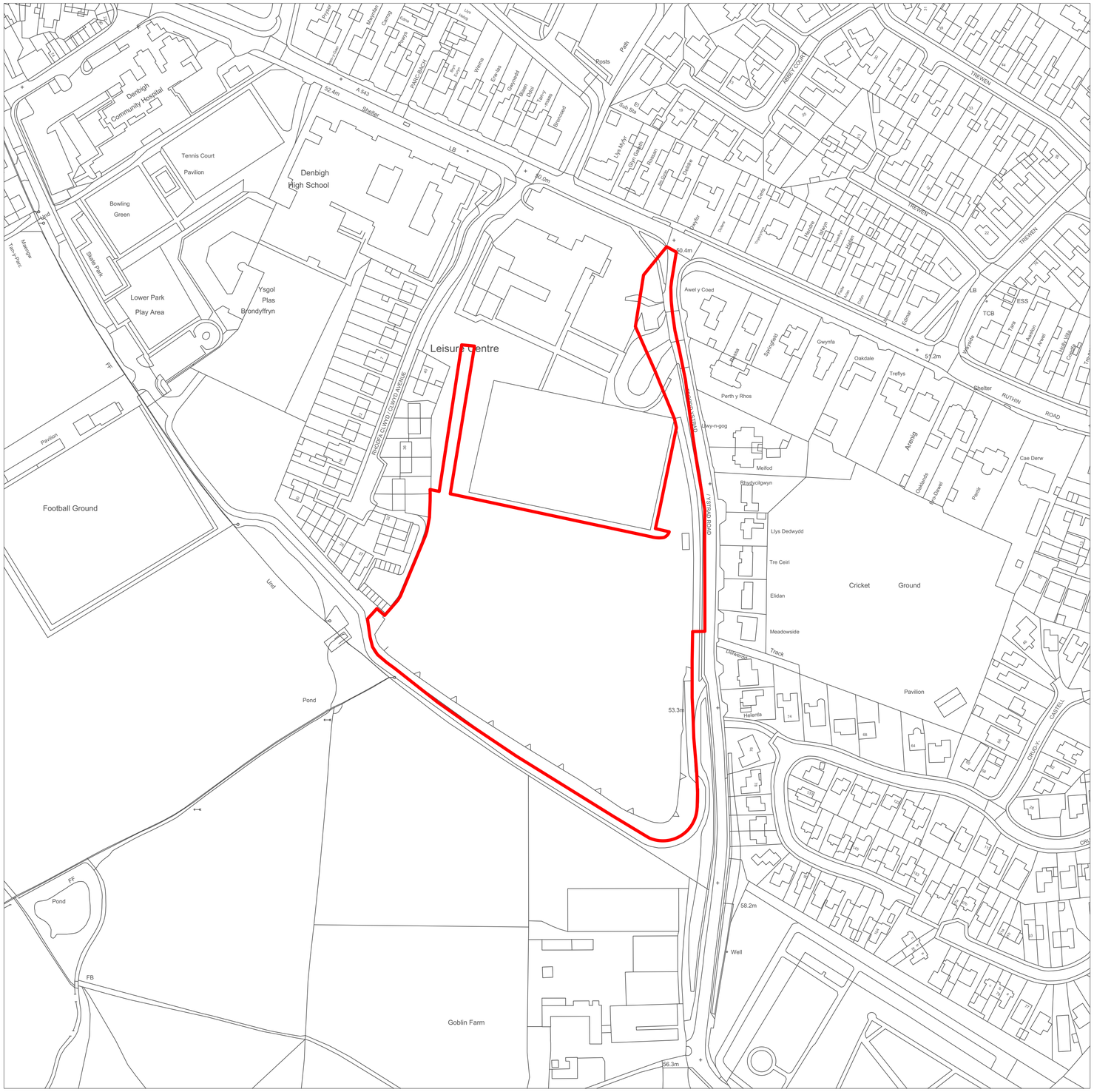
Appendix D – Design Drawings

Appendix E – Hydraulic Calculations

Appendix A Site Layouts

NOTE

1. Do not scale from this drawing.
2. All dimensions are in meters unless otherwise noted.
3. Information shown outside extent of works is for illustrative purposes only.
4. To be read in conjunction with all other Landscape Architect's drawings
Drawings YPB-ALA-XX-XX-DR-L-00000 Series,
Details YPB-ALA-XX-XX-DR-L-10000 Series,
NBS - YPB-ALA-XX-XX-SP-L-00002
MMP - YPB-ALA-XX-XX-RP-L-00001
5. To be read in conjunction with all other discipline's drawings and specifications.
6. Specification and details of build ups to paving, kerbs, edges and structures to be advised by Project Civil Engineer.
7. All subbases to retaining features, walls to Project Engineers details.
8. Formations levels are to be inspected and approved by the Project Engineer.
9. Highway works by others, cross over and carpark please refer to Civils package.
10. Drainage design, manhole cover positions & final levels to be coordinated with Drainage Engineers
11. Lighting design, to be coordinated with M&E details, columns are shown for coordination only.
12. Landscape contractor is responsible for all area take offs. Any areas or quantities shown are for information only. Plant numbers should account for slopes/gradients.
13. Plant substitutions require approval from Landscape Architect / Client due to safeguarding and health and safety issues in relation to SEND client requirements.
14. Any work to existing trees to be carried out by a suitability qualified Tree Surgeon; All work to be carried out in accordance with AMS. Tree Consultant to advise on all issues regarding works in relation to trees.
15. The following elements are intended to be specialist design packages, subcontractor / specialist to submit drawings for approval prior to procurement and manufacture: a. street furniture b. canopies c. cycle stores. d. metalwork package fencing, e. gates etc. Access control to be coordinated by M&E Consultant tbc by School. Sports furniture and finishes.
16. The following elements are intended to be specialist design packages, subcontractor / specialist designer to submit drawings for approval prior to procurement and manufacture: a. all street furniture b. external classroom canopies c. cycle store d. metalwork package including all fencing, handrails, gates etc. Access control / Gate suiting to be coordinated with WCL/ M&E Consultant tbc by School & DCC. sports furniture / finishes / linemarkings. All specialists to submit drawings for approval prior to procurement and manufacture and ensure these are designed in accordance with all relevant BS Standards and Guidance.
17. The contractor is to check all setting out information, levels and dimensions before construction. Any discrepancies are to be brought to the attention of Ares Landscape Architects before commencing on site.
18. Refer to designer risk assessment for details in relation to safeguarding / security issues due to SEND client requirements.
19. Site clearing works as per Ecological and Arboricultural reports.
20. Topsoil / Subsoil stripping to be carried out in accordance with Arboricultural Input for site strip, storage, remediation and repositioning on site. To be carried out in accordance with the Wates Soft Work Manual.
21.Provide small gaps of at least 15cm x 15cm at designated points under all boundary fences to allow movement of small mammals/hedgehogs. These are indicatively shown on the sustainability and biodiversity plans *YPB-ALA-00-XX-DR-L-00029* in 11No. locations.
22. Incoming services, meter, substations to MEP Information. Please refer to their package for detailed layouts.
23. Drainage design by Drainage Engineer, please refer to Curtins information.



KEY

Planning Application Boundary

ID	RISK	MITIGATION	DATE MITIGATED

RESIDUAL PROJECT RISKS

DATE	REV	DESCRIPTION OF REVISION	DRAWN BY	APPROVED BY
30/08/2022	P07	Updated Red Line for Planning Issue	KP	
30/08/2022	P06	Response to clarification tracker 160822 1. Red Line Amended to Suit Client Comments	KP	
04/07/2022	P05	Issued for Draft CPs	KP	KS

REVISIONS

STATUS
S2 - *FOR PLANNING*

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CLIENT :
Wates Construction Ltd

PROJECT TITLE :
Ysgol Plas Brondyffryn SEN

DRAWING TITLE :
Site Location Plan

DRAWING SCALE :	DRAWN BY :	DRAWN DATE :
1:1250	KP	20/01/2022
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A1	KS	ALA725

DRAWING NUMBER :	STATUS :	REVISION :
YPB-ALA-00-XX-DR-L-00001	**S2**	**P07**

KEY

Site

- Planning Application Boundary
- Proposed Building
- Proposed Canopy/ Building Overhang
- Proposed Main Entrance
- Proposed Classroom Entrance
- Proposed Plant Room Entrance
- Existing Tree
- Existing Hedge
- Existing Vegetation Removed to Facilitate Development
- Existing Floodlighting Columns for Neighbouring Leisure Centre All Weather Pitch (AWP)
- Existing Retaining Wall

Planting

Refer to Planting Strategy
Ref. YPB-ALA-00-XX-DR-L-00015

- Proposed Tree
- Amenity Lawn
- Amenity Planting
- Sensory Planting
- Hedge Planting
- Meadow Planting
- Swale Meadow Planting
- Woodland Planting
- Green Screen 'Fedge'

Paving

Refer to General Arrangement
Ref. YPB-ALA-00-XX-DR-L-00004

- Pedestrian Macadam
- Vehicular Macadam
- Permeable Macadam
- Wetpour safety surface
- Reinforced Grass
- MUGA Permeable Surface
- Play Markings
- Concrete Pad
- Self binding gravel
- Cobbled sensory path
- Concrete Block Paving
- Hazard Paving - Tactile
- Hazard Paving - Corduroy

Furniture

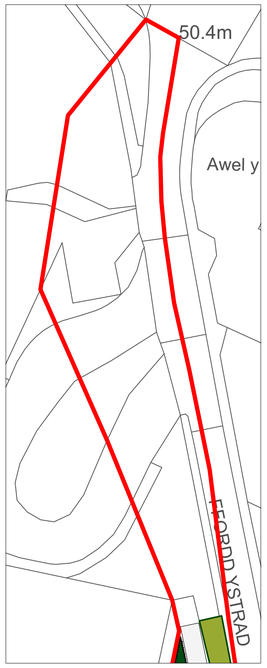
Refer to General Arrangement
Ref. YPB-ALA-00-XX-DR-L-00004
and External Furniture
Ref. YPB-ALA-00-XX-DR-L-00030

- Cycle Shelter
- Trike/Scooter Storage
- External Shed
- Wooden Shelter
- Shade sail
- Play Equipment
- Wayfinding signage
- Raised Planter
- Picnic bench
- Bench Seating
- Electric Car Charging Point
- Bollards
- Door Protection Barrier
- Parking Entrance Build Out Concrete Block Paving
- Parking Islands Concrete Block Paving
- Habitat houses
  Refer to Sustainability and Biodiversity drawing
  YPB-ALA-00-XX-DRL-00029

Fencing and Structures

Refer to Boundary Treatments
Ref. YPB-ALA-00-XX-DRL-00005

- Fencing
- Gates



INSERT A
Please refer to the Transport Statement and Drawings for details of work in this area.

NOTES

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ID	RISK	MITIGATION	DATE MITIGATED

RESIDUAL PROJECT RISKS

DATE	REV	DESCRIPTION OF REVISION	DRAWN BY	APPROVED BY
07/09/2022	P12	Updated Red Line for Planning Issue	KP	
30/08/2022	P11	Issued for Planning	KP	

REVISIONS

STATUS
S2 - *FOR PLANNING*

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CLIENT :
Wates Construction Ltd

PROJECT TITLE :
Ysgol Plas Brondyffryn SEN

DRAWING TITLE :
Landscape Illustrative Masterplan

DRAWING SCALE :	DRAWN BY :	DRAWN DATE :
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Appendix B Topographical Survey

Exploratory Hole Plan

SW	STORM WATER SEWERS
FW	FOUL WATER SEWERS
WM	WATER MAIN
GM	GAS MAIN
EL	ELECTRIC CABLES
DUCT	CABLE DUCTING
BT	BT (UNDERGROUND)
CCTV	CABLE TV
CCTV	CLOSED CIRCUIT TV
UI	UNIDENTIFIED FEATURE
UP	UNIDENTIFIED PIPE
UC	UNIDENTIFIED CABLE
UNPR	UNPROVEN FEATURE
SW	END OF TRACE
FW (C)	LATERAL CONNECTIONS
	EXTENT OF SURVEY BY SURVEY OPERATIONS LTD.
	EXTENT OF SURVEY BY SURVEY OPERATIONS LTD.()
0.0d	BURIED FEATURE FOUND USING RADAR
FW / SW	CONNECTIVITY BETWEEN CHAMBERS FROM CCTV REPORT
	BURIED FEATURE FOUND USING RADAR

UNIDENTIFIED - A buried feature or utility that has been located, but we are unable to state what it is.
UNPROVEN - The assumed location of a reported feature or utility, usually taken from records, but not found during the utility trace (due to various conditions).
CAUTION - Electric pot ended cables, even when they are live, are unable to be detected or traced.

UNDERGROUND UTILITIES SERVICES DISCLAIMER

We have endeavoured to locate existing services using records provided by Statutory Authorities as a guide. Some apparatus were untraceable and details have therefore been taken from Utility Record Drawings, which may be of poor quality. Consequently we cannot guarantee accuracy of information taken from such records.

Where indicated, no allowance has been made for sub-surface entry into manholes, other chambers or confined spaces below ground level. Therefore any details relating to depths, sizes etc, are taken from the surface and as such will be approximate.

We have endeavoured to supply you with the most accurate data possible by using methods and equipment that are at the forefront of our industry. We have taken great care in the detection of pipework and buried features, but as with all methods of detecting underground or buried utilities the information provided is based on results obtained from electromagnetic techniques, and as such may be liable to distortion or errors beyond the reasonable control of the operator or his instruments.

It is the responsibility of the user under Health & Safety (HSG47) Guidelines to satisfy himself of the suspected location of any services prior to excavation of the services shown.

NOTE 1

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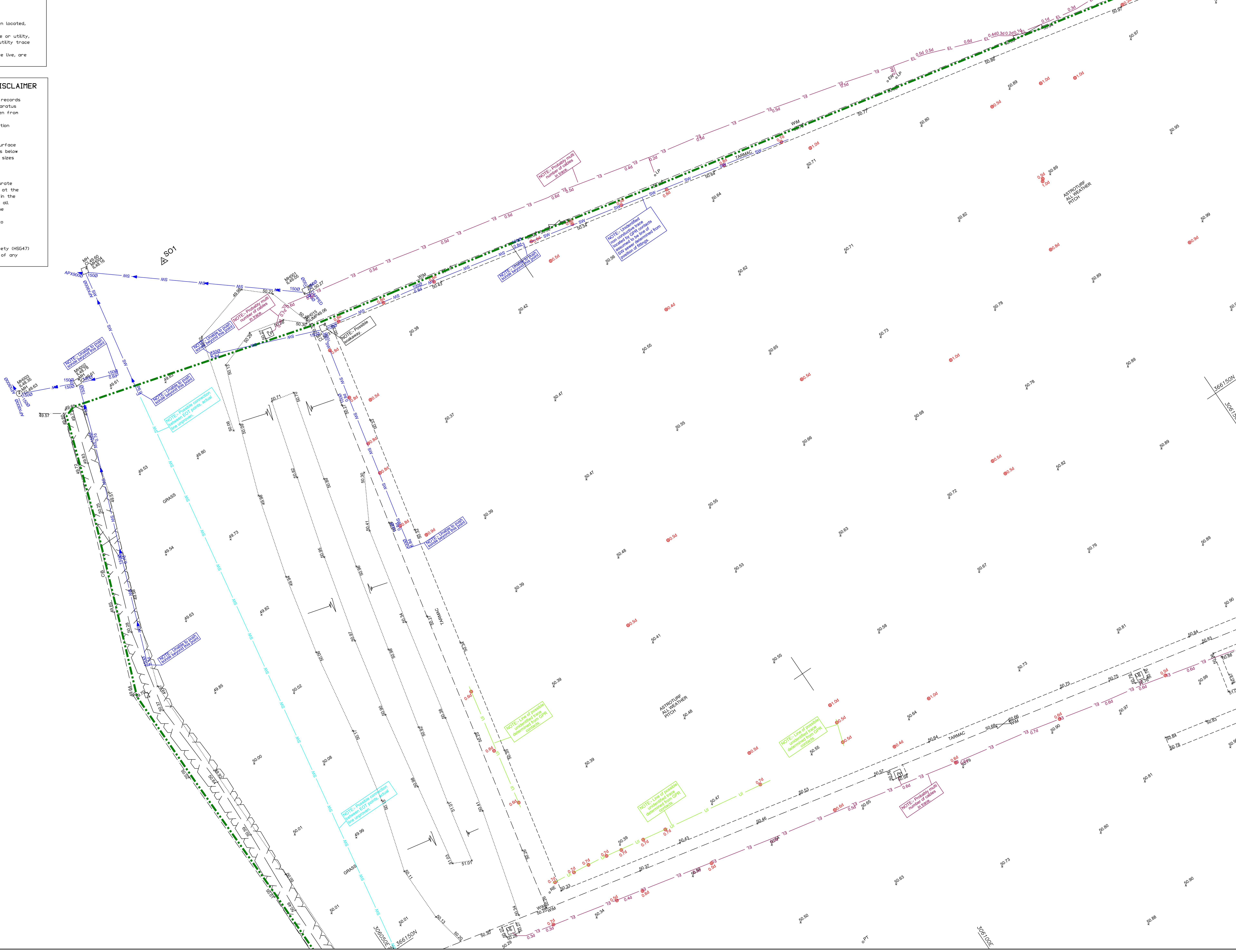

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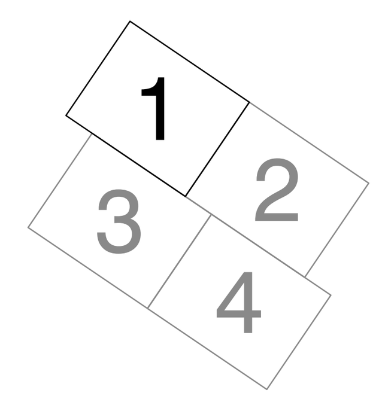
Utility survey added to topographical survey job number 22A138.

Sheet Layout



Survey OPERATIONS
Smith Street, Skelmersdale, Lancs. WN8 8LN
Tel: 01695 725662 Fax: 01695 51816
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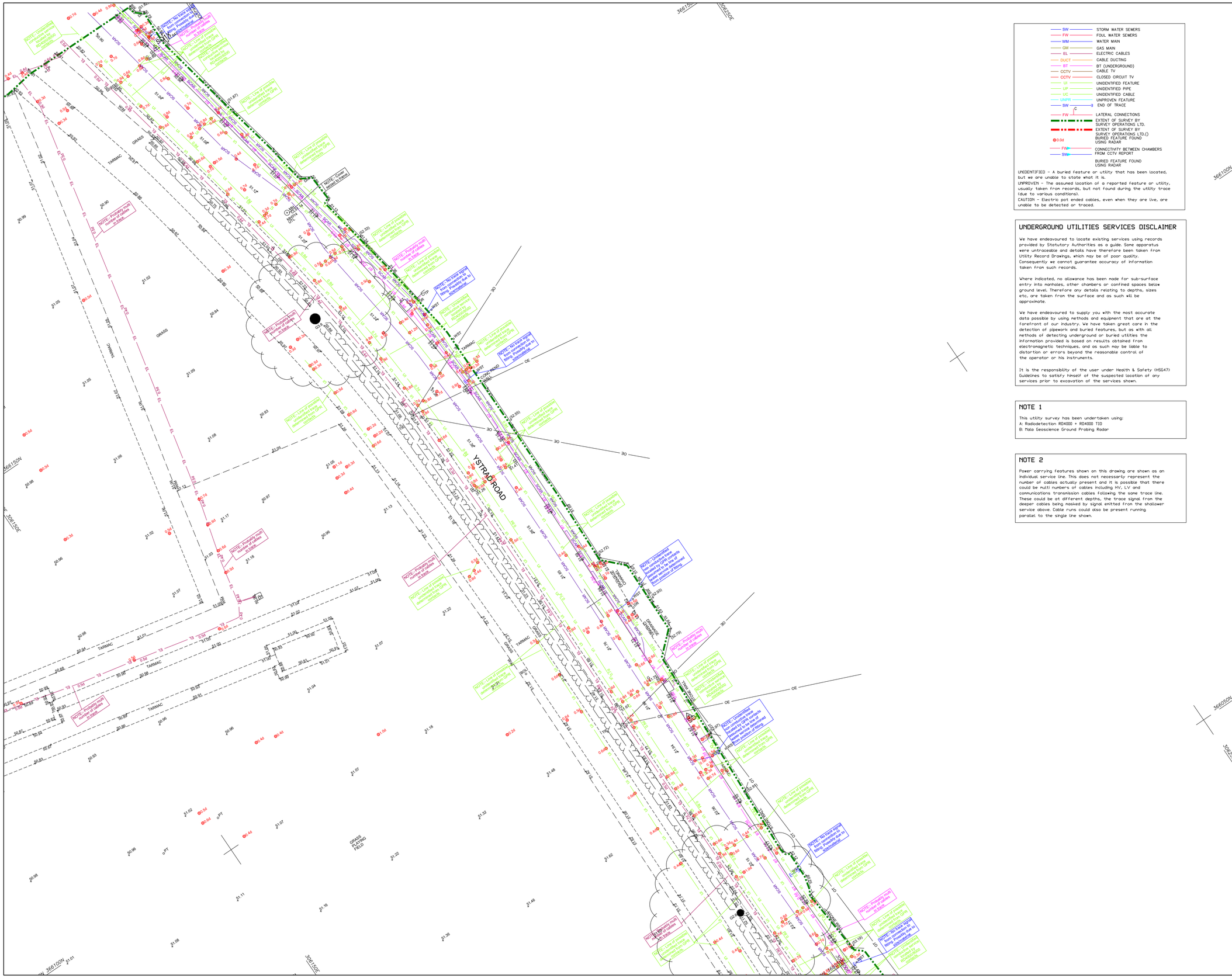
Client
Wates Construction Limited

Drawing Title
Utility Survey of Land at:
Denbigh Leisure Centre
Denbigh
Sheet 1 of 4

Scale(s)	1:200	Surveyor	SC
Date	FEB 22	Drawn	IT
Job Number	22A182	Checked	SO

Sheet Size & Drg Number & Revision
A1 22A182/001



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EXTENT OF SURVEY BY SURVEY OPERATIONS LTD.() BURIED FEATURE FOUND USING RADAR
⊘0.0d
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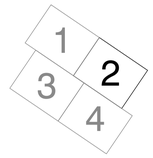

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Client
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Drawing Title
Utility Survey of Land at:
Denbigh Leisure Centre
Denbigh
Sheet 2 of 4

Scale(s)	1:200	Surveyor	SC
Date	FEB 22	Drawn	IT
Job Number	22A182	Checked	SO

Sheet Size & Drg Number & Revision
A1 22A182/002

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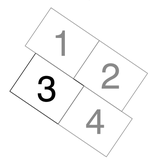

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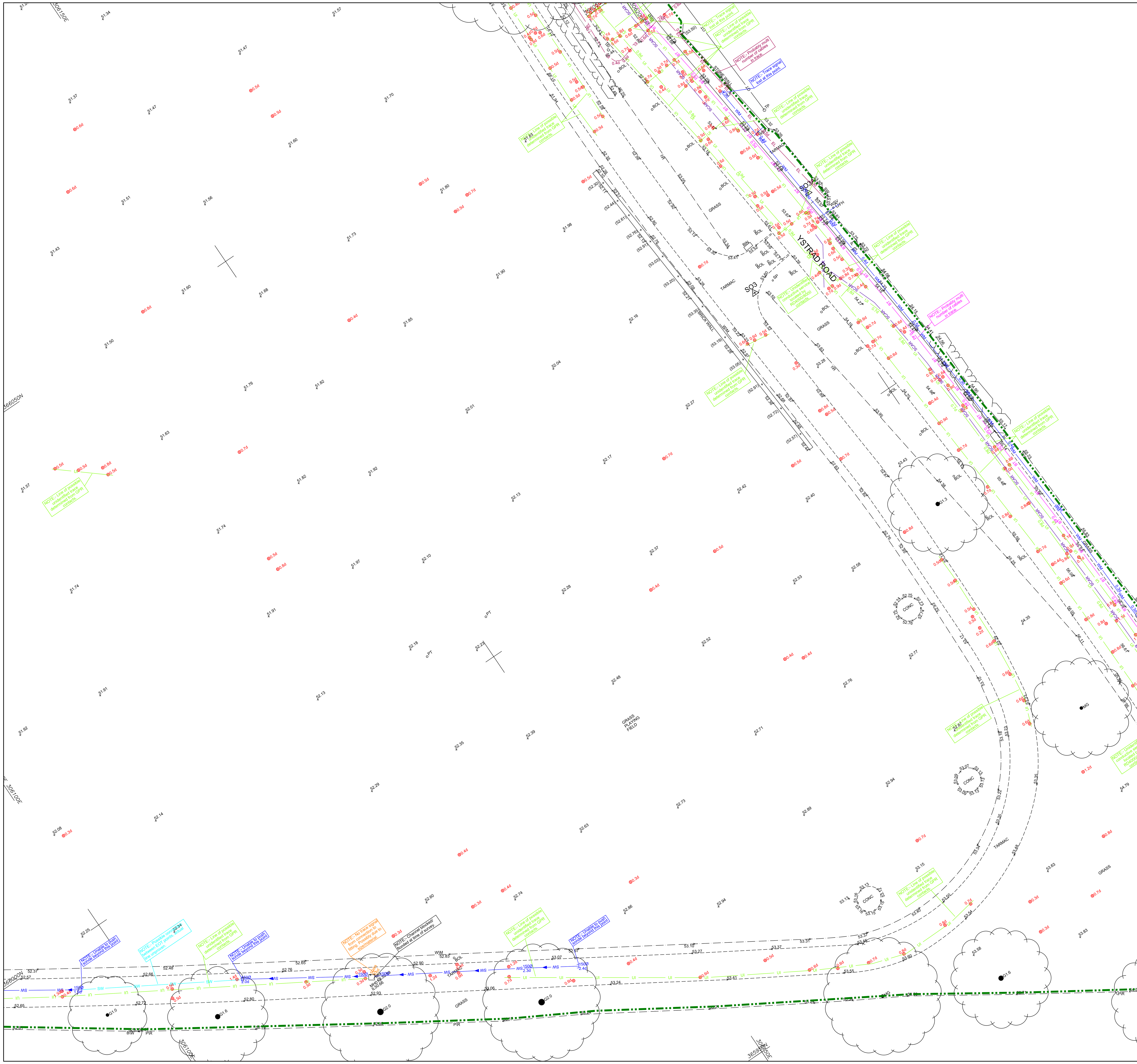
Denbigh
Sheet 3 of 4

Scale(s)	1:200	Surveyor	SC
Date	FEB 22	Drawn	IT
Job Number	22A182	Checked	SO

Sheet Size & Drg Number & Revision
A1 22A182/003



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Sheet Layout
1 2 3 4

SurveY OPERATIONS

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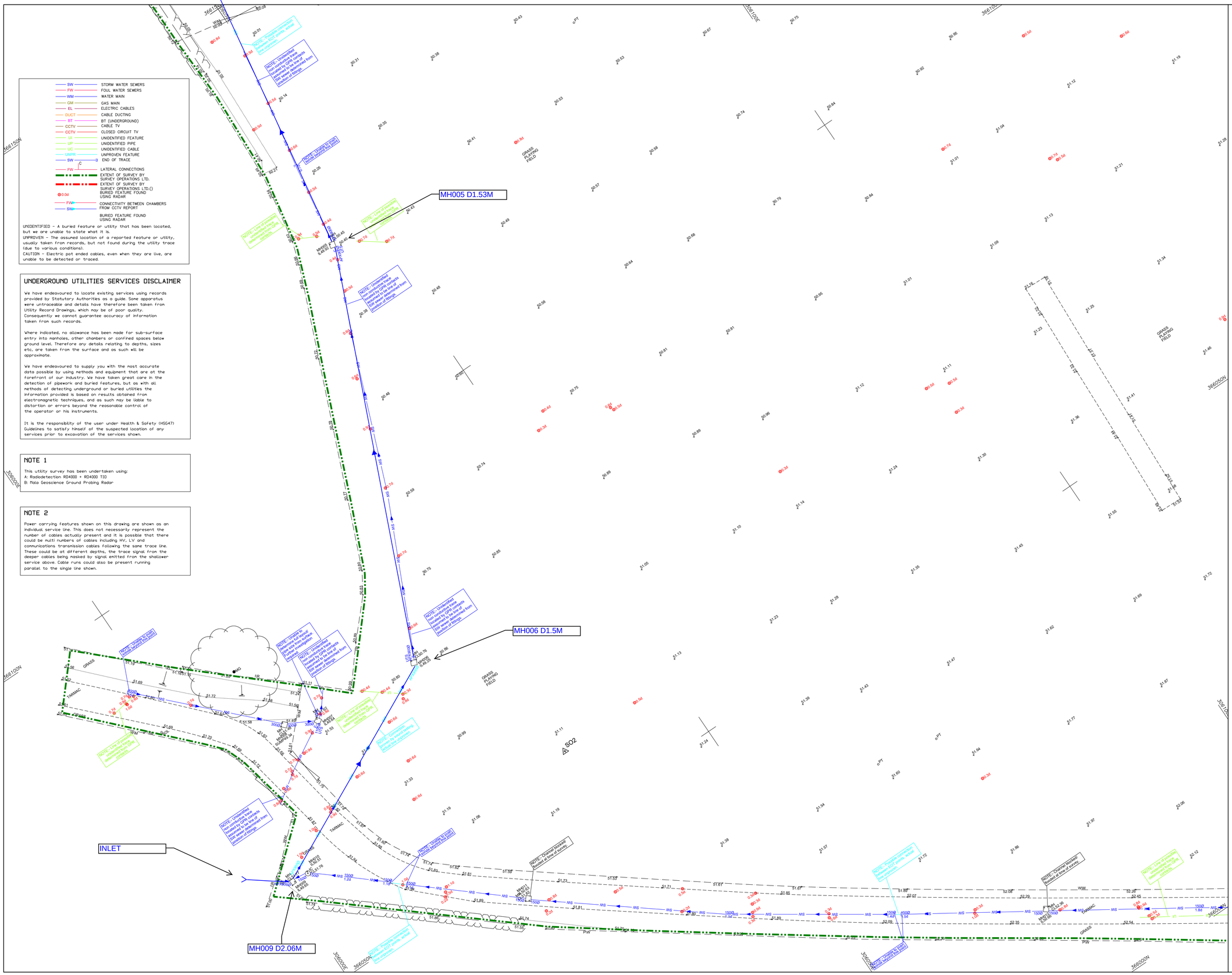
Sheet 4 of 4

Scale(s)	1:200	Surveyor	SC
Date	FEB 22	Drawn	IT
Job Number	22A182	Checked	SO

Sheet Size & Drg Number & Revision
A1 22A182/004



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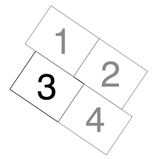

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Sheet 3 of 4

Scale(s)	1:200	Surveyor	SC
Date	FEB 22	Drawn	IT
Job Number	22A182	Checked	SO

Sheet Size & Drg Number & Revision
A1 22A182/003

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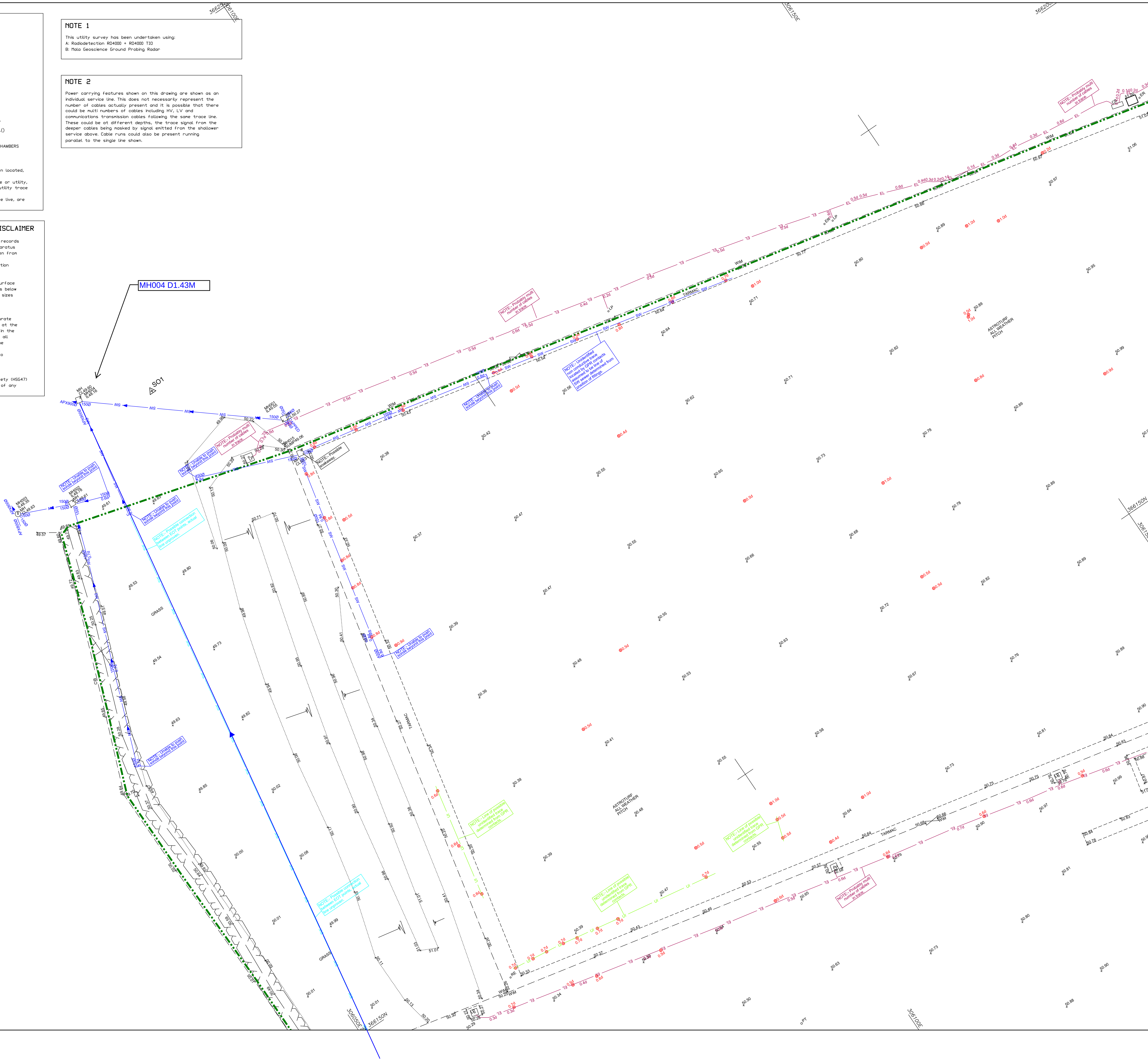

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Sheet Layout: 1, 2, 3, 4

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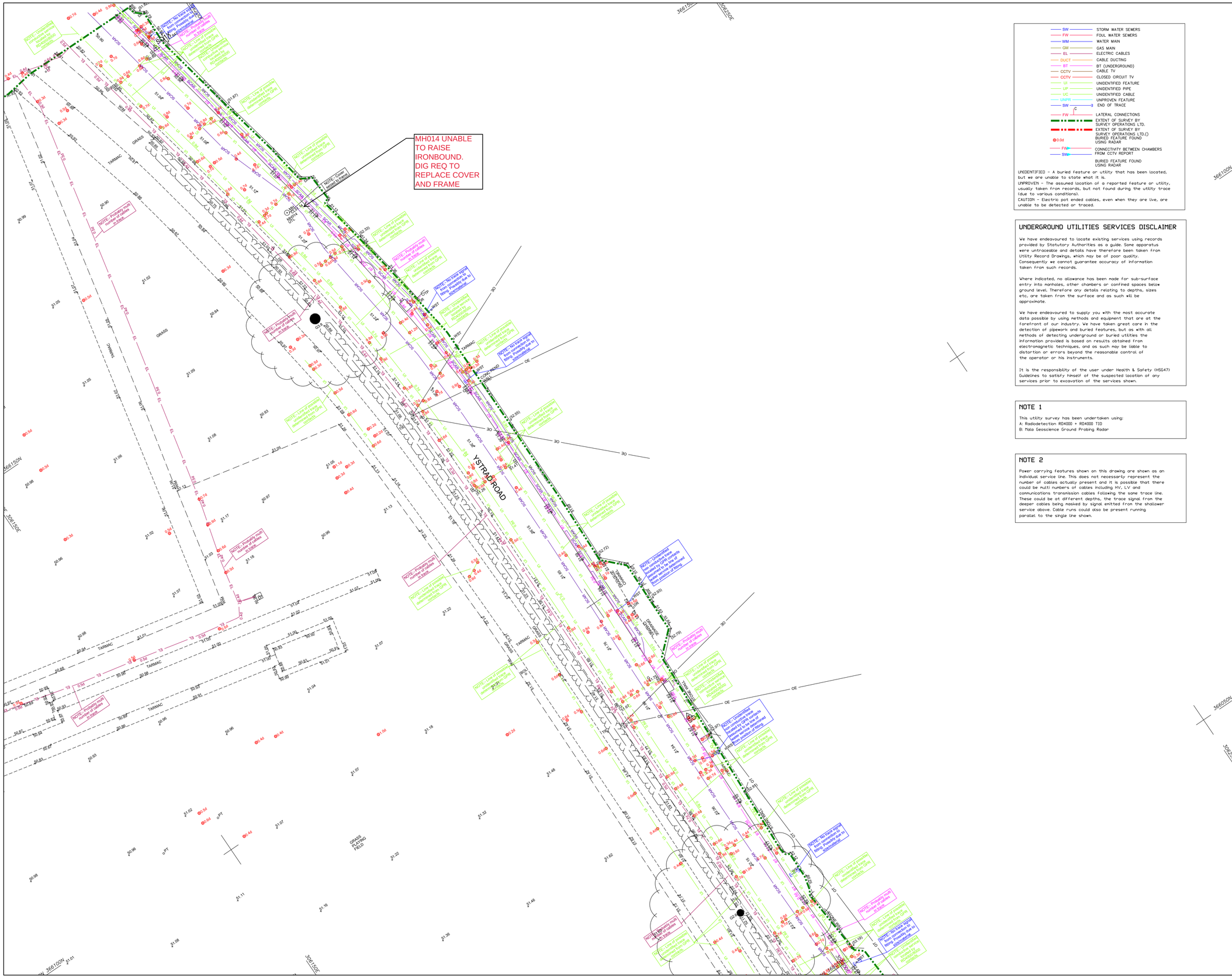

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Power carrying features shown on this drawing are shown as an individual service line. This does not necessarily represent the number of cables actually present and it is possible that there could be multi numbers of cables including HV, LV and communications transmission cables following the same trace line. These could be at different depths, the trace signal from the deeper cables being masked by signal emitted from the shallower service above. Cable runs could also be present running parallel to the single line shown.

Note:
The survey is plotted on a plane local Grid. Orientation to National Grid.
All levels relate to Ordnance Datum, achieved using the OS National GPS Network.

Survey Control Markers established for Mapping purposes only and should not be used for Construction without the written approval of Survey Operations Ltd.

SURVEY STATIONS

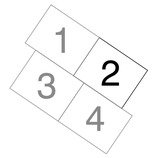
Name	Easting	Northing	Height
SO1	306070.29	366220.13	49.73
SO2	306035.12	366057.37	51.16
SO3	306194.00	366016.16	53.50
SO4	306201.68	366083.32	51.97
SO1X	306194.23	366180.42	50.99
SO3A	306204.51	366021.70	53.58

Levels shown in parenthesis indicate top of wall levels.

All drainage information must be verified with local authority records before use.

Utility survey added to topographical survey job number 22A138.

Sheet Layout



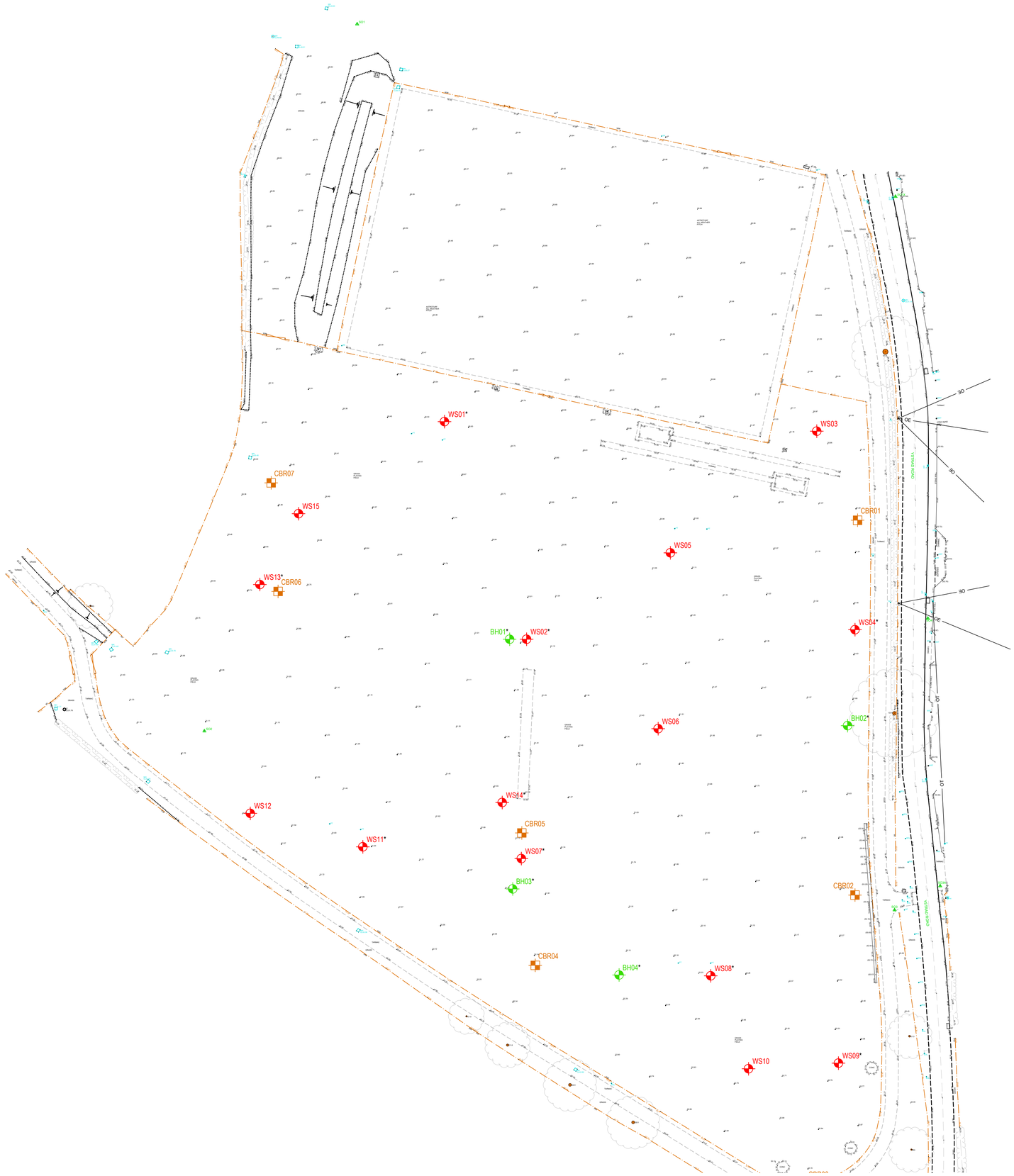
SurveY OPERATIONS
Smith Street, Skelmersdale, Lancs. WN8 8LN
Tel: 01695 725662 Fax: 01695 51816
Email: mail@survops.co.uk – www.survops.co.uk

Client
Wates Construction Limited

Drawing Title
Utility Survey of Land at:
Denbigh Leisure Centre
Denbigh
Sheet 2 of 4

Scale(s)	1:200	Surveyor	SC
Date	FEB 22	Drawn	IT
Job Number	22A182	Checked	SO

Sheet Size & Drg Number & Revision
A1 22A182/002



GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWING.

LEGEND

BH01 - BH04 — DENOTES CABLE PERCUSSIVE BOREHOLES, UP TO 15.45m BGL

WS01 - WS15 — DENOTES WINDOW SAMPLE BOREHOLES, UP TO 5.45m BGL

CBR01 - CBR07 — DENOTES CBR TESTS

* DENOTES AN INSTALLED WINDOW SAMPLE BOREHOLE

Rev:	Description:	Date:	By:	Chkd:
V01	ISSUED FOR INFORMATION	04/03/22	NG	RT

curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
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manchester@curtins.com
www.curtins.com
Civils & Structures • Transport Planning • Environmental • Infrastructure • Geotechnical • Conservation & Heritage • Principal Designer
Birmingham • Bristol • Cambridge • Cardiff • Douglas • Dublin • Edinburgh • Glasgow • Kendal • Leeds • Liverpool • London • Manchester • Nottingham

Status: SUITABLE FOR INFORMATION — S2

Project: YBP SCHOOL

Drg Title: EXPLORATORY HOLE LOCATION PLAN

Size:	Date:	Drawn By:	Designed By:	Checked By:
A1	04/03/22	N. GILL	R. TIDSEY	R. TIDSEY

Scale: 1:500

Project No:	Originator:	Volume:	Level:	Type:	Role:	Category / Number:	Rev:
079942	CUR	00	XX	DR	GE	80001	V01

\\mfs02\Projects\Other CCE Office Jobs\Manchester\YPB School\

Appendix C Consultations

Greenfield Run-off

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Jake Busby
Site name:	VPB
Site location:	DEnbigh

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

Site Details

Latitude:	53.18369° N
Longitude:	3.40633° W
Reference:	3531723242
Date:	Feb 10 2022 16:25

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 2.6

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	751	751
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	13.63	13.63
1 in 1 year (l/s):	11.99	11.99
1 in 30 years (l/s):	24.26	24.26
1 in 100 year (l/s):	29.71	29.71
1 in 200 years (l/s):	33.53	33.53

Dŵr Cymru
Welsh Water

Developer Services
PO Box 3146
Cardiff
CF30 0EH

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

Gwasanaethau Datblygu
Blwch Post 3146
Caerdydd
CF30 0EH

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

Mr Jake Busby
Curtins Consulting
51-55
Tithebarn St
Liverpool
Merseyside
L2 2SB

Date: 17/03/2022
Our Ref: PPA0006545

Dear Mr Busby,

Grid Ref: 306119 366061
Site Address: Ysgol plas Brondyffryn Ystrad Road Denbigh
Development: New Senior School

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

Firstly, we note that the proposal relates to a school at Ystrad Road, comprising approximately 116 staff and 230 pupils and to replace the existing school nearby, we acknowledge that the site comprises of a potential windfall development with no allocated status in the Local Development Plan (LDP). Accordingly, whilst it does not appear an assessment has been previously undertaken of the public sewerage and watermains systems, we offer the following comments as part of our appraisal of this development.

Please note, notwithstanding the following assessment, we would advise there is also a mandatory requirement to undertake pre-application consultation with all 'Specialist Consultees', including Dwr Cymru Welsh Water as the statutory water and sewerage undertaker, in accordance with Schedule 4 of Town & Country Planning (Development Management Procedure) (Wales) (Amendment) Order 2016. As a major development, amounting to more than 1000 sqm, you will be statutorily required to consult Welsh Water and a substantive response will be issued within 28 days from the date of the notice as per the requirements of Article 2E.

Public Sewerage Network

The proposed development site is located in the immediate vicinity of a separate sewerage system, comprising combined, foul and surface water public sewers, which drains to Denbigh Eglwyswen Wastewater Treatment Works (WwTW).

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

Foul Water Drainage – Sewerage Network

We have considered the impact of foul flows generated by the proposed development and concluded that flows can be accommodated within the public sewerage system. We advise that the flows should be connected to the foul sewer downstream of manhole SJ06661101 located in Ystrad Road to the east. Should a planning application be submitted for this development we will seek to control these points of communication via appropriate planning conditions and therefore recommend that any drainage layout or strategy submitted as part of your application takes this into account. However, should you wish for an alternative connection point to be considered please provide further information to us in the form of a drainage strategy, preferably in advance of a planning application being submitted.

You may need to apply to Dwr Cymru Welsh Water for any connection to the public sewer under Section 106 of the Water industry Act 1991. However, if the connection to the public sewer network is either via a lateral drain (i.e. a drain which extends beyond the connecting property boundary) or via a new sewer (i.e. serves more than one property), it is now a mandatory requirement to first enter into a Section 104 Adoption Agreement (Water Industry Act 1991). The design of the sewers and lateral drains must also conform to the Welsh Ministers Standards for Foul Sewers and Lateral Drains, and conform with the publication "Sewers for Adoption"- 7th Edition. Further information can be obtained via the Developer Services pages of www.dwrcymru.com.

Surface Water Drainage

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

In addition, please note that no highway or land drainage run-off will be permitted to discharge directly or indirectly into the public sewerage system.

SEWAGE TREATMENT

No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site.

WATER SUPPLY

A water supply can be made available to service this proposed development. However, this would require the installation of off-site mains from our ''7" CI' diameter watermain in ''Grid referebce 306167,366286 Ruthin road. ' location. A budgetary cost for providing a watermain to the periphery of your development will be provided upon application. Under Sections 40 - 41 of the Water Industry Act 1991 the cost is requisitionable and, subject to us receiving your detailed site layout plan and your programme for construction, we would be able to provide a more accurate assessment of the developer's contribution. These details should be sent to the above address.

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

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

Please quote our reference number in all communications and correspondence.

Yours faithfully,

Owain George
Planning Liaison Manager
Developer Services

ENC. WATER PLAN, SEWER PLAN, PRE PLANNING NOTES.

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

Jake Busby

From: North Planning <NorthPlanning@cyfoethnaturiolcymru.gov.uk>
Sent: 09 February 2022 09:48
To: Jake Busby
Subject: LL16 3HE - Ystrad Road, Denbigh, Denbighshire, LL16 3HE (Charged pre-app) - NRW Response NRW:08540861

Dear Jake,

Thank you for consulting Natural Resources Wales on the above application.

We have reviewed the planning application submitted to us, and from the information provided we do not consider that the proposed development affects a matter listed on our Consultation Topics, *Development Planning Advisory Service: Consultation Topics* (September 2018): https://naturalresources.wales/guidance-and-advice/business-sectors/planning-and-development/our-role-in-planning-and-development/our-role-in-planning-and-development/?lang=en. We therefore do not have any comment to make on the proposed development.
Please note that our decision not to comment does not rule out the potential for the proposed development to affect other interests, including environmental interests of local importance.

The Lead Local Flood Authority (as cited in the Flood and Water Management Act 2010) is normally the appropriate body to provide advice on existing surface water flood risk and the management of surface water drainage from new developments.

Advice on localised flood risk from pluvial, surface water or groundwater should be sought as early as possible in the development process from the relevant Lead Local Flood Authority (in this case Denbighshire County Council). NRW does not provide advice on such matters, unless a development scheme is located within an Internal Drainage District.

Information regarding accessing our data, maps and reports can also be found at Natural resources Wales / Access our data, maps and reports . Further specific information regarding the data used in the Flood Map for Planning can be requested by contacting datadistribution@naturalresourceswales.gov.uk.

The applicant should be advised that, in addition to planning permission, it is their responsibility to ensure that they secure all other permits/consents relevant to their development.

We trust that the above comments are of assistance however, should you have any queries, please do not hesitate to contact me.

Kind Regards
Rachel Burke

Tîm Cynllunio Datblygu / Development Planning Team
Cyfoeth Naturiol Cymru / Natural Resources Wales

www.cyfoethnaturiolcymru.gov.uk / www.naturalresourceswales.gov.uk

Yn falch o arwain y ffordd at ddyfodol gwell i Gymru trwy reoli'r amgylchedd ac adnoddau naturiol yn gynaliadwy / Proud to be leading the way to a better future for Wales by managing the environment and natural resources sustainably.

Croesewir gohebiaeth yn Gymraeg a byddwn yn ymateb yn Gymraeg, heb i hynny arwain at oedi / Correspondence in Welsh is welcomed, and we will respond in Welsh without it leading to a delay.

Jake Busby

From: Wayne Hope <wayne.hope@denbighshire.gov.uk>
Sent: 01 March 2022 17:07
To: Jake Busby
Cc: Land Drainage Consultations
Subject: RE: LL16 3HE - Ystrad Road, Denbigh, Denbighshire, LL16 3HE (Charged pre-app) - NRW Response NRW:08540861

Sorry Jake, I don't have that information.

It might be useful to have a quick meeting to discuss the proposals from a SAB and flood risk perspective. Earliest availability I have is 7th March pm.

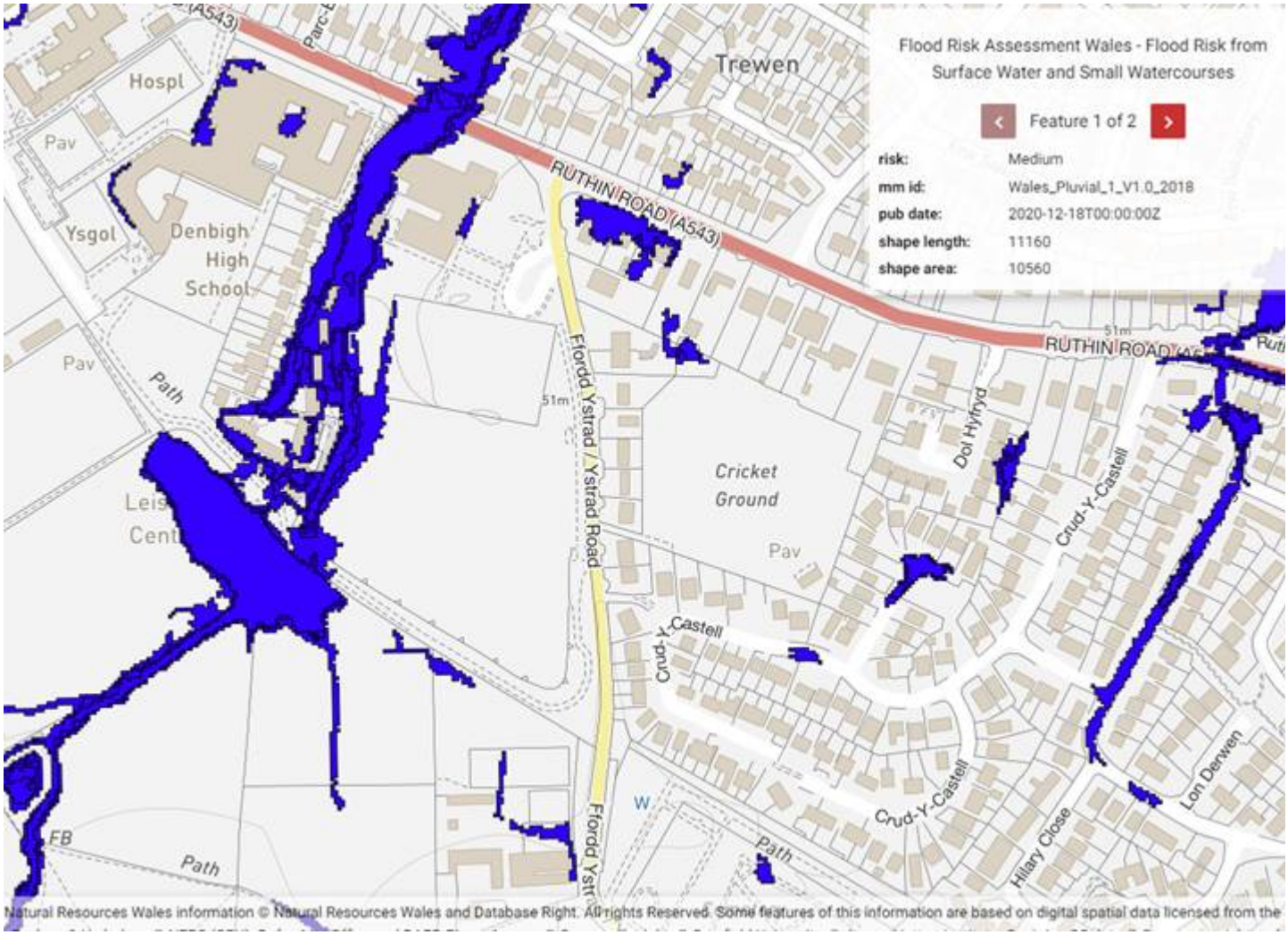
Regards,

Wayne Hope
Rheolwr Risg Llifogydd / Flood Risk Manager
Priffyrdd, Cyfleusterau a Gwasanaethau Amgylcheddol/Highways & Environmental Services
Ffon / Tel: 01824 706901
Symudol / Mobile: 07787 221451
e-bost: wayne.hope@sirddinbych.gov.uk
e-mail: wayne.hope@denbighshire.gov.uk
www.sirddinbych.gov.uk / www.denbighshire.gov.uk

From: Jake Busby [mailto:Jake.Busby@curtins.com]
Sent: 01 March 2022 15:32
To: Wayne Hope <wayne.hope@denbighshire.gov.uk>
Cc: Land Drainage Consultations <landdrainage.consultations@denbighshire.gov.uk>
Subject: FW: LL16 3HE - Ystrad Road, Denbigh, Denbighshire, LL16 3HE (Charged pre-app) - NRW Response NRW:08540861

Hi Wayne,

Hope you are well. I am looking at Ysgol Plas Brondyffryn currently and there is an identified flood risk within the new site. It's defined as from surface water / small watercourse. As far as I can tell it's because there is a culverted watercourse within the site which backs up at the culvert entrance and exceeds the land level resulting in overland flow. I was wondering if you could provide the predicted level data?



Kind Regards,

Jake Busby (He/him) Senior Engineer
Curtins
T. 0151 726 2000 | M. 07894615289 | jake.busby@curtins.com

From: North Planning <NorthPlanning@cyfoethnaturiolcymru.gov.uk>
Sent: 09 February 2022 09:48
To: Jake Busby <Jake.Busby@curtins.com>
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The applicant should be advised that, in addition to planning permission, it is their responsibility to ensure that they secure all other permits/consents relevant to their development.

We trust that the above comments are of assistance however, should you have any queries, please do not hesitate to contact me.

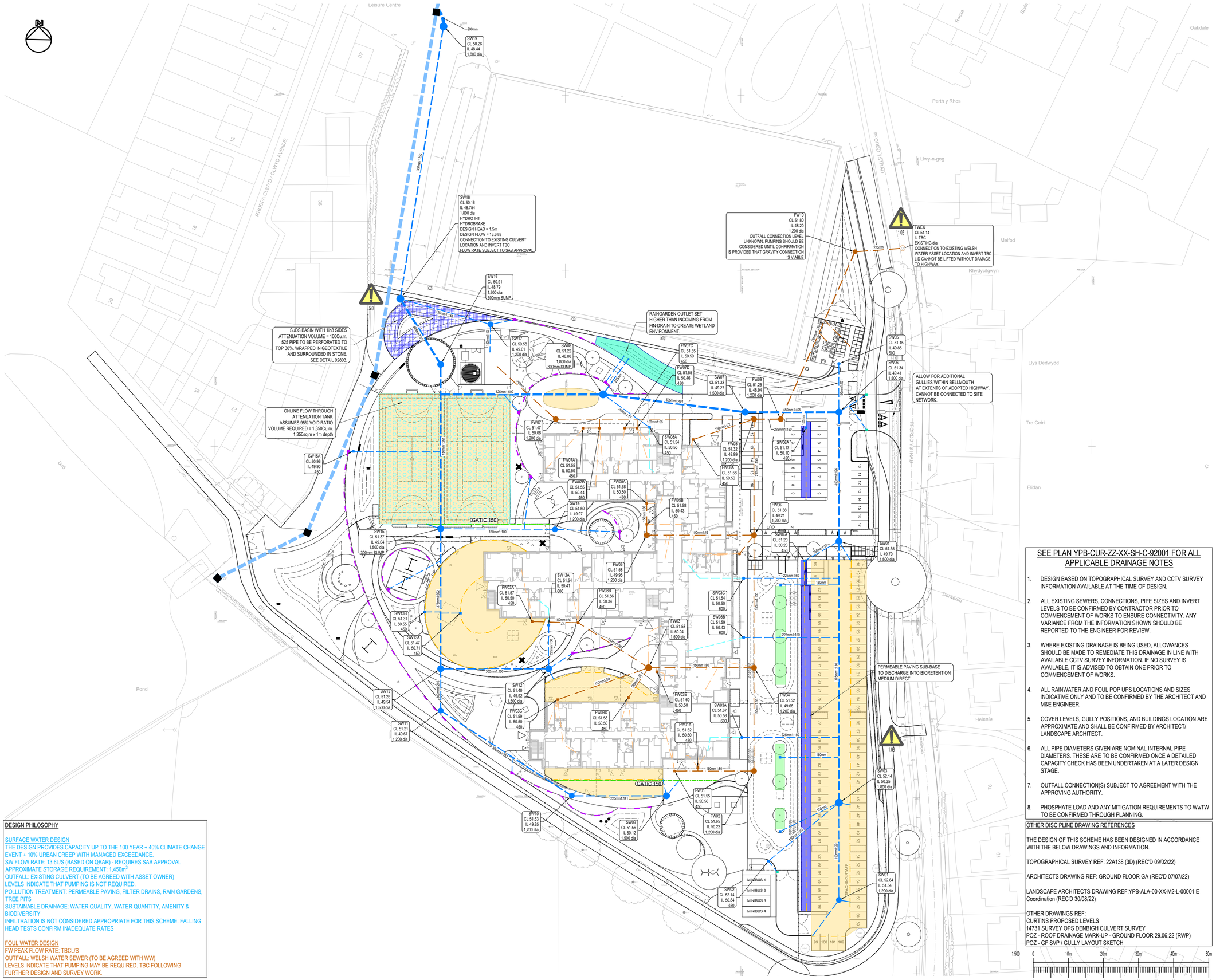
Kind Regards
Rachel Burke

Tîm Cynllunio Datblygu / Development Planning Team
Cyfoeth Naturiol Cymru / Natural Resources Wales

www.cyfoethnaturiolcymru.gov.uk / www.naturalresourceswales.gov.uk

above and do not necessarily represent the views of Denbighshire County Council. However, as a Public Body, Denbighshire County Council may be required to disclose this e-mail [or any response to it] under legislative provisions.

Appendix D – Design Drawings



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3. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWING.
5. LAYOUTS BASED ON INFORMATION AVAILABLE AT THE TIME OF PRODUCTION. ANY VARIANCE FROM THE INFORMATION SHOWN SHOULD BE REPORTED TO THE ENGINEER FOR REVIEW.
6. LAYOUT SUBJECT TO LOCATING EXISTING UTILITIES. ALL EXISTING SERVICES TO BE LOCATED PRIOR TO COMMENCEMENT OF ANY WORKS, AND WHERE NECESSARY PROTECTION OR DIVERSIONS TO BE UNDERTAKEN TO AVOID CONFLICT WITH THE PROPOSED WORK.
7. SECTIONS OF ADOPTABLE HIGHWAY SUBJECT TO APPROVAL AND CONSULTATION BY LOCAL AUTHORITY.
8. ASSETS SHOWN MAY NOT ACCURATELY REPRESENT THE TRUE LOCATION ON SITE.
9. NOT FOR CONSTRUCTION FOR INFORMATION ONLY

KEY

- PROPOSED PRIVATE SW SEWER
- PROPOSED PRIVATE FW SEWER
- PROPOSED 150Ø ABG FIN DRAIN TO EDGE. OUTLET TO BE MIN. 200 IC.
- EXISTING 900Ø SURFACE WATER CULVERT AT 1.5m DEPTH
- PROPOSED LINEAR DRAIN
- 150Ø FULLY PERFORATED PIPE
- D400 ROAD GULLY WITH 150Ø CONNECTION
- CELLULAR ATTENUATION SYSTEM - SDS GEOLIGHT OR SIMILAR APPROVED FLOW THROUGH SYSTEM
  VENTING LOCATION TBC BY MANUFACTURER.
- TREEPIT SYSTEM - GREENBLUE URBAN OR SIMILAR
  SYSTEM DESIGN BY OTHERS
- BIORETENTION - SEE DETAIL SHEET 92802
  UNDERDRAINED WITH 150mm PERFORATED PIPE
- RAINGARDEN - DETAIL TO BE COORDINATED WITH LANDSCAPE ARCHITECT
- PERMEABLE PAVING - SEE EXTERNAL WORKS DETAILS FOR PROPOSALS
  UNDERDRAINED WITH 150mm PERFORATED PIPE
- SuDS BASIN -
  GRAVEL BASE TO ENCOURAGE INFILTRATION

SEE PLAN YPB-CUR-ZZ-XX-SH-C-92001 FOR ALL APPLICABLE DRAINAGE NOTES

1. DESIGN BASED ON TOPOGRAPHICAL SURVEY AND CCTV SURVEY INFORMATION AVAILABLE AT THE TIME OF DESIGN.
2. ALL EXISTING SEWERS, CONNECTIONS, PIPE SIZES AND INVERT LEVELS TO BE CONFIRMED BY CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS TO ENSURE CONNECTIVITY. ANY VARIANCE FROM THE INFORMATION SHOWN SHOULD BE REPORTED TO THE ENGINEER FOR REVIEW.
3. WHERE EXISTING DRAINAGE IS BEING USED, ALLOWANCES SHOULD BE MADE TO REMEDIATE THIS DRAINAGE IN LINE WITH AVAILABLE CCTV SURVEY INFORMATION. IF NO SURVEY IS AVAILABLE, IT IS ADVISED TO OBTAIN ONE PRIOR TO COMMENCEMENT OF WORKS.
4. ALL RAINWATER AND FOUL POP UPS LOCATIONS AND SIZES INDICATIVE ONLY AND TO BE CONFIRMED BY THE ARCHITECT AND M&E ENGINEER.
5. COVER LEVELS, GULLY POSITIONS, AND BUILDINGS LOCATION ARE APPROXIMATE AND SHALL BE CONFIRMED BY ARCHITECT/ LANDSCAPE ARCHITECT.
6. ALL PIPE DIAMETERS GIVEN ARE NOMINAL INTERNAL PIPE DIAMETERS. THESE ARE TO BE CONFIRMED ONCE A DETAILED CAPACITY CHECK HAS BEEN UNDERTAKEN AT A LATER DESIGN STAGE.
7. OUTFALL CONNECTION(S) SUBJECT TO AGREEMENT WITH THE APPROVING AUTHORITY.
8. PHOSPHATE LOAD AND ANY MITIGATION REQUIREMENTS TO WwTW TO BE CONFIRMED THROUGH PLANNING.

OTHER DISCIPLINE DRAWING REFERENCES

THE DESIGN OF THIS SCHEME HAS BEEN DESIGNED IN ACCORDANCE WITH THE BELOW DRAWINGS AND INFORMATION.

TOPOGRAPHICAL SURVEY REF: 22A138 (3D) (REC'D 09/02/22)

ARCHITECTS DRAWING REF: GROUND FLOOR GA (REC'D 07/07/22)

LANDSCAPE ARCHITECTS DRAWING REF:YPB-ALA-00-XX-M2-L-00001 E Coordination (REC'D 30/08/22)

OTHER DRAWINGS REF:
CURTINS PROPOSED LEVELS
14731 SURVEY OPS DENBIGH CULVERT SURVEY
POZ - ROOF DRAINAGE MARK-UP - GROUND FLOOR 29.06.22 (RWP)
POZ - GF SVP / GULLY LAYOUT SKETCH

DESIGN PHILOSOPHY

SURFACE WATER DESIGN
THE DESIGN PROVIDES CAPACITY UP TO THE 100 YEAR + 40% CLIMATE CHANGE EVENT + 10% URBAN CREEP WITH MANAGED EXCEEDANCE.
SW FLOW RATE: 13.6L/S (BASED ON QBAR) - REQUIRES SAB APPROVAL
APPROXIMATE STORAGE REQUIREMENT: 1,450m³
OUTFALL: EXISTING CULVERT (TO BE AGREED WITH ASSET OWNER)
LEVELS INDICATE THAT PUMPING IS NOT REQUIRED.
POLLUTION TREATMENT: PERMEABLE PAVING, FILTER DRAINS, RAIN GARDENS, TREE PITS
SUSTAINABLE DRAINAGE: WATER QUALITY, WATER QUANTITY, AMENITY & BIODIVERSITY
INFILTRATION IS NOT CONSIDERED APPROPRIATE FOR THIS SCHEME. FALLING HEAD TESTS CONFIRM INADEQUATE RATES

FOUL WATER DESIGN
FW PEAK FLOW RATE: TBCL/S
OUTFALL: WELSH WATER SEWER (TO BE AGREED WITH WW)
LEVELS INDICATE THAT PUMPING MAY BE REQUIRED. TBC FOLLOWING FURTHER DESIGN AND SURVEY WORK.

1:500 scale bar: 0, 10m, 20m, 30m, 40m, 50m
1:1 scale bar: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

Rev:	Description:	Date:	By:	Chkd:
P07	CLARIFICATIONS (S4)	01/09/22	GDP	JDB
P06	STAGE 3 (S4)	08/07/22	JDB	AF
P05	PLANNING (S2)	27/05/22	JDB	AF
P04	STAGE 2 (S4)	08/03/22	MB	JDB
P03	SITE LAYOUT AMENDED (S4)	25/02/22	MB	JDB

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0151 726 2000
liverpool@curtins.com
www.curtins.com
Civils & Structures • Transport Planning • Environmental • Infrastructure • Geotechnical • Conservation & Heritage • Principal Designer
Birmingham • Bristol • Cambridge • Cardiff • Douglas • Dublin • Edinburgh • Glasgow • Kendal • Leeds • Liverpool • London • Manchester • Nottingham

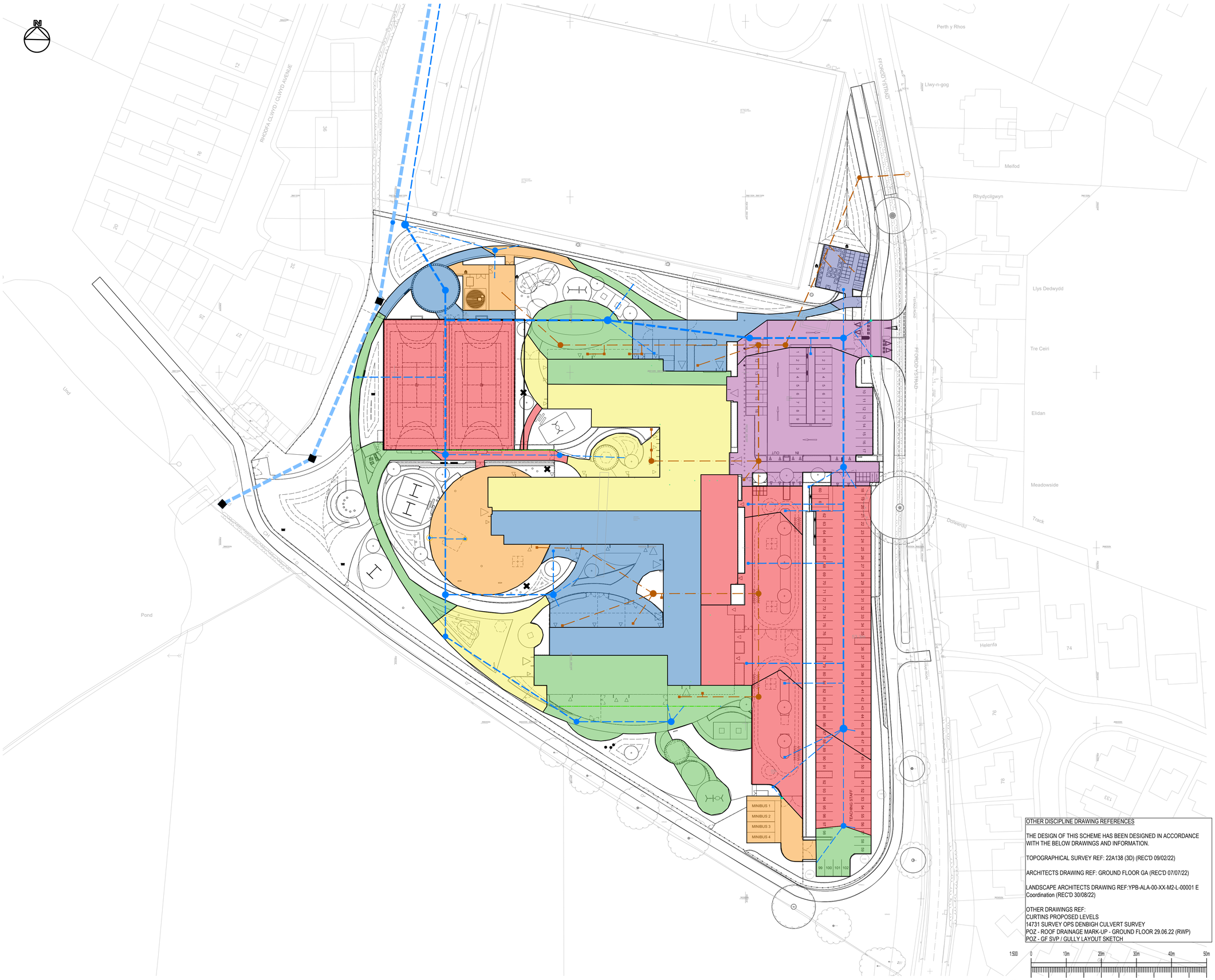
Status: SUITABLE FOR INFORMATION — S2

Project: YSGOL PLAS BRONDYFFRYN

Drg Title: DRAINAGE GENERAL ARRANGEMENT

Drawn By	Designed By	Checked By
LB	JDB	AF
	Date: 11/02/2022	Scales @ A1: 1:500

Project No - Originator - Function - Spatial - Form - Discipline - Number: YPB - CUR - 00 - XX - DR - C - 92001
Revision: P07



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7. SECTIONS OF ADOPTABLE HIGHWAY SUBJECT TO APPROVAL AND CONSULTATION BY LOCAL AUTHORITY.
8. ASSETS SHOWN MAY NOT ACCURATELY REPRESENT THE TRUE LOCATION ON SITE.
9. NOT FOR CONSTRUCTION FOR INFORMATION ONLY

DRAINAGE NOTES:

1. DESIGN BASED ON TOPOGRAPHICAL SURVEY AND CCTV SURVEY INFORMATION AVAILABLE AT THE TIME OF DESIGN.
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4. ALL RAINWATER AND FOUL POP UPS LOCATIONS AND SIZES INDICATIVE ONLY AND TO BE CONFIRMED BY THE ARCHITECT AND M&E ENGINEER.
5. COVER LEVELS, GULLY POSITIONS, AND BUILDINGS LOCATION ARE APPROXIMATE AND SHALL BE CONFIRMED BY ARCHITECT/ LANDSCAPE ARCHITECT.
6. ALL PIPE DIAMETERS GIVEN ARE NOMINAL INTERNAL PIPE DIAMETERS. THESE ARE TO BE CONFIRMED ONCE A DETAILED CAPACITY CHECK HAS BEEN UNDERTAKEN AT A LATER DESIGN STAGE.
7. OUTFALL CONNECTION(S) SUBJECT TO AGREEMENT WITH THE APPROVING AUTHORITY.

NOTE: AREAS HATCHED ARE ALLOWED FOR WITHIN DRAINAGE DESIGN, AMENDMENT TO DRAINED AREAS WILL REQUIRE ADJUSTMENT TO HYDRAULIC MODEL.

OTHER DISCIPLINE DRAWING REFERENCES

THE DESIGN OF THIS SCHEME HAS BEEN DESIGNED IN ACCORDANCE WITH THE BELOW DRAWINGS AND INFORMATION.

TOPOGRAPHICAL SURVEY REF: 22A138 (3D) (REC'D 09/02/22)

ARCHITECTS DRAWING REF: GROUND FLOOR GA (REC'D 07/07/22)

LANDSCAPE ARCHITECTS DRAWING REF:YPB-ALA-00-XX-M2-L-00001 E Coordination (REC'D 30/08/22)

OTHER DRAWINGS REF:
CURTINS PROPOSED LEVELS
14731 SURVEY OPS DENBIGH CULVERT SURVEY
POZ - ROOF DRAINAGE MARK-UP - GROUND FLOOR 29.06.22 (RWP)
POZ - GF SVP / GULLY LAYOUT SKETCH

1:500 0 10m 20m 30m 40m 50m
1:1 0 10 20 30 40 50 60 70 80 90 100

Rev:	Description:	Date:	By:	Chkd:
P04	PLANNING (S2)	01/09/22	GDP	JDB
P03	PLANNING (S2)	27/05/22	JDB	AF
P02	SITE LAYOUT AMENDED (S4)	25/02/22	MB	JDB
P01	ISSUED FOR COMMENT (S3)	14/02/22	LB	JDB

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Status: SUITABLE FOR STAGE APPROVAL S4

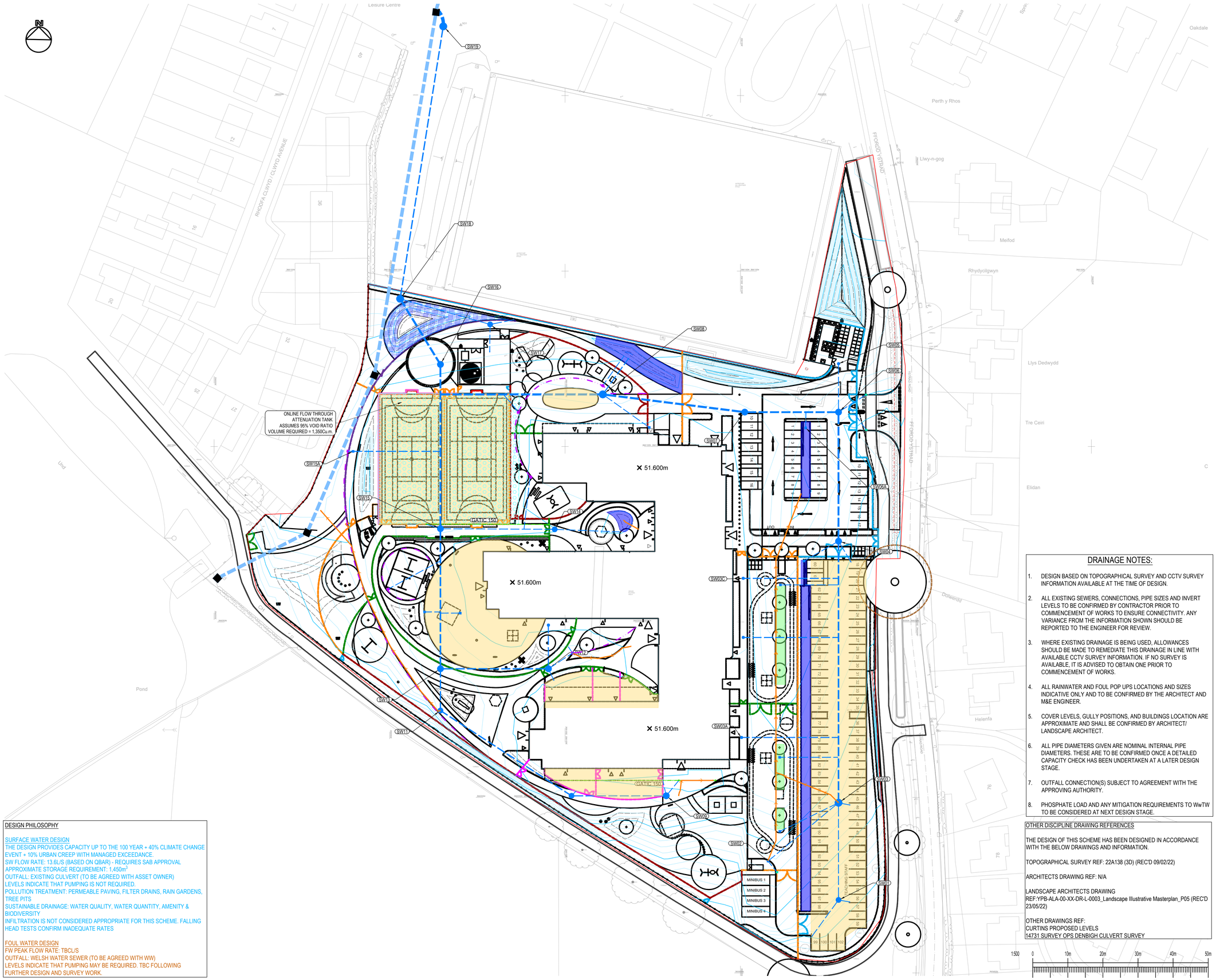
Project: YSGOL PLAS BRONDYFFRYN

Drg Title: DRAINAGE CATCHMENTS

Drawn By	Designed By	Checked By
LB	JDB	JDB
	Date: 11/02/2022	Scales @ A1: 1:500

Project No - Originator - Function - Spatial - Form - Discipline - Number: YPB - CUR - 00 - XX - DR - C - 92050

Revision: P04



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KEY

- PROPOSED PRIVATE SW SEWER
- OVERLAND FLOW PATH
  (1 in 100 YEAR + 40% CC + 10%A)
- PROPOSED ABG FIN DRAIN TO EDGE
- EXISTING 900Ø SURFACE WATER CULVERT AT 1.5m DEPTH
- PROPOSED LINEAR DRAIN
- CELLULAR ATTENUATION SYSTEM - SDS GEOLIGHT OR SIMILAR APPROVED FLOW THROUGH SYSTEM
  VENTING LOCATION TBC BY MANUFACTURER.
- TREEPIT SYSTEM - GREENBLUE URBAN OR SIMILAR
  SOIL DESIGN BY OTHERS
- RAINGARDEN - DETAIL TO BE COORDINATED WITH LANDSCAPE ARCHITECT
  UNDERDRAINED WITH 150mm PERFORATED PIPE
- PERMEABLE PAVING - SEE EXTERNAL WORKS DETAILS FOR PROPOSALS
  UNDERDRAINED WITH 150mm PERFORATED PIPE
- SuDS BASIN - MAX DEPTH 1800mm WITH 1in4 SIDE SLOPES
  GRAVEL BASE TO ENCOURAGE INFILTRATION

DRAINAGE NOTES:

1. DESIGN BASED ON TOPOGRAPHICAL SURVEY AND CCTV SURVEY INFORMATION AVAILABLE AT THE TIME OF DESIGN.
2. ALL EXISTING SEWERS, CONNECTIONS, PIPE SIZES AND INVERT LEVELS TO BE CONFIRMED BY CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS TO ENSURE CONNECTIVITY. ANY VARIANCE FROM THE INFORMATION SHOWN SHOULD BE REPORTED TO THE ENGINEER FOR REVIEW.
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7. OUTFALL CONNECTION(S) SUBJECT TO AGREEMENT WITH THE APPROVING AUTHORITY.
8. PHOSPHATE LOAD AND ANY MITIGATION REQUIREMENTS TO WwTW TO BE CONSIDERED AT NEXT DESIGN STAGE.

DESIGN PHILOSOPHY

SURFACE WATER DESIGN
THE DESIGN PROVIDES CAPACITY UP TO THE 100 YEAR + 40% CLIMATE CHANGE EVENT + 10% URBAN CREEP WITH MANAGED EXCEEDANCE.
SW FLOW RATE: 13.6L/S (BASED ON QBAR) - REQUIRES SAB APPROVAL
APPROXIMATE STORAGE REQUIREMENT: 1,450m³
OUTFALL: EXISTING CULVERT (TO BE AGREED WITH ASSET OWNER)
LEVELS INDICATE THAT PUMPING IS NOT REQUIRED.
POLLUTION TREATMENT: PERMEABLE PAVING, FILTER DRAINS, RAIN GARDENS, TREE PITS
SUSTAINABLE DRAINAGE: WATER QUALITY, WATER QUANTITY, AMENITY & BIODIVERSITY
INFILTRATION IS NOT CONSIDERED APPROPRIATE FOR THIS SCHEME. FALLING HEAD TESTS CONFIRM INADEQUATE RATES

FOUL WATER DESIGN
FW PEAK FLOW RATE: TBCL/S
OUTFALL: WELSH WATER SEWER (TO BE AGREED WITH WW)
LEVELS INDICATE THAT PUMPING MAY BE REQUIRED. TBC FOLLOWING FURTHER DESIGN AND SURVEY WORK.

OTHER DISCIPLINE DRAWING REFERENCES

THE DESIGN OF THIS SCHEME HAS BEEN DESIGNED IN ACCORDANCE WITH THE BELOW DRAWINGS AND INFORMATION.

TOPOGRAPHICAL SURVEY REF: 22A138 (3D) (REC'D 09/02/22)

ARCHITECTS DRAWING REF: N/A

LANDSCAPE ARCHITECTS DRAWING
REF:YPB-ALA-00-XX-DR-L-0003_Landscape Illustrative Masterplan_P05 (REC'D 23/05/22)

OTHER DRAWINGS REF:
CURTINS PROPOSED LEVELS
14731 SURVEY OPS DENBIGH CULVERT SURVEY

Rev:	Description:	Date:	By:	Chkd:
P02	PLANNING (S2)	01/09/22	GDP	JDB
P01	PLANNING (S2)	27/05/22	JDB	AF

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Status: SUITABLE FOR INFORMATION — S2

Project: YSGOL PLAS BRONDYFFRYN

Drg Title: DRAINAGE EXCEEDANCE ROUTING

Drawn By	Designed By	Checked By
JDB	JDB	AF
	Date: 27/05/2022	Scales @ A1: 1:500

Project No - Originator - Function - Spatial - Form - Discipline - Number: YPB - CUR - 00 - XX - DR - C - 92071
Revision: P02

\\fs03\Projects\079942-Ysgol_Plas_Brondyffryn\04-Production\4A-Models-Drawings\C\CAD\92\

Appendix E – Hydraulic Calculations

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	10	Minimum Backdrop Height (m)	0.600
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

	Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)	Notes
✓	1	0.017	5.00	52.836	1500	1.300	
✓	2	0.024	5.00	52.136	450	1.300	
✓	3	0.360	5.00	52.144	1500	1.792	
✓	4			51.352	1500	1.650	
✓	5	0.018	5.00	51.146	450	1.300	
✓	6	0.180	5.00	51.336	1500	1.927	
✓	7	0.047	5.00	51.332	1500	2.064	
✓	8	0.078	5.00	51.216	1500	2.031	
✓	9	0.137	5.00	51.540	1500	1.425	
✓	10			51.624	1200	1.775	
✓	11	0.055	5.00	51.207	1500	1.535	
✓	12	0.190	5.00	51.533	1500	1.425	
✓	13	0.071	5.00	51.325	1500	1.803	
✓	14	0.178	5.00	51.558	1500	1.425	
✓	15	0.193	5.00	51.366	1500	2.023	
✓	16	0.029	5.00	50.929	1500	1.840	
✓	17	0.026	5.00	50.661	1500	1.350	
✓	18			50.200	1800	1.446	Auto-design is off
✓	18_OUT			49.600	100	1.147	

Links

	Name	US Node	DS Node	Length (m)	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)
?	1.000	1	3	27.690	51.536	50.577	0.959	28.9	150	5.25
?	2.000	2	3	26.051	50.836	50.577	0.259	100.6	150	5.43
✓	1.001	3	4	74.530	50.352	49.777	0.575	129.6	375	6.21
✓	1.002	4	6	36.778	49.702	49.409	0.293	125.5	450	6.55
?	3.000	5	6	13.802	49.846	49.709	0.137	100.7	150	5.23
✓	1.003	6	7	26.719	49.409	49.343	0.066	404.8	450	7.00
✓	1.004	7	8	40.774	49.268	49.185	0.083	491.3	525	7.67

	Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
?	1.000	1	3	1.880	33.2	2.5	1.150	1.417	1.150	1.417	0.017	0.0
?	2.000	2	3	1.002	17.7	3.6	1.150	1.417	1.150	1.417	0.024	0.0
✓	1.001	3	4	1.590	175.6	56.8	1.417	1.200	1.200	1.417	0.401	0.0
✓	1.002	4	6	1.813	288.3	55.3	1.200	1.477	1.200	1.477	0.401	0.0
?	3.000	5	6	1.001	17.7	2.7	1.150	1.477	1.150	1.477	0.018	0.0
✓	1.003	6	7	1.004	159.7	79.9	1.477	1.539	1.477	1.539	0.599	0.0
✓	1.004	7	8	1.004	217.3	82.4	1.539	1.506	1.506	1.539	0.646	0.0

Links

	Name	US Node	DS Node	Length (m)	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)
✓	1.005	8	16	47.043	49.185	49.089	0.096	490.0	525	8.45
✓	4.000	9	10	32.282	50.115	49.924	0.191	169.0	225	5.54
✓	4.001	10	11	43.119	49.849	49.672	0.177	243.6	300	6.25
✓	4.002	11	13	18.308	49.672	49.597	0.075	244.1	300	6.56
?	5.000	12	13	54.368	50.108	49.597	0.511	106.4	300	5.59
✓	4.003	13	15	33.504	49.522	49.418	0.104	322.2	375	7.11
?	6.000	14	15	56.488	50.133	49.493	0.640	88.3	300	5.56
✓	4.004	15	16	46.804	49.343	49.164	0.179	261.5	450	7.74
?	1.006	16	18	26.367	49.089	48.754	0.335	78.7	525	8.63
✓	7.000	17	18	30.105	49.311	48.850	0.461	65.3	150	5.40
?	1.007	18	18_OUT	75.313	48.754	48.453	0.301	250.2	300	9.87

	Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
✓	1.005	8	16	1.005	217.5	88.0	1.506	1.315	1.315	1.506	0.724	0.0
✓	4.000	9	10	1.003	39.9	20.4	1.200	1.475	1.200	1.475	0.137	0.0
✓	4.001	10	11	1.003	70.9	19.3	1.475	1.235	1.235	1.475	0.137	0.0
✓	4.002	11	13	1.002	70.8	26.5	1.235	1.428	1.235	1.428	0.192	0.0
?	5.000	12	13	1.524	107.7	28.3	1.125	1.428	1.125	1.428	0.190	0.0
✓	4.003	13	15	1.004	110.9	60.0	1.428	1.573	1.428	1.573	0.453	0.0
?	6.000	14	15	1.674	118.3	26.5	1.125	1.573	1.125	1.573	0.178	0.0
✓	4.004	15	16	1.252	199.2	104.7	1.573	1.315	1.315	1.573	0.824	0.0
?	1.006	16	18	2.526	546.8	189.7	1.315	0.921	0.921	1.315	1.577	0.0
✓	7.000	17	18	1.246	22.0	3.9	1.200	1.200	1.200	1.200	0.026	0.0
?	1.007	18	18_OUT	0.989	69.9	179.7	1.146	0.847	0.847	1.146	1.603	0.0

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	27.690	28.9	150	Default Pipe	52.836	51.536	1.150	52.144	50.577	1.417
2.000	26.051	100.6	150	Default Pipe	52.136	50.836	1.150	52.144	50.577	1.417
1.001	74.530	129.6	375	Default Pipe	52.144	50.352	1.417	51.352	49.777	1.200
1.002	36.778	125.5	450	Default Pipe	51.352	49.702	1.200	51.336	49.409	1.477
3.000	13.802	100.7	150	Default Pipe	51.146	49.846	1.150	51.336	49.709	1.477
1.003	26.719	404.8	450	Default Pipe	51.336	49.409	1.477	51.332	49.343	1.539
1.004	40.774	491.3	525	Default Pipe	51.332	49.268	1.539	51.216	49.185	1.506
1.005	47.043	490.0	525	Default Pipe	51.216	49.185	1.506	50.929	49.089	1.315
4.000	32.282	169.0	225	Default Pipe	51.540	50.115	1.200	51.624	49.924	1.475

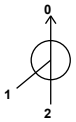
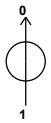
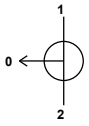
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1500	Manhole	1	3	1500	Manhole	1
2.000	2	450	Manhole	1	3	1500	Manhole	1
1.001	3	1500	Manhole	1	4	1500	Manhole	1
1.002	4	1500	Manhole	1	6	1500	Manhole	1
3.000	5	450	Manhole	1	6	1500	Manhole	1
1.003	6	1500	Manhole	1	7	1500	Manhole	1
1.004	7	1500	Manhole	1	8	1500	Manhole	1
1.005	8	1500	Manhole	1	16	1500	Manhole	1
4.000	9	1500	Manhole	1	10	1200	Manhole	1

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
4.001	43.119	243.6	300	Default Pipe	51.624	49.849	1.475	51.207	49.672	1.235
4.002	18.308	244.1	300	Default Pipe	51.207	49.672	1.235	51.325	49.597	1.428
5.000	54.368	106.4	300	Default Pipe	51.533	50.108	1.125	51.325	49.597	1.428
4.003	33.504	322.2	375	Default Pipe	51.325	49.522	1.428	51.366	49.418	1.573
6.000	56.488	88.3	300	Default Pipe	51.558	50.133	1.125	51.366	49.493	1.573
4.004	46.804	261.5	450	Default Pipe	51.366	49.343	1.573	50.929	49.164	1.315
1.006	26.367	78.7	525	Default Pipe	50.929	49.089	1.315	50.200	48.754	0.921
7.000	30.105	65.3	150	Default Pipe	50.661	49.311	1.200	50.200	48.850	1.200
1.007	75.313	250.2	300	Default Pipe	50.200	48.754	1.146	49.600	48.453	0.847

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
4.001	10	1200	Manhole	1	11	1500	Manhole	1
4.002	11	1500	Manhole	1	13	1500	Manhole	1
5.000	12	1500	Manhole	1	13	1500	Manhole	1
4.003	13	1500	Manhole	1	15	1500	Manhole	1
6.000	14	1500	Manhole	1	15	1500	Manhole	1
4.004	15	1500	Manhole	1	16	1500	Manhole	1
1.006	16	1500	Manhole	1	18	1800	Manhole	1
7.000	17	1500	Manhole	1	18	1800	Manhole	1
1.007	18	1800	Manhole	1	18_OUT	100	Manhole	1

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	306177.922	365970.797	52.836	1.300	1500		0	1.000	51.536	150
2	306157.856	365981.874	52.136	1.300	450		0	2.000	50.836	150
3	306177.922	365998.487	52.144	1.792	1500		1 2 0	2.000 1.000 1.001	50.577 50.577 50.352	150 150 375
4	306177.922	366073.017	51.352	1.650	1500		1 0	1.001 1.002	49.777 49.702	375 450
5	306177.922	366123.597	51.146	1.300	450		0	3.000	49.846	150
6	306177.922	366109.795	51.336	1.927	1500		1 2 0	3.000 1.002 1.003	49.709 49.409 49.409	150 450 450

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
7	306151.203	366109.795	51.332	2.064	1500	1	1.003	49.343	450
						0	1.004	49.268	525
8	306110.744	366114.853	51.216	2.031	1500	1	1.004	49.185	525
						0	1.005	49.185	525
9	306132.382	366000.467	51.540	1.425	1500	0	4.000	50.115	225
10	306100.100	366000.467	51.624	1.775	1200	1	4.000	49.924	225
						0	4.001	49.849	300
11	306064.481	366024.768	51.207	1.535	1500	1	4.001	49.672	300
						0	4.002	49.672	300
12	306118.849	366043.076	51.533	1.425	1500	0	5.000	50.108	300
13	306064.481	366043.076	51.325	1.803	1500	1	5.000	49.597	300
						2	4.002	49.597	300
						0	4.003	49.522	375
14	306120.969	366076.405	51.558	1.425	1500	0	6.000	50.133	300
15	306064.481	366076.580	51.366	2.023	1500	1	6.000	49.493	300
						2	4.003	49.418	375
						0	4.004	49.343	450
16	306064.481	366123.384	50.929	1.840	1500	1	4.004	49.164	450
						2	1.005	49.089	525
						0	1.006	49.089	525
17	306078.639	366134.787	50.661	1.350	1500	0	7.000	49.311	150
18	306050.628	366145.819	50.200	1.446	1800	1	7.000	48.850	150
						2	1.006	48.754	525
						0	1.007	48.754	300
18_OUT	306065.098	366219.729	49.600	1.147	100	1	1.007	48.453	300

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	10	0
100	40	0	0
100	40	10	0

Node 18_OUT Surcharged Outfall

Overrides Design Area	x	Depression Storage Area (m²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		

Applies to All storms

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
0	1.000	360	1.000	720	1.000	1080	1.000	1440	1.000

Node 18 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	48.754	Product Number	CTL-SHE-0160-1360-1500-1360
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	13.6	Min Node Diameter (mm)	1500

Node 16 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	49.089
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	1245

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1350.0	0.0	1.000	1350.0	0.0	1.001	0.0	0.0

Node 18 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	49.250
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	510

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	40.0	0.0	0.950	240.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	106.020	30.000
2 year 15 minute winter	74.400	30.000
2 year 30 minute summer	69.973	19.800
2 year 30 minute winter	49.104	19.800
2 year 60 minute summer	46.922	12.400
2 year 60 minute winter	31.174	12.400
2 year 120 minute summer	31.596	8.350
2 year 120 minute winter	20.992	8.350
2 year 180 minute summer	25.324	6.517
2 year 180 minute winter	16.461	6.517
2 year 240 minute summer	20.538	5.428
2 year 240 minute winter	13.645	5.428
2 year 360 minute summer	16.127	4.150
2 year 360 minute winter	10.483	4.150
2 year 480 minute summer	12.923	3.415
2 year 480 minute winter	8.585	3.415
2 year 600 minute summer	10.714	2.930
2 year 600 minute winter	7.320	2.930
2 year 720 minute summer	9.640	2.584
2 year 720 minute winter	6.478	2.584
2 year 960 minute summer	8.034	2.116
2 year 960 minute winter	5.322	2.116
2 year 1440 minute summer	5.929	1.589
2 year 1440 minute winter	3.985	1.589
30 year +10% A 15 minute summer	285.016	80.650
30 year +10% A 15 minute winter	200.011	80.650
30 year +10% A 30 minute summer	190.754	53.977
30 year +10% A 30 minute winter	133.862	53.977
30 year +10% A 60 minute summer	130.274	34.428
30 year +10% A 60 minute winter	86.551	34.428
30 year +10% A 120 minute summer	80.054	21.156
30 year +10% A 120 minute winter	53.186	21.156
30 year +10% A 180 minute summer	61.512	15.829
30 year +10% A 180 minute winter	39.984	15.829
30 year +10% A 240 minute summer	48.604	12.844
30 year +10% A 240 minute winter	32.291	12.844
30 year +10% A 360 minute summer	36.962	9.512
30 year +10% A 360 minute winter	24.026	9.512
30 year +10% A 480 minute summer	28.957	7.653
30 year +10% A 480 minute winter	19.238	7.653
30 year +10% A 600 minute summer	23.592	6.453
30 year +10% A 600 minute winter	16.119	6.453
30 year +10% A 720 minute summer	20.926	5.608
30 year +10% A 720 minute winter	14.063	5.608
30 year +10% A 960 minute summer	17.052	4.490
30 year +10% A 960 minute winter	11.296	4.490
30 year +10% A 1440 minute summer	12.183	3.265
30 year +10% A 1440 minute winter	8.188	3.265
100 year +40% CC 15 minute summer	559.148	158.220
100 year +40% CC 15 minute winter	392.384	158.220
100 year +40% CC 30 minute summer	374.816	106.060
100 year +40% CC 30 minute winter	263.029	106.060

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 60 minute summer	258.504	68.315
100 year +40% CC 60 minute winter	171.744	68.315
100 year +40% CC 120 minute summer	156.317	41.310
100 year +40% CC 120 minute winter	103.853	41.310
100 year +40% CC 180 minute summer	118.429	30.476
100 year +40% CC 180 minute winter	76.982	30.476
100 year +40% CC 240 minute summer	92.512	24.448
100 year +40% CC 240 minute winter	61.463	24.448
100 year +40% CC 360 minute summer	69.156	17.796
100 year +40% CC 360 minute winter	44.953	17.796
100 year +40% CC 480 minute summer	53.543	14.150
100 year +40% CC 480 minute winter	35.573	14.150
100 year +40% CC 600 minute summer	43.224	11.823
100 year +40% CC 600 minute winter	29.533	11.823
100 year +40% CC 720 minute summer	38.049	10.197
100 year +40% CC 720 minute winter	25.571	10.197
100 year +40% CC 960 minute summer	30.618	8.062
100 year +40% CC 960 minute winter	20.282	8.062
100 year +40% CC 1440 minute summer	21.530	5.770
100 year +40% CC 1440 minute winter	14.469	5.770
100 year +40% CC +10% A 15 minute summer	559.148	158.220
100 year +40% CC +10% A 15 minute winter	392.384	158.220
100 year +40% CC +10% A 30 minute summer	374.816	106.060
100 year +40% CC +10% A 30 minute winter	263.029	106.060
100 year +40% CC +10% A 60 minute summer	258.504	68.315
100 year +40% CC +10% A 60 minute winter	171.744	68.315
100 year +40% CC +10% A 120 minute summer	156.317	41.310
100 year +40% CC +10% A 120 minute winter	103.853	41.310
100 year +40% CC +10% A 180 minute summer	118.429	30.476
100 year +40% CC +10% A 180 minute winter	76.982	30.476
100 year +40% CC +10% A 240 minute summer	92.512	24.448
100 year +40% CC +10% A 240 minute winter	61.463	24.448
100 year +40% CC +10% A 360 minute summer	69.156	17.796
100 year +40% CC +10% A 360 minute winter	44.953	17.796
100 year +40% CC +10% A 480 minute summer	53.543	14.150
100 year +40% CC +10% A 480 minute winter	35.573	14.150
100 year +40% CC +10% A 600 minute summer	43.224	11.823
100 year +40% CC +10% A 600 minute winter	29.533	11.823
100 year +40% CC +10% A 720 minute summer	38.049	10.197
100 year +40% CC +10% A 720 minute winter	25.571	10.197
100 year +40% CC +10% A 960 minute summer	30.618	8.062
100 year +40% CC +10% A 960 minute winter	20.282	8.062
100 year +40% CC +10% A 1440 minute summer	21.530	5.770
100 year +40% CC +10% A 1440 minute winter	14.469	5.770

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.47%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	51.563	0.027	2.3	0.0541	0.0000	OK
15 minute winter	2	10	50.880	0.044	3.3	0.0231	0.0000	OK
15 minute winter	3	11	50.495	0.143	54.5	0.8246	0.0000	OK
15 minute winter	4	11	49.830	0.128	52.8	0.2267	0.0000	OK
15 minute winter	5	10	49.885	0.039	2.5	0.0168	0.0000	OK
15 minute winter	6	11	49.636	0.227	78.3	0.8260	0.0000	OK
15 minute winter	7	11	49.533	0.265	83.5	0.5899	0.0000	OK
15 minute winter	8	11	49.494	0.309	93.3	0.7825	0.0000	OK
15 minute winter	9	10	50.224	0.109	18.7	0.4026	0.0000	OK
15 minute winter	10	11	49.951	0.102	18.1	0.1157	0.0000	OK
15 minute winter	11	11	49.802	0.130	25.3	0.3232	0.0000	OK
15 minute winter	12	10	50.208	0.100	25.9	0.4420	0.0000	OK
15 minute winter	13	11	49.721	0.199	58.8	0.5095	0.0000	OK
15 minute winter	14	11	50.224	0.091	24.3	0.3899	0.0000	OK
15 minute winter	15	11	49.584	0.241	105.8	0.8855	0.0000	OK
1440 minute winter	16	1500	49.455	0.366	14.6	470.7285	0.0000	OK
1440 minute winter	17	1650	49.456	0.145	0.2	0.3110	0.0000	OK
1440 minute winter	18	1500	49.455	0.701	0.7	14.4669	0.0000	SURCHARGED
15 minute summer	18_OUT	1	49.453	1.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	3	2.2	1.067	0.067	0.0581	
15 minute winter	2	2.000	3	3.2	0.757	0.180	0.1097	
15 minute winter	3	1.001	4	52.8	1.400	0.301	2.8136	
15 minute winter	4	1.002	6	52.8	0.907	0.183	2.1595	
15 minute winter	5	3.000	6	2.4	0.692	0.137	0.0483	
15 minute winter	6	1.003	7	77.5	1.073	0.485	1.9360	
15 minute winter	7	1.004	8	85.0	0.788	0.391	4.9215	
15 minute winter	8	1.005	16	105.6	1.959	0.485	3.1816	
15 minute winter	9	4.000	10	18.1	0.971	0.455	0.6023	
15 minute winter	10	4.001	11	18.2	0.724	0.256	1.0883	
15 minute winter	11	4.002	13	24.7	0.882	0.349	0.5207	
15 minute winter	12	5.000	13	25.6	1.159	0.238	1.2873	
15 minute winter	13	4.003	15	57.5	1.058	0.519	1.8354	
15 minute winter	14	6.000	15	23.5	1.302	0.199	1.0210	
15 minute winter	15	4.004	16	104.0	1.266	0.522	3.8587	
1440 minute winter	16	1.006	18	-0.7	0.100	-0.001	4.9699	
1440 minute winter	17	7.000	18	0.2	0.019	0.009	0.5270	
1440 minute winter	18	Hydro-Brake®	18_OUT	0.0				1.3

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 99.47%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	51.582	0.046	6.9	0.0950	0.0000	OK
15 minute winter	2	10	50.917	0.081	9.7	0.0456	0.0000	OK
15 minute winter	3	11	50.637	0.285	161.5	1.7627	0.0000	OK
15 minute winter	4	11	50.070	0.368	156.8	0.6504	0.0000	OK
15 minute winter	5	11	50.009	0.163	7.3	0.0757	0.0000	SURCHARGED
15 minute winter	6	11	49.982	0.573	229.1	2.1884	0.0000	SURCHARGED
15 minute winter	7	11	49.794	0.526	246.4	1.1934	0.0000	SURCHARGED
15 minute summer	8	10	49.686	0.501	264.9	1.3089	0.0000	OK
15 minute winter	9	12	50.671	0.556	55.3	2.1598	0.0000	SURCHARGED
15 minute winter	10	12	50.378	0.529	45.6	0.5979	0.0000	SURCHARGED
15 minute winter	11	12	50.286	0.614	63.6	1.5690	0.0000	SURCHARGED
15 minute winter	12	12	50.363	0.255	76.7	1.2002	0.0000	OK
15 minute winter	13	12	50.198	0.676	149.8	1.7795	0.0000	SURCHARGED
15 minute winter	14	10	50.298	0.165	71.8	0.7455	0.0000	OK
15 minute winter	15	11	49.967	0.624	287.6	2.4133	0.0000	SURCHARGED
1440 minute winter	16	1020	49.666	0.577	31.8	740.9503	0.0000	SURCHARGED
1440 minute winter	17	1020	49.666	0.355	0.5	0.7769	0.0000	SURCHARGED
1440 minute winter	18	1020	49.666	0.912	13.0	37.1374	0.0000	SURCHARGED
15 minute summer	18_OUT	1	49.453	1.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	3	6.8	1.417	0.206	0.1528	
15 minute winter	2	2.000	3	9.4	1.004	0.533	0.2454	
15 minute winter	3	1.001	4	156.8	1.765	0.893	6.8005	
15 minute winter	4	1.002	6	159.8	1.056	0.554	5.4705	
15 minute winter	5	3.000	6	7.3	0.847	0.415	0.2430	
15 minute winter	6	1.003	7	229.4	1.448	1.436	4.2322	
15 minute winter	7	1.004	8	249.6	1.220	1.149	8.7290	
15 minute summer	8	1.005	16	279.1	2.486	1.283	5.2800	
15 minute winter	9	4.000	10	45.6	1.146	1.143	1.2839	
15 minute winter	10	4.001	11	46.7	0.818	0.660	3.0364	
15 minute winter	11	4.002	13	65.2	0.976	0.920	1.2892	
15 minute winter	12	5.000	13	71.1	1.234	0.660	3.6513	
15 minute winter	13	4.003	15	153.5	1.391	1.384	3.6954	
15 minute winter	14	6.000	15	70.6	1.393	0.597	3.1113	
15 minute winter	15	4.004	16	282.9	1.807	1.421	6.9881	
1440 minute winter	16	1.006	18	12.6	0.059	0.023	5.6961	
1440 minute winter	17	7.000	18	0.5	0.314	0.022	0.5300	
1440 minute winter	18	Hydro-Brake®	18_OUT	12.5				627.9

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.47%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	11	52.306	0.770	23.1	1.5624	0.0000	SURCHARGED
15 minute winter	2	11	52.136	1.300	17.3	0.6864	1.7030	FLOOD
15 minute winter	3	11	52.144	1.792	267.2	10.3667	2.0143	FLOOD
15 minute winter	4	11	51.107	1.405	227.1	2.4830	0.0000	FLOOD RISK
15 minute winter	5	11	50.963	1.117	13.0	0.4869	0.0000	FLOOD RISK
15 minute winter	6	11	50.880	1.471	355.4	5.3478	0.0000	SURCHARGED
15 minute winter	7	11	50.419	1.151	388.3	2.5579	0.0000	SURCHARGED
15 minute winter	8	11	50.070	0.885	442.1	2.2426	0.0000	SURCHARGED
15 minute winter	9	10	51.540	1.425	98.4	5.2583	8.4527	FLOOD
15 minute summer	10	11	51.289	1.440	56.8	1.6285	0.0000	SURCHARGED
15 minute winter	11	11	51.207	1.535	84.5	3.8129	0.8257	FLOOD
15 minute winter	12	10	51.533	1.425	136.5	6.3185	5.4531	FLOOD
15 minute winter	13	11	51.118	1.596	218.3	4.0770	0.0000	FLOOD RISK
15 minute winter	14	11	51.383	1.250	127.9	5.3292	0.0000	FLOOD RISK
15 minute winter	15	11	50.675	1.332	449.0	4.8940	0.0000	SURCHARGED
720 minute winter	16	690	50.009	0.920	89.3	1182.2660	0.0000	SURCHARGED
720 minute winter	17	690	50.009	0.698	1.6	1.5023	0.0000	SURCHARGED
720 minute winter	18	690	50.009	1.255	20.7	94.2262	0.0000	FLOOD RISK
15 minute summer	18_OUT	1	49.453	1.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	3	20.8	1.423	0.626	0.4875	
15 minute winter	2	2.000	3	17.4	1.094	0.980	0.4586	
15 minute winter	3	1.001	4	227.1	2.059	1.294	8.2204	
15 minute winter	4	1.002	6	231.4	1.461	0.803	5.8272	
15 minute winter	5	3.000	6	12.9	0.820	0.728	0.2430	
15 minute winter	6	1.003	7	356.6	2.251	2.233	4.2335	
15 minute winter	7	1.004	8	389.3	1.802	1.792	8.8085	
15 minute winter	8	1.005	16	446.0	2.789	2.050	7.6584	
15 minute winter	9	4.000	10	54.8	1.379	1.375	1.2839	
15 minute summer	10	4.001	11	61.7	0.877	0.871	3.0364	
15 minute winter	11	4.002	13	87.9	1.248	1.241	1.2892	
15 minute winter	12	5.000	13	98.1	1.394	0.911	3.8286	
15 minute winter	13	4.003	15	215.6	1.955	1.945	3.6954	
15 minute winter	14	6.000	15	115.0	1.633	0.972	3.9778	
15 minute winter	15	4.004	16	448.9	2.834	2.254	7.3408	
720 minute winter	16	1.006	18	19.4	0.090	0.035	5.6961	
720 minute winter	17	7.000	18	1.5	0.388	0.067	0.5300	
720 minute winter	18	Hydro-Brake®	18_OUT	13.6				1078.4

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.47%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	11	52.330	0.794	20.9	1.6320	0.0000	SURCHARGED
15 minute winter	2	10	52.136	1.300	19.0	0.7345	3.0524	FLOOD
15 minute winter	3	10	52.144	1.792	288.2	11.0871	8.6071	FLOOD
15 minute winter	4	11	51.191	1.489	225.6	2.6312	0.0000	FLOOD RISK
15 minute winter	5	11	51.091	1.245	14.3	0.5779	0.0000	FLOOD RISK
15 minute winter	6	11	50.980	1.571	365.6	6.0042	0.0000	SURCHARGED
15 minute winter	7	11	50.498	1.230	399.7	2.7892	0.0000	SURCHARGED
960 minute winter	8	900	50.193	1.008	36.3	2.6326	0.0000	SURCHARGED
15 minute winter	9	10	51.540	1.425	108.3	5.5319	11.1472	FLOOD
15 minute winter	10	10	51.294	1.445	55.6	1.6345	0.0000	SURCHARGED
15 minute winter	11	10	51.207	1.535	87.2	3.9219	4.1937	FLOOD
15 minute winter	12	10	51.533	1.425	150.2	6.6975	8.6382	FLOOD
15 minute winter	13	10	51.149	1.627	206.4	4.2843	0.0000	FLOOD RISK
15 minute winter	14	11	51.558	1.425	140.7	6.4339	0.5290	FLOOD
15 minute winter	15	11	50.744	1.401	463.1	5.4152	0.0000	SURCHARGED
960 minute winter	16	900	50.193	1.104	78.2	1285.4750	0.0000	SURCHARGED
960 minute winter	17	900	50.193	0.882	1.4	1.9315	0.0000	SURCHARGED
960 minute winter	18	900	50.193	1.439	20.5	134.8940	0.0000	FLOOD RISK
15 minute summer	18_OUT	1	49.453	1.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	3	19.5	1.390	0.587	0.4875	
15 minute winter	2	2.000	3	17.0	0.991	0.962	0.4586	
15 minute winter	3	1.001	4	225.6	2.046	1.285	8.2204	
15 minute winter	4	1.002	6	233.9	1.476	0.811	5.8272	
15 minute winter	5	3.000	6	14.3	0.839	0.807	0.2430	
15 minute winter	6	1.003	7	364.8	2.303	2.285	4.2335	
15 minute winter	7	1.004	8	402.2	1.862	1.851	8.8085	
960 minute winter	8	1.005	16	36.1	0.778	0.166	10.1628	
15 minute winter	9	4.000	10	55.6	1.399	1.396	1.2839	
15 minute winter	10	4.001	11	61.6	0.874	0.869	3.0364	
15 minute winter	11	4.002	13	88.1	1.251	1.245	1.2892	
15 minute winter	12	5.000	13	96.8	1.375	0.899	3.8286	
15 minute winter	13	4.003	15	213.4	1.935	1.925	3.6954	
15 minute winter	14	6.000	15	124.8	1.772	1.054	3.9778	
15 minute winter	15	4.004	16	463.4	2.925	2.327	7.3408	
960 minute winter	16	1.006	18	19.3	0.089	0.035	5.6961	
960 minute winter	17	7.000	18	1.3	0.388	0.059	0.5300	
960 minute winter	18	Hydro-Brake®	18_OUT	13.6				1324.1

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