Legacy Gas Peaking Plant
Surface Water Drainage Assessment

For Axis

KRS.0310.026.R.001.A

June 2020

www.krsenvironmental.com

CONTACT DETAILS

Registered Office:
KRS Environmental Ltd
3 Princes Square
Princes Street
Montgomery
Powys
SY15 6PZ

Tel: 01686 668957
Mob: 07857 264 376

Office also at:
KRS Environmental Ltd
The Media Centre
7 Northumberland Street
Huddersfield
West Yorkshire
HD1 1RL

Tel: 01484 437420
Mob: 07857 264 376

Email: keelan@krsenvironmental.com
Web: www.krsenvironmental.com
LinkedIn: uk.linkedin.com/in/keelanserjeant/

Legacy Gas Peaking Plant	
Project	Surface Water Drainage Assessment
Client	Axis
Status	Final
Prepared by	Emma Serjeant LL.B
Reviewed by	Keelan Serjeant BSc (Hons), MSc, MCIWEM
Date	June 2020

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EXECUTIVE SUMMARY

The purpose of this report is to assess the potential for disposing of surface water. This Surface Water Drainage Assessment demonstrates that the Proposed Development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the SuDS Standards. The Proposed Development will considerably reduce the flood risk posed to the Site and to off-Site locations due to the adoption of a Sustainable Drainage Systems (SuDS) Strategy.

The Proposed Development should not therefore be precluded on the grounds of flood risk or drainage.

1.0 INTRODUCTION

1.1 Background

This Surface Water Drainage Assessment has been prepared by KRS Environmental Limited at the request of Axis to support a planning application for the development of a gas peaking plant ("the Proposed Development") at the National Grid Site, Bronwylfa Road, Legacy, Rhostyllen.

It is recognised that developments that are designed without regards to the surface water runoff are likely to result in increased impact on existing off-site service provision and may lead to an increase in flood risk.

1.2 Purpose

This Surface Water Drainage Assessment complies with the principles of Sustainable Drainage Systems (SuDS) presented in the 'Statutory Standards for Sustainable Drainage Systems – Designing, constructing, operating and maintaining surface water drainage systems'[1]. A Surface Water Drainage Assessment is presented with reference to the hydrological and hydrogeological context of the Proposed Development.

The report findings are based upon professional judgement and are summarised below with detailed recommendations provided at the end of the report. The report includes baseline data on: flood risk from the Environment Agency, rainfall data from the Flood Estimation Handbook (FEH) and hydrogeological information from the British Geological Survey (BGS). The assessment summarises and refers to these datasets in the text.

Wrexham County Borough Council as a Lead Local Flood Authority (LLFA) and a SuDS Approving Body (SAB) is a statutory consultee for major planning applications in relation to surface water drainage, requiring that all planning applications are accompanied by a SuDS Strategy. The aim of the SuDS Strategy is to identify water management measures, including SuDS, to provide surface water runoff reduction and treatment. Whilst the Proposed Development would not constitute a 'major development' due to its scale, a SuDS approach has been adopted to the management of surface water runoff from the site .

1.3 Surface Water Management Overview

It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the development site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

A SuDS Strategy for the Proposed Development has been developed to manage and reduce the flood risk posed by the surface water runoff from the site. An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the site. The assessment considers the impact of the Proposed Development compared to current conditions. Therefore, the surface water attenuation requirement for the Proposed Development can be determined and reviewed against existing arrangements.

1 Welsh Government (2018) Statutory Standards for Sustainable Drainage Systems – Designing, constructing, operating and maintaining surface water drainage systems.

The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect.

1.4 What are SuDS?

SuDS are designed to replicate, as closely as possible, the natural drainage from the site (before development) to ensure that the flood risk downstream of the site does not increase as a result of the land being developed. SuDS can also significantly improve the quality of water leaving the site and can enhance the amenity and biodiversity that a site has to offer.

There are a range of SuDS options available to provide effective surface water management that intercept and store excess run-off. The standards set out appropriate design criteria based on four main parameters:

1. Runoff Destination (in order of preference)

    a) Collect for re-use;
    b) To ground;
    c) To surface water body;
    d) To road drain or surface water sewer;
    e) To combined sewer

2. Peak flow rate and volume (pre-and post-development)

3. Water Quality (based on potential hazards arising from development and sensitivity of the runoff destination)

4. Function (design; flood risk; operation and maintenance)

These parameters are then used to develop a drainage strategy based on the following six principles;

1. Manage surface runoff at source
2. Manage on the surface
3. Utilise public space and integrate into the drainage design
4. Effective operation and maintenance
5. Account for climate change and changes in impermeable area
6. Affordability

This report aims to identify the most practicable runoff destination and drainage parameters for each site. A Surface Water Drainage Assessment is presented with reference to the hydrological and hydrogeological context of the Proposed Development.

1.5 Report Structure

This Surface Water Drainage Assessment has the following report structure:

- Section 2 details the Site location and the Proposed Development description;
- Section 3 outlines the SuDS Strategy: and

- Section 4 presents a summary and conclusions.

2.0 LOCATION & DEVELOPMENT DESCRIPTION

2.1 Site Location

The Site is situated at the National Grid Site, Bronwylfa Road, Legacy, Rhostyllen. The site is centred on approximate National Grid Reference 329371, 348610. The location of the Site is shown in Figure 1.

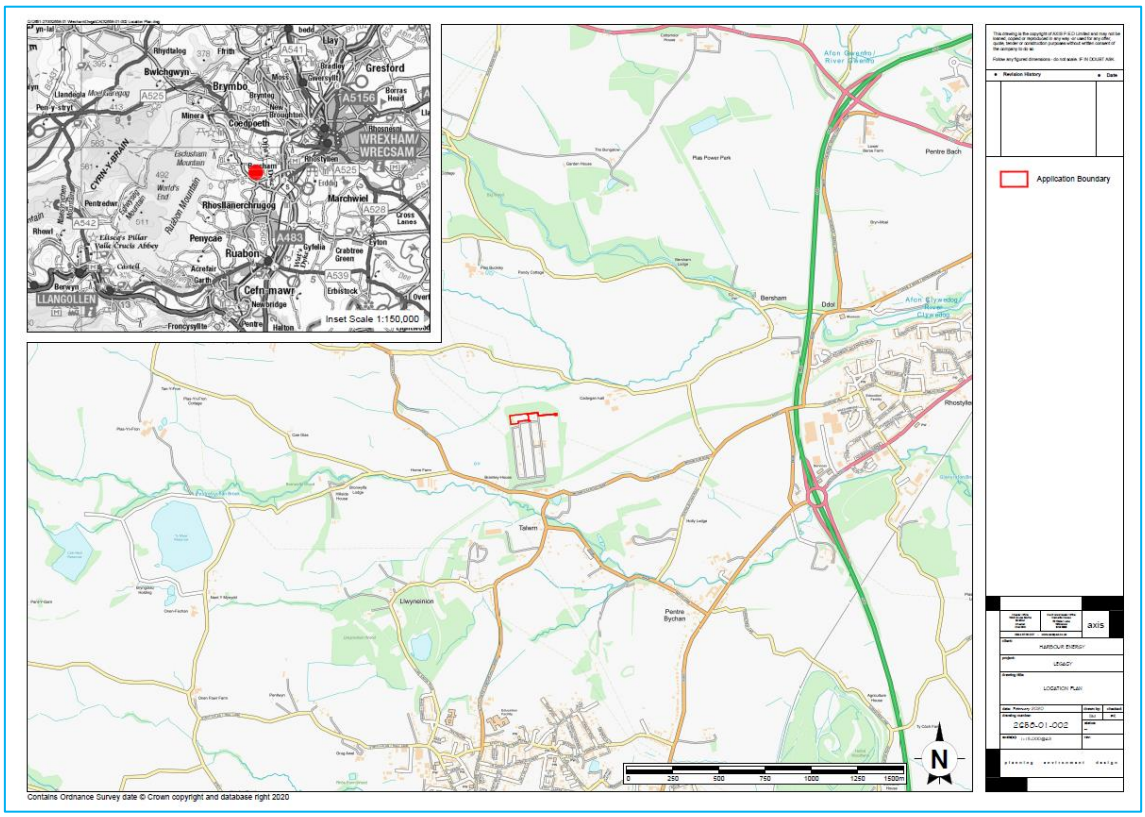

Figure 1 - Site Location

2.2 Existing Development

The Site is currently a disused parcel of land immediately to the north of a National Grid electricity site.

2.3 Proposed Development

The Proposed Development is for a gas peaking plant and associated infrastructure (see Appendix 1). Further details with regard to the proposed development can be found in the accompanying information submitted with the planning application.

2.4 Catchment Hydrology / Drainage

A small drainage ditch is located approximately 40m to the north west of the Site. The Site currently comprises permeable land with no formal drainage system.

2.5 Ground Levels

The Environment Agency's LiDAR Digital Terrain Model (DTM) shows that the Site has a ground level of 150.00 metres Above Ordnance Datum (mAOD).

2.6 Ground Conditions

The British Geological Survey (BGS) map shows that the bedrock deposits consist of the Pennine Lower Coal Measures Formation and Pennine Middle Coal Measures Formation (undifferentiated) - Mudstone, siltstone and sandstone. Sedimentary bedrock formed approximately 310 to 319 million years ago in the Carboniferous Period. The superficial deposits consist of Till, Devensian - diamicton. Superficial deposits formed up to 2 million years ago in the Quaternary Period.

Information from the National Soil Resources Institute details the site area as being situated on slowly permeable seasonally wet acid loamy and clayey soils. The Wallingford Winter Rain Acceptance Potential (WRAP) map indicates that the site lies within WRAP Class 4: Clayey or loamy over clayey soils with an impermeable layer at shallow depth.

3.0 SURFACE WATER DRAINAGE

3.1 Surface Water Management Overview

It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the development site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the Site. The assessment considers the impact of the Proposed Development compared to current conditions. Therefore, the surface water attenuation requirement for the developed site can be determined and reviewed against existing arrangements.

The requirement for managing surface water runoff from developments depends on the predeveloped nature of the site. If it is an undeveloped greenfield site, then the impact of the development will need to be mitigated so that the runoff from the site replicates the natural drainage characteristics of the pre-developed site. The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific offsite arrangements are made and result in the same net effect.

It should be acknowledged that the satisfactory collection, control and discharge of surface water runoff are now a principle planning and design consideration.

3.2 Climate Change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. The recommended national precautionary sensitivity range for peak rainfall intensity is 30%.

3.3 Opportunities for Discharge of Surface Water

Possible receptors for runoff generated onsite have been assessed in line with the prioritisation set out in the Defra non-statutory technical standards for SuDS. There are four possible options to discharge the surface water. The Runoff Destination is (in order of preference):

1) Collect for re-use;
2) Infiltrate to ground;
3) Discharge to a surface water body;
4) Discharge to a surface water sewer / highway drain; and
5) Discharge to a combined sewer.

It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local runoff profile by using systems that can either attenuate runoff and reduce peak flow rates or positively impact on the existing surface water runoff.

3.3.1 Collect for re-use

The reuse of water from roofed areas to provide grey (non-potable) water for flushing WCs within buildings can reduce storm runoff without the need for treatment or oil separators since the risk of spillage or contamination is low.

Such a system would require one or more tanks at roof level and under optimum conditions these would be kept as near as full as possible to ensure a reliable water supply. For the purposes of a worst case design scenario it is assumed that the tanks would be full at the start of an extreme rainfall event and hence all storm rainfall would enter the surface water drainage system rather than grey water storage. Whilst there may be merit in including such a scheme in the overall designs these are not considered appropriate in the SuDS assessment.

The proposed development is for a gas peaking plant and associated infrastructure. Whilst the first priority is to collect rainwater for re-use, rainwater harvesting was considered and deemed not suitable. From a cost / benefit approach, individual single systems are considered to be unsuitable. A shared communal system was also considered but deemed inappropriate with regard to management and maintenance.

The use of rainwater harvesting is not a viable / cost effective approach for the management of surface water runoff at the site, taking into account the potential water supply benefits of such systems.

3.3.2 Discharge to Ground

In determining the future surface runoff from the Site, the potential of using infiltration has been considered. An overview of the general ground conditions may be used to gauge if there is potential for their application. As detailed previously, information from the National Soil Resources Institute details the site area as being situated on on slowly permeable seasonally wet acid loamy and clayey soils.

Whilst the permeability and infiltration rate of the Site would be confirmed by a site investigation into the hydrogeology prior to construction, the ground conditions suggest infiltration would provide inception storage, but disposal of significant volumes of runoff may not be appropriate. At this stage, it is proposed that the surface water runoff from the site can be discharged partially via infiltration SuDS methods.

3.3.3 Discharge to Surface Water Body

Should infiltration be found to be unsuitable, the next option is discharge to a surface waterbody. There is a drainage ditch to the north east of the site. If the potential of discharge to a surface water body is required, then discharge to this drainage ditch should be investigated further.

3.3.4 Discharge to Road Drain, Surface Water Sewer or Combined Sewer

In the event that discharge of surface water via infiltration or discharge to a watercourse is deemed unsuitable, then discharge to the public sewer would not be possible. There are no public surface water or combined sewers located within the vicinity of the site. Therefore, it would not be possible to discharge surface water runoff from the site into a sewer.

3.3.5 Summary

For the purposes of this assessment the most likely scenario, of discharging to the ground has been considered. However, should infiltration testing prove that this would not be a viable option the option of discharge to the drainage ditch would be investigated further to ensure the most sustainable solution is used. The various drainage options would be explored further at the detailed design stage

and it is suggested that a suitably worded planning condition requiring the detailed drainage proposals to be submitted and approved is included in any permission.

3.4 Surface Water Runoff

Currently the majority of rainfall infiltrates into the soil substrate and/or runoff from the Site. It is proposed that the Site will be surfaced with grass, crushed permeable stone and compacted impermeable stone or hardstanding. The proposed impermeable area will total 2,991m^2 and proposed permeable area will total 1,474m^2.

An estimation of surface water runoff is required to permit effective site surface water management and prevent any increase in flood risk to off-site receptors. In accordance with The SuDS Manual, the Greenfield runoff from the Site has been calculated using the IoH124 method[2]. Table 1 shows the IoH124 method Greenfield runoff rates calculated for the proposed impermeable area of approximately 2,991m^2. The mean annual maximum flow rate from a Greenfield site (QBAR: approximately a 2.30 year return period) has been calculated to be 1.70 litres/second (l/s) (see Appendix 2).

Table 1 - IoH124 Method Greenfield Runoff Rates

Rainfall Event	Runoff Rate (l/s)
1	1.50
QBAR (rural)	1.70
30	2.90
100	3.60

The method used for calculating the runoff complies with the SuDS Standards and assumes that the excess runoff associated with the Proposed Development (plus an allowance for future climate change) will need to be managed by the proposed SuDS scheme.

3.5 SuDS Strategy

One of the aims of the SuDS Standards is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of amenity and biodiversity. Systems incorporating these features are often termed SuDS and it is the requirement that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible.

The objective of this SuDS Strategy is to ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the site. The SuDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the Site.
- No increase in flooding to people or property off-site as a result of the Proposed Development.
- No surface water flooding of the Site.
- A 30% increase in rainfall intensity due to climate change during the lifetime of the development.
- A 10% increase in impermeable areas due to urban creep.

[2] Institute of Hydrology, Flood Estimation of Small Catchments, June 1994.

- Maintain / improve surface water quality.
- Provide amenity and biodiversity benefits.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. The proposed SuDS Strategy will take the form of:

- Permeable surfaces - crushed permeable stone and grass.
- Surface water attenuation storage in the form of an infiltration trench along the perimeter of the site.
- If required - surface water attenuation storage in the form of an attenuation basin and/or underground storage /oversized pipes. Runoff rates would be restricted to 2.00l/s to the watercourse.

The principle applied in the design of storage is to limit the discharge rate of surface water runoff from the developed site for events of similar frequency of occurrence to the same peak rate of runoff as that which takes place from a greenfield site prior to development.

The SuDS Strategy will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this Site. The adoption of a SuDS Strategy for the Site represents an enhancement from the current conditions as the current surface water runoff from the Site is uncontrolled, untreated, unmanaged, and unmitigated. In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

3.5.1 Discharge to Ground

The gas engines and ancillary equipment will sit on concrete rafts, the apron in front of the gas engines will be constructed from compacted impermeable surfaces. These areas, where possible, will be constructed to shed water to any adjacent permeable areas. The rest of the Site will be constructed from free draining stone or grass which will allow infiltration of rainfall.

The free draining stone will have a sufficient void ratio of 30% and permeability of granular fill to allow adequate percolation and to control the risk of blockage (examples include coarse aggregate 4-40mm (4/40), 4-20mm (4/20) as defined in BS 753313:2009 or Type 3 sub-base 0-40mm (0/40)). A permeable/open-graded (reduced fines) sub-base layer (i.e. Type 3 with a void ratio of 30%) will be used as a drainage layer below the permeable surfaces which will be sufficiently permeable to allow water to drain through and to store water temporarily. The selected gravel fill and bedding would be clean, free-draining, angular shaped material in the specified size range.

Infiltration capacities of free draining stone are significantly greater than the design rainfall intensities and are not a limiting factor. A minimum value of 2500mm/hr is considered reasonable within The SuDS Manual (see Section 20.5.1 of the SuDS Manual). These are SuDS source control compliant and will as a minimum provide storage for the first 5mm (interception storage). Permeable surfaces, together with their associated substructures, are an efficient means of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium. These systems encourage biological treatment of flow and extraction of oils and heavy metals from the runoff. Treatment processes that occur within the surface structure and the geotextile layers include:

- Filtration

- Absorption
- Biodegradation
- Sedimentation

It will also assist in reducing the flood profile of the Site by significantly attenuating the runoff from the Proposed Development within the sub-base material.

3.5.2 Discharge to Surface Water Body

Should infiltration be found to be unsuitable and a connection to the drainage ditch to the east of the site can be secured, it is proposed that surface storage (e.g. basin) and/or underground storage tanks, oversized drainage networks or cellular storage will be used to provide the required attenuation storage volume. Additional storage would be provided within the manholes, pipes and drainage gullies which will provide betterment over and above the 1 in 100 year (+30%) event.

The QBAR or 1 in 2.30 year greenfield runoff rate has been calculated to be 1.70l/s. Therefore, a value of 1.70l/s has been used as the limiting discharge rate before discharge into the drainage ditch. Table 2 shows the volume of storage required for the Proposed Development estimated within the MicroDrainage Software for the 1 in 100 year event, with a 30% allowance for climate change (increase in peak rainfall) assuming the proposed impermeable area with a 10% increase due to urban creep (i.e. 3,290m^2) with 1.70l/s used as the limiting discharge rate before discharge to the drainage ditch (see Appendix 3). The required attenuation storage volume is 249 - 362m^3.

These options will be explored further during pre-construction activities with the agreement of the Local Planning Authority, the Lead Local Flood Authority and Dwr Cymru/Welsh Water, where required and it is suggested that a suitably worded planning condition requiring the detailed drainage proposals to be submitted and approved is included in any permission.

Table 2 - Attenuation Storage Calculations

Return Period (yrs)	Limiting Discharge Rate (l/s)	Volume (m^3)
100 +30%	1.70	249 - 362

3.6 Designing for Local Drainage System Failure

When considering residual risk, it is necessary to make predictions as to the impacts of a storm event that exceeds the design event, or the impact of a failure of the local drainage system. The SuDS Strategy applies a safe and sustainable approach to discharging rainfall runoff from the site and this reduces the risk of flooding however, it is not possible to completely remove the risk.

As part of the SuDS Strategy it must be demonstrated that the flooding of property would not occur in the event of local drainage system failure and/or design exceedance. It is not economically viable or sustainable to build a drainage system that can accommodate the most extreme events. Consequently, the capacity of the drainage system may be exceeded on rare occasions, with excess water flowing above ground. However, this is considered unlikely in the immediate future due to the 30% allowance for climate change used in the calculations.

The design of the Proposed Development provides an opportunity to manage this local drainage system failure/exceedance flow and ensure that indiscriminate flooding of property does not occur. There will not be an extensive sewerage network on the Proposed Development and therefore any potential exceedance flooding would be from the sewers and lateral drains connecting the impermeable areas to the storage areas. It is very unlikely that a catastrophic failure would occur. An

exceedance or blockage event of the sewers would not affect the proposed buildings/structures because the finished floor level will be raised above surrounding ground levels, ensuring any exceedance flooding would not affect the buildings/structures. Exceedance flows would be contained within the permeable areas within the site and would flow to the lower ground levels. It is not considered that there is an increased risk to the site or properties located adjacent to the site.

Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the structures and through contouring of the hardstanding areas. When considering the impacts of a storm event that exceeds the design event, there is safety factor, even under the design event conditions. Consequently, if this event were to be exceeded there is additional capacity with the system to accommodate this (i.e. within the manholes, pipes etc.). If this freeboard was to be exceeded the consequences would be similar, if not less than for the local drainage system failure. Consequently, the impact of an exceedance event is not considered to represent any significant flood hazard.

The above manages and mitigates the flood risk from surface water runoff to the adjacent premises and site infrastructure from surface water runoff generated by the Proposed Development.

4.0 CONCLUSIONS

4.1 Conclusion

This Surface Water Drainage Assessment demonstrates that the Proposed Development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the SuDS Standards. The Proposed Development will considerably reduce the flood risk posed to the Site and to off-Site locations due to the adoption of a SuDS Strategy.

The Proposed Development should not therefore be precluded on the grounds of flood risk or drainage.

APPENDIX 1 – Proposed Site Layout

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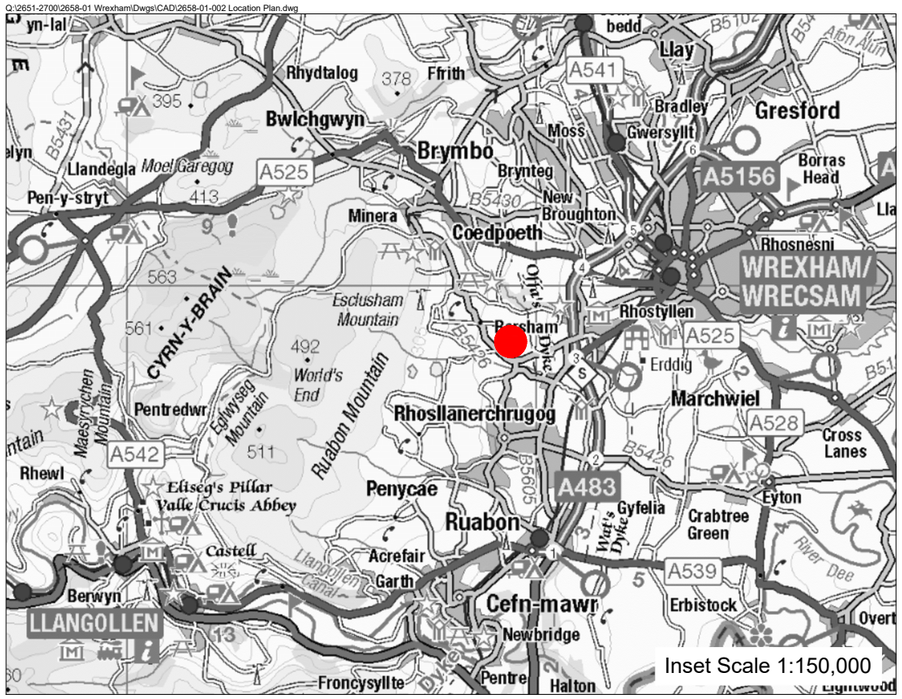

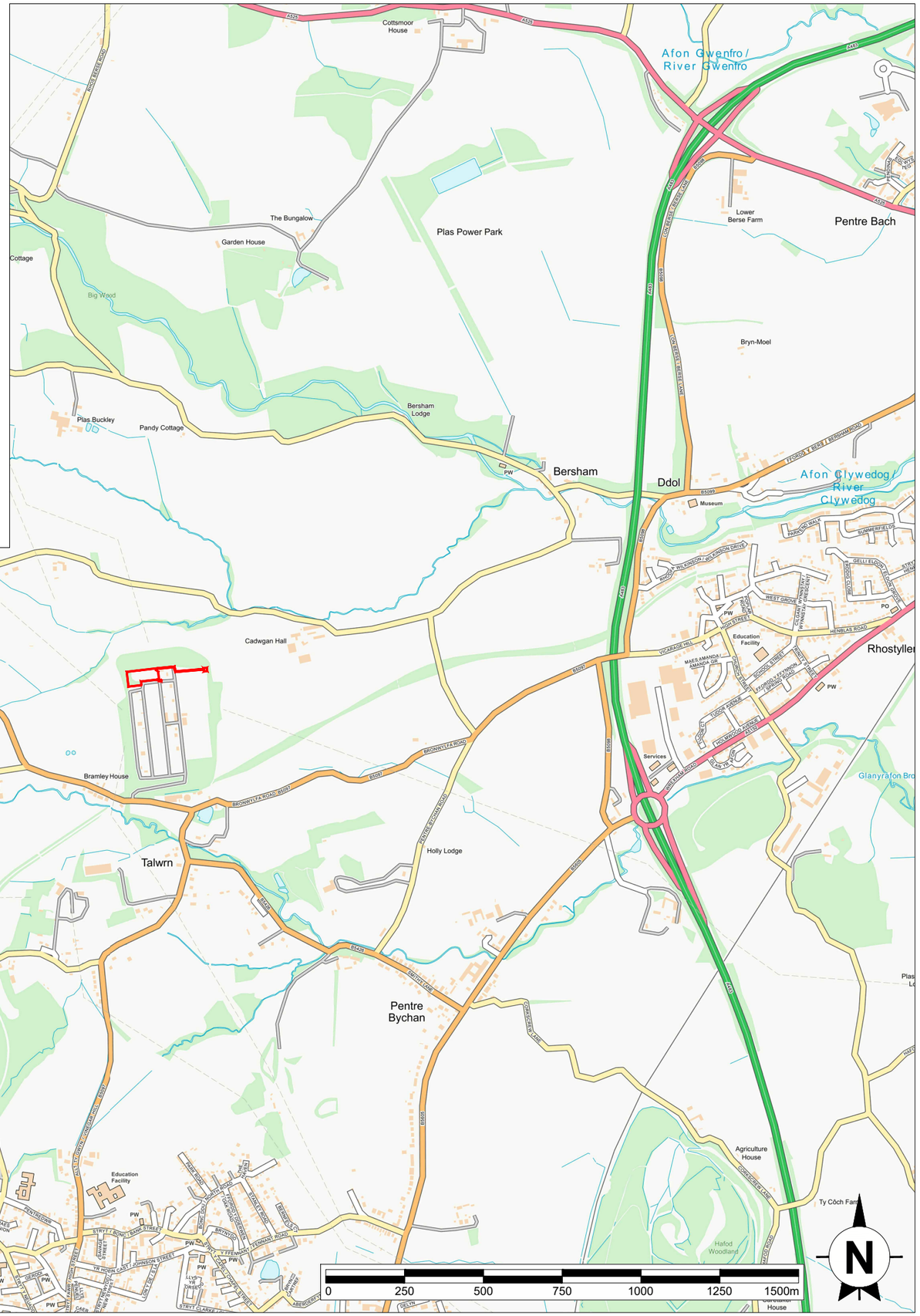

Revision History	Date

Application Boundary

Chester Office:
Well House Barns
Bretton
Chester
CH4 0DH

South Manchester Office:
Camellia House
76 Water Lane
Wilmslow
SK9 5BB

0844 8700 007 - www.axisped.co.uk

axis

client: HARBOUR ENERGY

project: LEGACY

drawing title: LOCATION PLAN

date: February 2020	drawn by: SM	checked: PR
drawing number: 2658-01-002	status: --	
scale(s): 1:15,000@A3	rev:	

planning environment design

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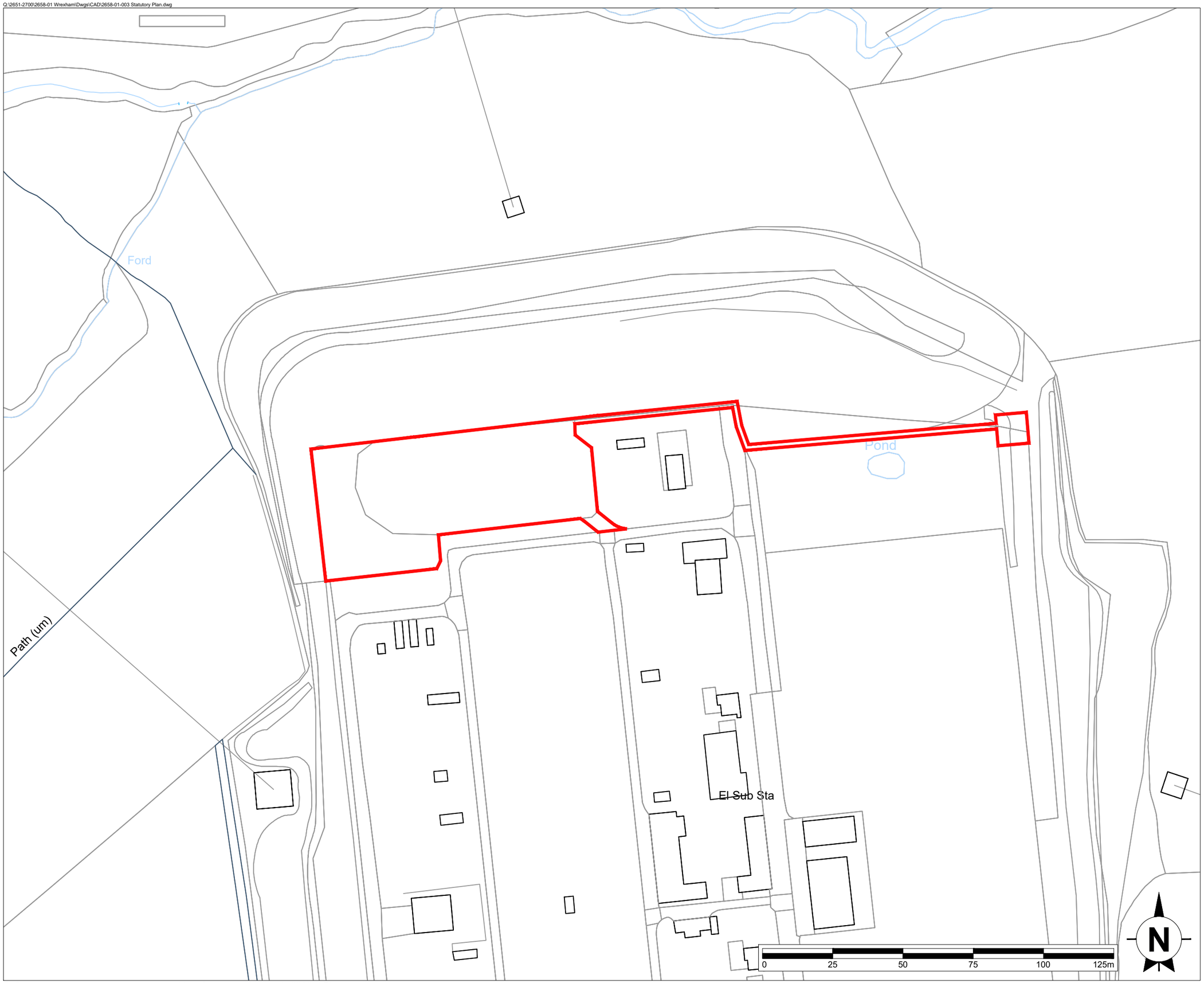

Follow any figured dimensions - do not scale. IF IN DOUBT ASK.

Revision History	Date

Application Boundary (4465m²)

Chester Office:
Well House Barns
Bretton
Chester
CH4 0DH

South Manchester Office:
Camellia House
76 Water Lane
Wilmslow
SK9 5BB

0844 8700 007 - www.axisped.co.uk

axis

client: HARBOUR ENERGY

project: LEGACY

drawing title: STATUTORY PLAN

date: February 2020	drawn by: SM	checked: PR
drawing number: 2658-01-003	status: --	
scale(s): 1:1250@A3	rev:	

planning environment design

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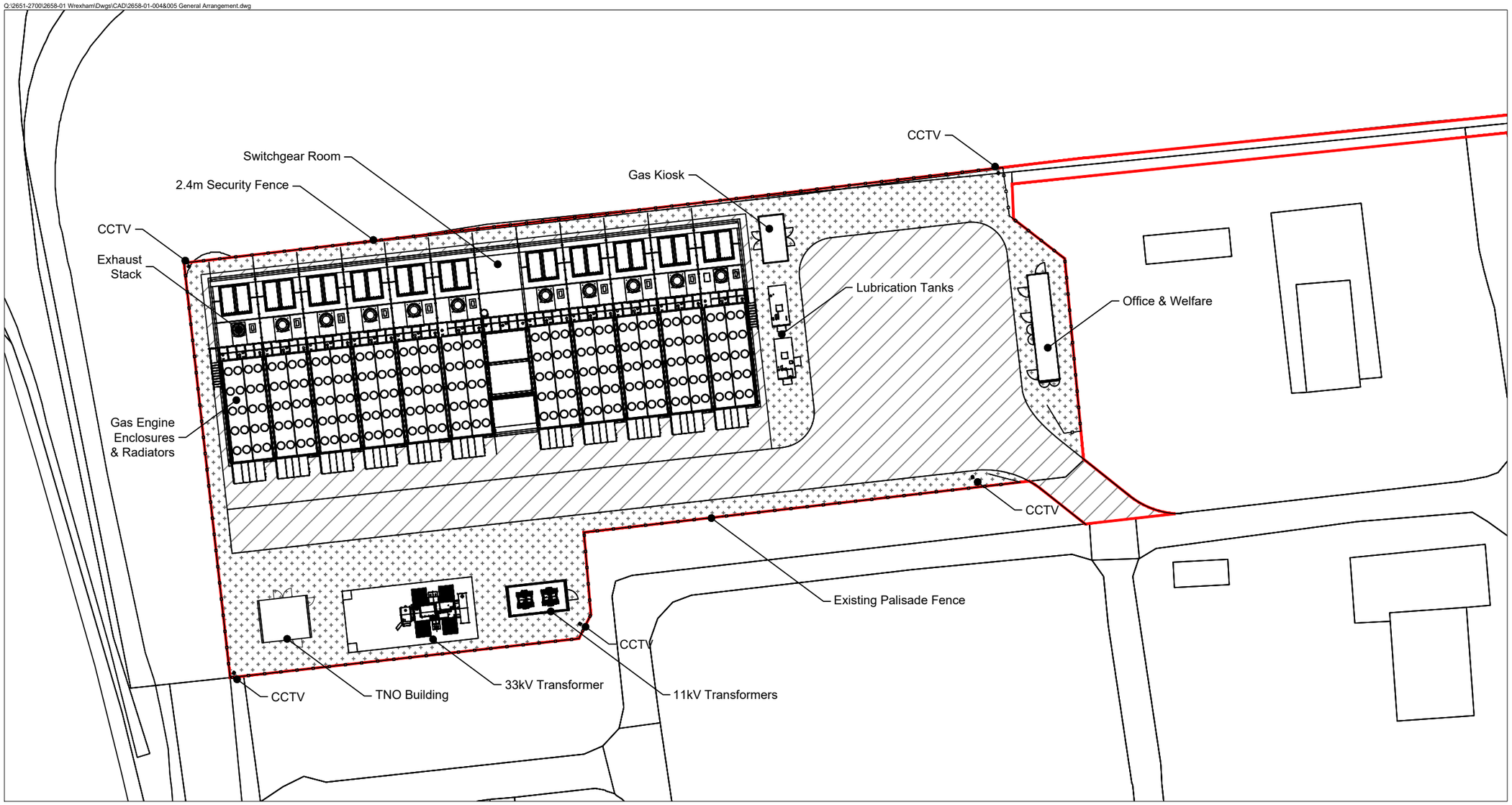

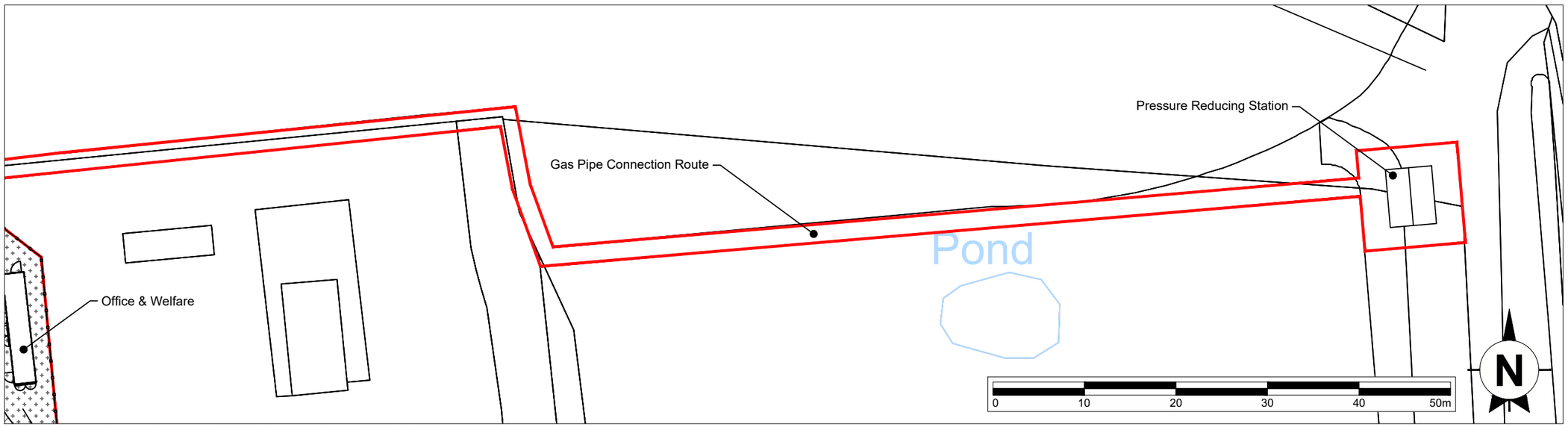

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Revision History	Date

Application Boundary

2.4m Security Fencing

Hardstanding

Stone Surfacing

Chester Office:
Well House Barns
Bretton
Chester
CH4 0DH

South Manchester Office:
Camellia House
76 Water Lane
Wilmslow
SK9 5BB

0844 8700 007 - www.axisped.co.uk

axis

client: HARBOUR ENERGY

project: LEGACY

drawing title: GENERAL ARRANGEMENT

date: February 2020	drawn by: SM	checked: PR
drawing number: 2658-01-004	status: --	
scale(s): 1:500@A3	rev:	

planning environment design

APPENDIX 2 – Ioh 124 Method Calculations

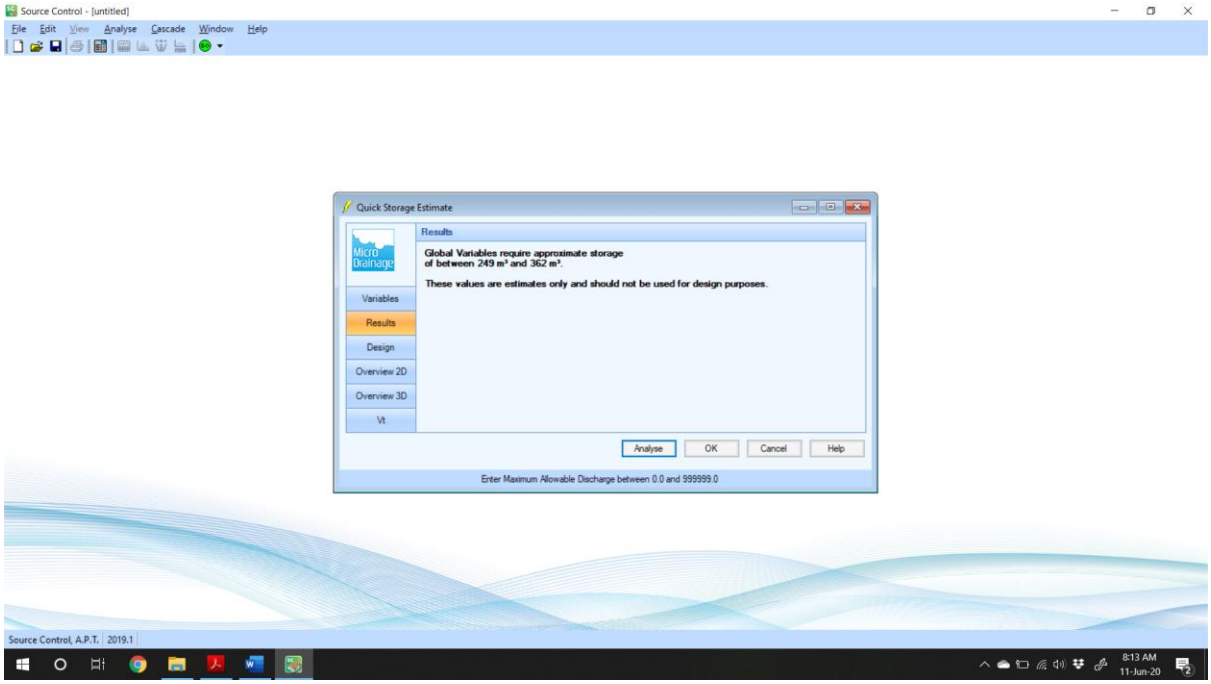
ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 854 Urban 0.000
Area (ha) 0.299 Soil 0.450 Region Number Region 9

Results	**l/s**
QBAR Rural	1.7
QBAR Urban	1.7
Q100 years	3.6
Q1 year	1.5
Q30 years	2.9
Q100 years	3.6

APPENDIX 3 – 1 in 100 Year (+30%) Attenuation Storage Calculations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Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Results
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These values are estimates only and should not be used for design purposes.
Analyse
OK
Cancel
Help
Enter Maximum Allowable Discharge between 0.0 and 999999.0
Source Control, A.P.T. 2019.1
8:13 AM
11-Jun-20

KRS Environmental Ltd

Mob: 07857 264 376

Tel: 01686 668957

Tel: 01484 437420

Email: keelan@krsenvironmental.com

Web: www.krsenvironmental.com