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FLOOD RISK ASSESSMENT FOR A DRY ANAEROBIC DIGESTION FACILITY AND HEALTHCARE WASTE ENERGY RECOVERY FACILITY

THE HEATH, WOODHURST, CAMBRIDGESHIRE

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GENERAL NOTES

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1 INTRODUCTION

1.1 Background

A Planning Application is being prepared for construction of a Dry Anaerobic Digestion (AD) Facility and Healthcare Waste Energy Recovery Facility ('the site') at an existing waste management site near the village of Woodhurst in Huntingdonshire. The site has an extensive planning history dating back to 1992.

Hafren Water has been commissioned to carry out an assessment of the flood risk to and from the site to support the Planning Application. This assessment is presented below.

1.2 Data sources

The following data sources have been used in this assessment:

GP Planning

- Site layout drawings

Ordnance Survey (OS)

- 1:25,000 and 1:50,000 series mapping

British Geological Survey (BGS)

- Geology viewer (BGS website) and Webmap Service

Cranfield Soil and Agrifood Institute (landis.org.uk website)

- Soils map

Environment Agency (EA)

- Flood risk mapping: data.gov.uk open data sources accessed 4/2/2021

Cambridgeshire County Council

- Cambridgeshire Flood & Water Supplementary Planning Document, July 2016
- Surface Water Drainage Guidance for Developers, Nov 2019

Huntingdonshire District Council

- Huntingdonshire Local Plan (adopted May 2019)
- Level 1 and 2 Strategic Flood Risk Assessment – June 2017

1.3 National Planning Policy Framework and Planning Practice Guidance

This Flood Risk Assessment (FRA) has been undertaken with regard to the statutory requirements of the National Planning Policy Framework (NPPF) and with reference to Planning Practice Guidance (PPG) in relation to development and flood risk. The latter ensures that flood risk is taken into account at all stages of the planning process and to avoid inappropriate development in areas potentially at risk of flooding.

The location of the site in Flood Zone 1 conforms to the NPPF sequential approach to development. Given this is the zone of lowest flood risk and is an appropriate development to this flood zone an Exception Test is not applicable.

1.4 Local and regional policy

Cambridgeshire County Council is the Lead Local Flood Authority for the area encompassing the site whilst Huntingdonshire District Council is the Local Planning Authority. The nearest Internal Drainage Board is Waterboys, Somersham and Pidley 3 km to the north of the site and does not overlap with the site or drainage channels in the immediate surroundings.

Cambridgeshire Flood and Water Supplementary Planning Document - July 2016

This document provides guidance on the design of measures to manage and mitigate flood risk including sustainable drainage systems in support of local plan policies. This includes the need to complete a pro-forma to ensure that all required information is presented to the Council in site-specific flood risk assessments (*Appendix 3050/FRA/A4*).

Huntingdonshire Level 1 and 2 Strategic Flood Risk Assessment – June 2017

The aim of the Strategic Flood Risk Assessment (SFRA) is to inform the selection of options for Local Plan allocations and to support the determination of planning applications. The SFRA also provides guidance for developers including the content of site-specific flood risk assessments.

Cambridgeshire County Council Surface Water Drainage Guidance for Developers - November 2019

This document provides technical guidance to developers in the preparation of surface water drainage strategies to support planning applications.

The preferred method of surface water disposal is to ground in a soakaway or through permeable paving or swales. The feasibility of this will depend on whether infiltration rates exceed a minimum of 1 x 10^{-6} m/s as demonstrated by on-site infiltration tests. The base of infiltration structures must be at least 1 m above the anticipated groundwater level as determined from trial pits or boreholes.

Discharges to a waterway will need to show that the watercourse has an outfall and is in a suitable condition to receive surface water. Discharges to highway drains would only be permitted through existing proven connections unless it is intended to upgrade the highway drainage system to allow sufficient capacity. Discharges to a sewer would need to be agreed with Anglian Water.

Existing peak run-off rates and volumes in units of l/s/ha and m^3/ha are required for design storm events with 1 in 100 (including climate change), 1 in 30 and 1 in 1 annual probabilities.

Developed site run-off rates from the positively drained area of a greenfield site will need to be constrained to greenfield rates or less. Where a simple flow control is proposed the greenfield peak rate will be limited to Q_{BAR} (mean annual flow rate). Where a complex flow control is proposed peak run-off rates should not exceed corresponding greenfield event frequency up to and including the 1 in 100 plus climate change event. Run-off volume from the developed greenfield site during a 1 in 100, 6-hour design storm event should not exceed the greenfield run-off volume for the same event.

Developed site peak run-off rates from the positively drained area of a brownfield site will need to achieve at least a reduction in run-off compared to existing rates and, where possible, to re-instate greenfield rates. Run-off volume from the developed brownfield site during a 1 in 100, 6-hour design storm event should be close to the greenfield run-off volume for the same event. Where this is not practical, run-off volume should be discharged at a rate that does not adversely affect flood risk.

Storage basins should have a depth no greater than 2 m with side slopes no greater than 1 in 3 unless it is a special site such as a basin that has no access to the general public. The design of long-term storage is based on the developed site run-off volume in excess of the 1 in 100, 6-hour greenfield volume. The developed site run-off volume is determined for the 1 in 100, critical duration which will be much longer than 6 hours. The design of attenuation storage should be based on the 1 in 100 plus climate change event assuming the permitted discharge rate.

Climate change adjustments should use an upper end estimate to assess flood risk whilst central estimates should be used for design purposes.

Flow routes for run-off events in excess of the 1 in 100 design storm event should minimise the risks to people and property both on and off-site.

Huntingdonshire Local Plan - adopted May 2019

The local plan contains the following policies that are of relevance to flooding. Of possible relevance to the proposed development are the following elements within the two policies:

LP 5 Flood Risk

A proposal will only be supported where all forms of flood risk, including breaches of flood defences or other defence failures, have been addressed.

Where necessary the sequential approach and sequential test are applied and passed.

LP 15 Surface Water

The proposal incorporates sustainable drainage systems in accordance with the Cambridgeshire Flood and Water Supplementary Planning Document.

If the drainage system would directly or indirectly involve discharge to a watercourse that the Environment Agency is responsible for the details of the discharge have been agreed with them.

1.5 Regulatory requirement for this assessment

The site is located within the Environment Agency's Flood Zone 1. Due to the site area exceeding 1 hectare (ha), a FRA is required in accordance with the National Planning Policy Framework and Planning Policy Guidance.

Pre-application advice from Cambridgeshire County Council in August/September 2020 requested preparation of a flood risk assessment and surface water drainage strategy. This should demonstrate that the existing surface water network has capacity to receive run-off from the additional impermeable area of the proposed development.

2 BASELINE CONDITIONS

2.1 Location and setting

The site is located in a rural setting where the nearest village is Woodhurst, 1.5 km to the northwest (*Drawing 3050/FRA/01*). The site is centred on National Grid Reference (NGR) TL 33406 75296 and postcode PE28 3BS, it is positioned on the northeastern side of the junction between St Ives Road (B1040) to the west and Bluntisham Heath Road to the south.

The planning application site has a total area of 8.92 ha which partly overlaps an existing waste management facility. The existing facility contains offices, welfare buildings, workshops, weighbridges, hardstanding for composting and four water management lagoons and a waste water treatment plant. In addition to parts of the existing facility, the proposed development will occupy unused ground immediately to the north of the existing site.

2.2 Topography

The landholding, in which the site is located, has a relatively shallow gradient from south to north. The highest elevations of 32.8 metres Above Ordnance Datum (mAOD) occur in the southwest corner next to the junction of St Ives Road and Bluntisham Heath Road. Ground falls away more steeply to the north of the existing lagoons to reach elevations of less than 26.5 mAOD towards the northern boundary.

Bluntisham Heath Road along the southern boundary of the landholding runs along an east to west trending shallow ridge. Land to the north of the road and site falls gently away towards the village of Somersham where ground elevations reach 10 mAOD. Land to the south of the road falls away towards St Ives and reaches a similar elevation of 10 mAOD.

2.3 Hydrology

There are no natural watercourses or waterbodies within the site.

The nearest main river is the Great River Ouse which is approximately 5 km to the southeast at its nearest point. The headwaters of two ordinary watercourses, which are minor tributaries of the Great Ouse and Nene rivers, are located on the opposite side of St Ives Road, 0.5 km to the northwest and 1 km to the southwest of the site.

Roadside drainage ditches occur along the western and southern boundaries of the wider landholding.

Four small surface water management lagoons occur within the existing waste facility.

2.4 Ground conditions

According to the classifications given by the Cranfield National Soil Resources Institute, the predominant soil type across the site is '*lime-rich loamy and clayey soils with impeded drainage*'.

Superficial deposits comprise Diamicton of the Oadby Member. This is a heterogeneous mixture of clay, sand, gravel, and boulders of varying size. Therefore, infiltration properties will be variable and depend on the extent of clay.

Bedrock beneath the site comprises sedimentary mudstones of the West Walton Formation and Ampthill Clay Formation (undifferentiated). The Environment Agency classifies this as unproductive strata due to its low permeability and negligible significance for water supply or river base flow.

The nearest BGS logs are for two boreholes constructed 3 km to the east of the site (TL37SW9 and TL37SE9) on Wood Farm, Bluntisham. Water was encountered in one of the holes at a depth of 6 m below ground level.

2.5 Proposed development

2.5.1 Land use

The proposed development contains the following main elements:

i) Dry Anaerobic Digestion (AD) facility
ii) Healthcare Waste Energy Recovery Facility (which will provide heat to the AD facility),
iii) Vehicle Re-Fuelling Station
iv) Pellet Fertiliser Production Facility
v) Waste Transfer Station
vi) Woodchip Biomass Fuel Storage Building
vii) Surface Water Storage Lagoons
viii) and associated development within the existing waste management facility

The new development will create new low permeability areas totalling 7.9 ha. This area will partly overlap with the existing low permeability areas which total 8.2 ha (*Appendix 3050/FRA/A1*). Low permeability land use areas within the existing and proposed development comprise:

- Existing hardstanding – 44,770 m^2
- Existing compost pad – 19,850 m^2
- Existing building roof – 14,510 m^2
- Existing lagoons (n^{os} 1, 2, 3 and 4) all excepting no1 to be removed – 560, 720, 680, 1,300 m^2

- New hardstanding/pavement – 42,350 m2
- New building roof – 15,000 m2
- New lagoons (nos 1, 2, 3 and 4)– 2,900, 2,900, 2,900, 2,900 m2
- New roadway – 9,930 m2

2.5.2 Surface water management

Due to the inter-connection of existing and proposed site layouts surface water management on the two sites will need to be integrated.

The existing site's surface water management system was approved following a previous planning application for the existing waste facility (*Appendix 3050/FRA/A2*). An existing network of pipes directs clean roof water into a containment lagoon (Lagoon N^{o} 4) where water is re-used on-site. Any excess water will be discharged under licence to a drainage ditch to the north of the site. Dirty water from working areas is directed through a network of pipes to a series of three balancing lagoons (Lagoon N^{os} 1, 2 and 3) which feed a water treatment plant. This allows the discharge of treated water from the site to a nearby ditch in the northwest corner of the site. Off-site discharge is limited to 100 m^3/day by permit number PRCNF/18042.

The three existing dirty water storage lagoons are reported to have a combined area of approximately 1,960 m^2 and a combined volume of 7,330 m^3 including freeboard (depth 0.75 m) storage volume. The existing clean water lagoon has an area of 1,300 m^2 and total volume of 3,500 m^3 (*Appendix 3050/FRA/A2*).

The clean and all excepting one of the dirty water lagoons will be built over and replaced by new lagoons constructed on unused land towards the northern boundary of the site. One of the existing dirty water lagoons will be retained as a balancing pond to convey water to the new lagoons.

The new clean water lagoon will receive surface water run-off from existing buildings as well as roads and roofs in the new site. Water will be re-used on-site with any excess water discharged to an external drainage ditch under the existing licence which permits a maximum discharge rate of 100 m^3/day.

Under normal rainfall conditions dirty surface water run-off from the new waste processing areas will drain to three new lagoons via a retained existing lagoon. During storm rainfall conditions surface water run-off in excess of the capacity of the dirty water lagoons will be diverted into the newly constructed clean water lagoon. Depending on the water quality, outflow from the clean water lagoon will be discharged off-site at the permitted rate or re-used on-site.

The new clean water lagoon will have an emergency overflow crest to direct water into the existing drain at the northwest corner of the site during storm rainfall events in excess of the design event. Details of the lagoon's size are given in Section 5.3.

An existing drain in the northwest corner of the site flows northwards and runs along the eastern side of the Somersham Road (B1040) before crossing to the western side of the road. The drain then enters the extensive fenland drainage system within the River Nene catchment. The capacity of the drain is not known but is assumed to be able to accommodate the licensed discharge.

2.6 Climate change

Within the UK, projections of future climate change predict that there will be more frequent, short duration, high intensity rainfall events and periods of long duration rainfall. The NPPF recommends that the effects of climate change are incorporated into Flood Risk Assessments. Recommended precautionary sensitivity ranges for peak rainfall intensities are outlined on the Environment Agency website (latest update 22nd July 2020) and are summarised in *Table 3050/FRA/T1*.

3050/FRA/T1: Recommended increases in rainfall due to climate change			
Peak rainfall intensity - applies across all of England	Years		
	'2020s' (2015 to 2039)	'2050s' (2040 to 2069)	'2080s' (2070 to 2115)
Upper estimate	+10%	+20%	+40%
Central estimate	+5%	+10%	+20%

The proposed lifetime of a development is generally assumed to be 60 years for commercial development and 100 years for residential. Also, if a development is highly sensitive to flooding an 'upper' estimate is assumed to be applicable.

A peak rainfall intensity adjustment of 40% for climate change has been used to calculate run-off rates and volumes for the site drainage strategy (Section 5.2).

3 EXISTING FLOOD RISK TO SITE

3.1 Flood mechanism

The risk of flooding to the site has been assessed by examining the likelihood of flooding, the hazard caused if it were to flood and its vulnerability. This has been undertaken for a range of likely sources.

Flooding to the site considers the following potential sources:

- Fluvial flow
- Tidal
- Surface water run-off
- Groundwater
- Sewer and/or water mains leakage

As required by the National Planning Practice Guidance, the return period to be considered for fluvial and rainfall events is 100 years and for tidal events is 200 years. The effect of climate change has been factored into the assessment.

3.2 Receptors internal to the site

The proposed development will include offices, workshops, and a range of plant associated with the AD facility. This will not include any residential use and it is understood measures will be in place to control pollution. According to Planning Practice Guidance Table 2 of Flood Risk and Coastal Change (6th March 2014) this is a 'less vulnerable' development for flood resilience purposes.

3.3 Fluvial flooding

Fluvial (river) flooding occurs when a watercourse cannot accommodate the volume of water draining into it from the surrounding catchment.

The site is located entirely within Flood Zone 1 for fluvial flooding on the Environment Agency's indicative flood map. Flood Zone 1 is classified as 'low' flood risk, with a 1 in 1000-year or less (<0.1%) annual probability of fluvial flooding (*Drawing 3050/FRA/02*). The overall risk of fluvial flooding is therefore 'very low' and mitigation measures are not required.

According to Table 3 of Planning Practice Guidance, this is an appropriate land use for Flood Zone 1 and no Exception Test is required. This location also complies with a sequential approach to planning for flood risk.

3.4 Surface water flooding

Surface water (pluvial) flooding occurs when rainwater does not drain away through the normal drainage system or soak into the ground, but instead, lies on or flows over the ground. This can typically happen following high rainfall storm events when the internal drainage system is unable to cope with the amount of surface run-off or when ground profiles are uneven and facilitate ponding.

The Environment Agency's 'Risk of Flooding from Surface Water' map (*Drawing 3050/FRA/03*) shows that with the exception of field edge drainage ditches the area surrounding the site currently has less than 1 in 1000 annual probability of surface water flooding ('very low' risk). Due to the flatness of the terrain and absence of any significant surface run-off pathways leading into the site, surface water flood risk to the site from external areas is assessed as being very low.

No mitigation is proposed.

3.5 Groundwater flooding

Groundwater flooding occurs when the watertable rises to meet the ground surface. It is most likely in areas above an aquifer where water levels can rise following prolonged rainfall.

Published mapping of soils and geology suggest the site is underlain by clayey soils and a heterogeneous mixture of superficial clay, sand, gravel, and boulders overlying sedimentary mudstone bedrock. There are no known boreholes at the site or in close proximity. Water levels in a borehole 3 km to the east suggest a groundwater depth of 6 m. Existing lagoons on-site have been constructed to depths of approximately 3 m. Maps within the Huntingdonshire SFRA show the site has a 50% to 75% chance of being susceptible to groundwater flooding, although surrounding areas have a much lower susceptibility.

There are no known instances of groundwater flooding on-site and, with the exception of lagoons, no below ground structures are proposed. The risk of groundwater flooding is considered to be 'low'. Whilst no mitigation is proposed it would be prudent to carry out site investigations to establish the depth to watertable when designing any lagoons.

3.6 Flooding from sewers and water mains

Sewer flooding occurs when sewers are overwhelmed by heavy rainfall or when pipes become blocked or broken.

Given the rural surroundings, major sewage and water mains are unlikely to be present within the site. Also, with the exception of lagoons, no below ground structures are proposed for development. Therefore, flood risk posed by interaction of the development with water mains or sewers is considered to be 'very low' for the site. No mitigation is proposed other than the normal precautionary approach during construction activities involving excavations.

3.7 Reservoir flooding

Reservoir flooding occurs after the failure or overtopping of a dam wall or embankment and is rare in the UK due to regulatory inspections and maintenance.

The site is not located in an area exposed to reservoir flooding.

4 FLOOD RISK TO THE SURROUNDING AREA

4.1 Flood mechanism

Developments can potentially increase flood risk elsewhere through the following mechanisms:

- Fluvial flooding due to changes in flood flow routes
- Fluvial flooding due to a loss of floodplain storage
- Flooding due to an increase in surface water run-off

4.2 Receptors external to the site

Land use that is potentially at risk if a proposed development causes increased flooding in areas beyond its boundary is referred to as a 'receptor'. Potential receptors will be located down-gradient. The consequences of flooding will depend on the vulnerability classification of a receptor.

Residential properties are classified by Planning Practice Guidance as 'highly vulnerable' receptors. The nearest dwellings are associated with a mushroom farm, 60 m to the north of the site boundary and these are potentially at risk to surface run-off leaving the site. The Raptor Foundation is located to the north and is a similar distance away but is on the opposite, western, side of the B1086 road which is a barrier to flood pathways. Other properties are located over 400 m to the north at Cookoo Bridge Farm and therefore are not at risk. Dwellings are also located along the ridge at distances in excess of 400 m to the west and east. They are not down-gradient of the site. Hill Farm is located 200 m to the south. Flood pathways to the south are impeded by the existing waste facility and Bluntisham Heath Road (*Drawing 3050/FRA/01*).

The mushroom farm also contains land and buildings used for agriculture which is classified as 'less vulnerable'.

4.3 Fluvial flooding due to changes in flood flow routes

The site is located in Environment Agency Flood Zone 1 and is not within flood flow paths. The proposed development will not alter flood flow paths and will not cause an increase in fluvial flood risk to external areas.

4.4 Fluvial flooding due to a loss of floodplain storage

The site is located in Environment Agency Flood Zone 1 and is not within the floodplain. The proposed development will not result in the loss of floodplain storage, which could otherwise cause an increase in fluvial flood risk to external areas.

4.5 Flooding due to an increase in surface water run-off

The Environment Agency's 'Risk of Flooding from Surface Water' map (*Drawing 3050/FRA/03*) shows that the majority of the site currently has less than 1 in 1000 annual probability of surface water flooding ('very low' risk). Low lying areas where ponding of rainfall could occur exhibit a greater risk of flooding but are very limited in extent and will be changed by the proposed development.

The proposed development will create low permeability surfaces associated with roofs, hardstanding and roads which, together with similar surfaces in the existing site, will comprise a net total of 15.86 ha (excluding overlaps). This will lead to an increase in surface run-off which will require mitigation to limit the risk of flooding to external areas.

It is proposed that surface water management makes use of an existing water management system associated with the existing waste facility. Clean and dirty water run-off from both the existing and new sites will be conveyed to a series of water containment lagoons for treatment and subsequent re-use or discharge off-site under licence (Section 5).

5 FLOOD MITIGATION

5.1 Drainage design criteria

5.1.1 Design storm run-off

Local, regional and national planning objectives promote the use of SuDS in new developments to reduce the overall level of flood risk in the area. This aims to limit run-off from developed sites to greenfield rates and to ensure that surface water run-off is managed as close to its source as possible.

National guidelines require the management of run-off from roof and hardstanding areas in accordance with a hierarchy of measures prioritised by re-use, infiltration, attenuation and discharge. The soil and geological characteristics of the area are likely to prove unfavourable to the disposal of excess surface water by infiltration systems (Section 2.4). Therefore, recourse to containment and possibly controlled discharge to a nearby drainage ditch will be required.

The new and existing drainage systems will need to conform to present day guidance. Cambridgeshire County Council's Surface Water Drainage Guidance for Developers (Nov 2019, Section 1.4) sets out the following design criteria for surface water management systems:

> "*All new developments on greenfield land are required to discharge the run-off from the impermeable areas at the same greenfield run-off rate … Where a simple flow control is proposed, the peak run-off rate should be limited to QBAR (mean annual flow rate).*"
>
> "*Brownfield (previously developed land) sites must reduce the existing run-off from the site as part of the redevelopment. Where possible, in order to provide betterment, redevelopments should look to reinstate greenfield* [peak] *run-off rates*".
>
> "*The run-off volume from the development site to any surface water body or sewer in the 1% AEP (1 in 100), 6 hour rainfall event must be constrained to a value as close to the greenfield run-off volume for the same event, but should never exceed the run-off volume from the existing site*".
>
> "*To achieve the above, long term storage may be required. Long Term Storage is the term given to the volume of temporary storage which needs to be provided for the additional volume of surface water run-off that is generated by the development that is greater than the volume of greenfield run-off ……. the Long*

Term Storage volume is not calculated using the 1:100 year 6 hour event, but needs to be assessed using the critical duration event".

In compliance with the Cambridgeshire County Council guidance an updated surface water management system has been designed to contain a 1:100-year design storm event with a 40% adjustment for climate change. For compliance with guidance and for consistency with an existing approved water management system (*Appendix 3050/FRA/A2* to discharge conditions 18 and 19 in relation to consent H/05005/17/CW for the existing site) a design storm duration of 48 hours has been assumed in the calculation of run-off volumes.

Estimates of the developed site run-off and the equivalent greenfield site run-off are provided in the following section (Section 5.2). These values have been used to make a preliminary and conservative estimate of the required stormwater drainage capacity to replace an existing system operating for the existing waste facility (Section 5.3).

For the purposes of water management design, catchment areas represent the combined area of those parts of the existing and proposed sites where surface run-off will be managed or positively drained (roofs, roads, hardstanding and compost pad). Catchments have been divided into clean water (roofs and roads) and dirty water (hardstanding and compost pad) areas and includes areas of the existing site that will also drain to the proposed water management system.

5.1.2 Status of storage at beginning of design storm

It is commonly accepted that lagoons should be designed with a freeboard that accommodates the design flood inflow event without overtopping. The freeboard would occupy the storage zone above storage that is required for containment of any process water requirements.

It is understood that the developer would prefer to retain as much run-off as possible to help meet on-site water demands. The precise quantity of water needed is not known and for the purposes of this assessment is assumed to be at least equal to the capacity of the water treatment plant, 100 m^3/day.

A water balance has been used to assess the likely depth of water that could be expected on average in the lagoons in addition to storm events (*Table 3050/FRA/T2*). The negative balance in most months suggests water demand exceeds site run-off during average rainfall conditions and lagoons can be expected to be near empty (<0.03m) ahead of storm rainfall events. Therefore, the entire depth of lagoons is considered to be freeboard for the containment of storm events.

3050/FRA/T2: Lagoon water balance								
Month	Rain mm	Evap mm	Water demand m³	All dirty water run-off m³	All clean water run-off m³	All lagoons rain m³	All lagoons evap m³	Balance m³
Jan	46	16	-3100	1959	722	531	-180	-67
Feb	34	14	-2800	1457	537	395	-162	-574
Mar	37	31	-3100	1594	588	432	-360	-846
Apr	40	45	-3000	1697	626	460	-522	-739
May	46	62	-3100	1961	723	532	-719	-603
Jun	49	60	-3000	2116	780	574	-696	-226
Jul	46	93	-3100	1972	727	535	-1079	-946
Aug	54	93	-3100	2331	859	632	-1079	-357
Sep	48	60	-3000	2064	761	560	-696	-311
Oct	53	47	-3100	2284	842	619	-539	106
Nov	52	30	-3000	2206	813	598	-348	270
Dec	49	16	-3100	2112	779	573	-180	184
Notes: Rainfall Cambridge NIAB 1961-2020. Evaporation extrapolated from CIRIA SUDS manual 3 mm/day in summer Water demand assumed equal to treatment capacity 100 m³/day Run-off coefficient during normal rainfall = 0.4 Total dirty water area = 11.6 ha Total clean area = 4.2 ha								

5.2 Estimate of surface run-off

5.2.1 Greenfield rate

The peak 'greenfield' run-off rate from the area of the existing (8.2 ha) and proposed (15.8 ha) areas of the site that are and will be controlled by the proposed water management system have been estimated using the IH124 method (equation 7.1, Institute for Hydrology Report N° 124, 1994). The IH124 method to give a mean annual peak flow (Q_{BAR}) is of the form:

$$Q_{BAR(rural)} = 0.00108 AREA^{0.89} SAAR^{1.17} SOIL^{2.17}$$

Where: $Q_{BAR(rural)}$ mean annual flood, with a return period of 2.3 years (m³/s)

AREA catchment area (km²)

SAAR(4170) Standard Average Annual Rainfall (1941 to 1970) (mm)

SOIL soil index

A soil index (0.47) has been selected to be compatible with low permeability clay soils and an average rainfall of 539 mm determined from HR Wallingford online greenfield estimation tool. $Q_{BAR(rural)}$ can be multiplied using the UK Flood Studies Report regional growth curves to produce peak flood flows for any return period (the calculation record is provided in *Appendix 3050/FRA/A3*). Estimates of the greenfield Q_{BAR} run-off rate from areas of the existing and new sites where drainage will be managed are 29 l/s and 56 l/s, respectively.

5.2.2 Existing and developed site run-off rates

Peak run-off rates and volumes during a 48-hour 1 in 100-year return period event for the existing site as well as the new developed site have been estimated using the Rational Method. It is assumed that run-off occurs from areas where drainage will be managed (roofs, roads, hardstanding and compost pad). Run-off estimates are reported for clean and dirty water areas as this drainage will be conveyed to separate water storage lagoons.

The Rational Method to give peak flows (Q_p) is of the form:

$$Q_p = 2.78\ CiA$$

Where: C = run-off co-efficient (dimensionless)
i = rainfall intensity (mm/hr)
A = catchment area (ha)

The run-off co-efficient, C, varies for different surfaces and values used for this assessment are given in *Table 3050/FRA/T3*.

3050/FRA/T3: Rational method run-off co-efficient values

Description of positively drained area	Run-off co-efficient, C
Roof	0.90
Roads	0.80
Hardstanding	0.75
Compost Pad	1.00

Rainfall intensities at the site were obtained from the FEH website, using the 2013 rainfall model. Rainfall intensity is dependent on storm duration, which is taken as 48-hours. The effect of climate change on rainfall intensities (+40%) has been taken into account for the developed site (Section 2.6).

Appendix 3050/FRA/A3 contains a calculation record of the post-development run-off which is also summarised in *Table 3050/FRA/T4*.

The run-off will be managed by the implementation of a sustainable drainage system (SuDS), the details of which are outlined in Section 5.3.

3050/FRA/T4: Run-off rates and volumes			
Type of run-off	A Q_{BAR} greenfield l/s (m³)	B Licensed discharge l/s (m³)	C 48-hr 100-yr plus cc l/s (m³)
Dirty	41.3 (7,140)	1.16 (200)	83 (14,410)
Clean	15.1 (2,600)	1.16 (200)	33 (5,710)

Notes:
A Run-off from areas equivalent to those that will be positively drained (roads, roofs and hardstanding) using IH124 method
B Permitted discharge during 48-hour period
D Run-off to be positively drained (dirty 11.6 ha and clean 4.2 ha) which includes parts of existing site. Climate change adjustment = 40% and using Rational method

5.3 Drainage strategy

The proposed development consists of new buildings, roads and hardstanding areas from which run-off is categorised as being essentially 'clean' or 'dirty' depending on whether it requires treatment. The proposed site overlaps with areas of the existing site which already drain to an existing water management system. It is, therefore, proposed to augment the existing system to manage the additional run-off from the proposed development.

Ground conditions are likely to be unfavourable for surface water management by infiltration devices and it is therefore necessary to manage flood risk through storage.

Water from roofs and roads is considered to be relatively clean and will be conveyed to a 'clean' water lagoon, whilst dirty run-off from hardstanding areas will be conveyed to three existing 'dirty' water lagoons for subsequent treatment (*Drawings 3050/FRA/04 and 05*). Dirty water will be re-used on-site or discharged to the clean water lagoon after treatment. Excess water can be discharged from the site under licence.

The site is licensed to discharge treated water off-site to a ditch at the northern site boundary at a rate of 100 m^3/day. This corresponds to a constant discharge rate of just over 1 l/s and is relatively small compared to site run-off during a design storm event (*Table 3050/FRA/T4*).

During design storm rainfall conditions (48-hour 1 in 100-year plus 40% climate adjustment), the run-off volume from clean areas is estimated to be 5,710 m^3 (*Table 3050/FRA/T4*) and represents the required minimum capacity of the clean water lagoon. The estimated run-off from dirty areas of the site is 14,410 m^3 and represents the required combined capacity of the three dirty water lagoons. It is conservatively assumed no off-site discharge occurs during the 48-hour design storm event. Following storm events lagoon water can be treated and re-used within the site or discharged off-site under licence.

The perimeter of hardstanding areas between buildings will be fitted with raised kerbs. This will contain water should surcharges occur at internal drainage system inlets. Given the large areas involved this represents a significant volume of storm water storage that has not been taken into consideration in this drainage assessment. A more detailed design of the water management system may be required at a later stage of planning. If this assumes water storage lagoons are sized to manage on-site flood risk, whilst the storage created in kerbed hardstanding areas manages off-site flood risk, the required capacity of lagoons will be significantly reduced.

The maximum depth of the new clean and dirty water lagoons will depend on site investigations to confirm the depth to the watertable. Lagoons will not be accessible to the public. For the purposes of planning a lagoon depth of 2 m has been assumed, which means the area of the new clean water lagoon and each of the dirty water lagoons will be approximately 2,900 m^2. The water balance in Section 5.1.2 indicates the full depth of the lagoons can be considered to be available for storm water management.

The new clean water lagoon will be fitted with a pipe outlet to control licensed discharge to an external ditch. In the unlikely event that uncontrolled overflow from the lagoon occurs during storm rainfall in excess of the design event, overflow will gravitate to a ditch on the northwestern corner of the site. Details of the ditch flow capacity are not known but during such an extreme and rare event it is likely that water would overflow onto the road and possibly into neighbouring properties. Flow paths during such circumstances are likely to be widespread due to the flat terrain and water depths are not expected to be excessive. During events in excess of the design flood event, flooding potential to neighbouring properties in the mushroom farm and Raptor Centre will depend on doorstep threshold levels, but is not expected to be significant.

It is expected that Envar Composting Ltd would be responsible for on-going maintenance of the site's drainage system.

6 ADHERENCE TO POLICY OBJECTIVES

The proposed development is located outside river floodplains and therefore complies with national, regional or local policies regarding development planning and flood risk.

The on-going re-use of water and the proposed augmentation of water containment storage to manage increased surface run-off from roofs, hardstanding and road areas complies with Huntingdonshire Local Plan flood risk management policies LP 5 and LP 15 which require developments to consider all sources of flood risk and make use of sustainable drainage systems.

A preliminary assessment of storm water drainage requirements has been based on the Cambridgeshire County Council Surface Water Drainage Guidance and represents a conservative estimate of water containment storage.

7 SUMMARY AND CONCLUSION

A Flood Risk Assessment has been carried out in support of a Planning Application for the construction of a dry anaerobic digestion (AD) facility and Healthcare Waste Energy Recovery Facility at The Heath near the village of Woodhurst, Huntingdon.

The application site has an area of 8.46 ha and will overlap with parts of an existing waste management facility to the south as well as occupying unused ground immediately to the north. The existing waste facility to the south contains buildings, hardstanding areas, compost pad and four water management lagoons. With the exception of one lagoon all existing lagoons will be built over and require replacement and upgrade.

Both existing and proposed sites are relatively flat with a gentle south to north gradient. Natural ground comprises clayey soils with underlying superficial deposits of clay, sand, gravel, and boulders overlying a mudstone bedrock. Infiltration rates are therefore likely to be variable and will depend on the extent of clay. Surrounding land use is predominantly agricultural with a mushroom farm immediately to the north and a public road along the western boundary of the site.

The site is located entirely within Flood Zone 1. In the absence of any significant surface run-off pathways leading into the site, surface water flood risk from external areas is assessed as being very low. Due to the mudstone bedrock and clayey nature of superficial deposits and soils, the risk of groundwater flooding is considered to be 'low'. Flooding potential from sewers and water mains is considered to be 'very low' and reservoir flood risk is 'absent'.

The proposed development will create mainly low permeability surfaces comprising hardstanding, roads and roof areas totalling 7.9 ha. Together with similar surfaces in the existing site this will cause run-off from an area of 15.8 ha which requires management to limit the risk of flooding to external areas.

Ground conditions are likely to be unfavourable to surface water management by infiltration devices and it is therefore necessary to manage flood risk through means of surface storage.

The proposed site overlaps with areas of the existing waste facility which already drain to an existing water management system. It is proposed to augment the existing system to manage the additional run-off from the proposed development.

Under normal rainfall conditions water from roofs and roads will be conveyed to a new 'clean' water lagoon. 'Dirty' run-off from hardstanding areas will be conveyed to three new 'dirty' water lagoons for subsequent treatment. Treated water will be re-used on-site or discharged from the site under licence.

Estimates of clean and dirty water storage requirements are 5,710 m^3 and 14,410 m^3, respectively. Site water demand exceeds or is similar to the site run-off volume during average rainfall conditions and therefore lagoons can be expected to be empty ahead of storm rainfall events. The full depth of lagoons is assumed to be available for storm water management. For the purposes of planning all lagoons are assumed to have a depth of 2 m. This creates surface area requirements of 2,900 m^2 in each of the clean and three dirty water lagoons.

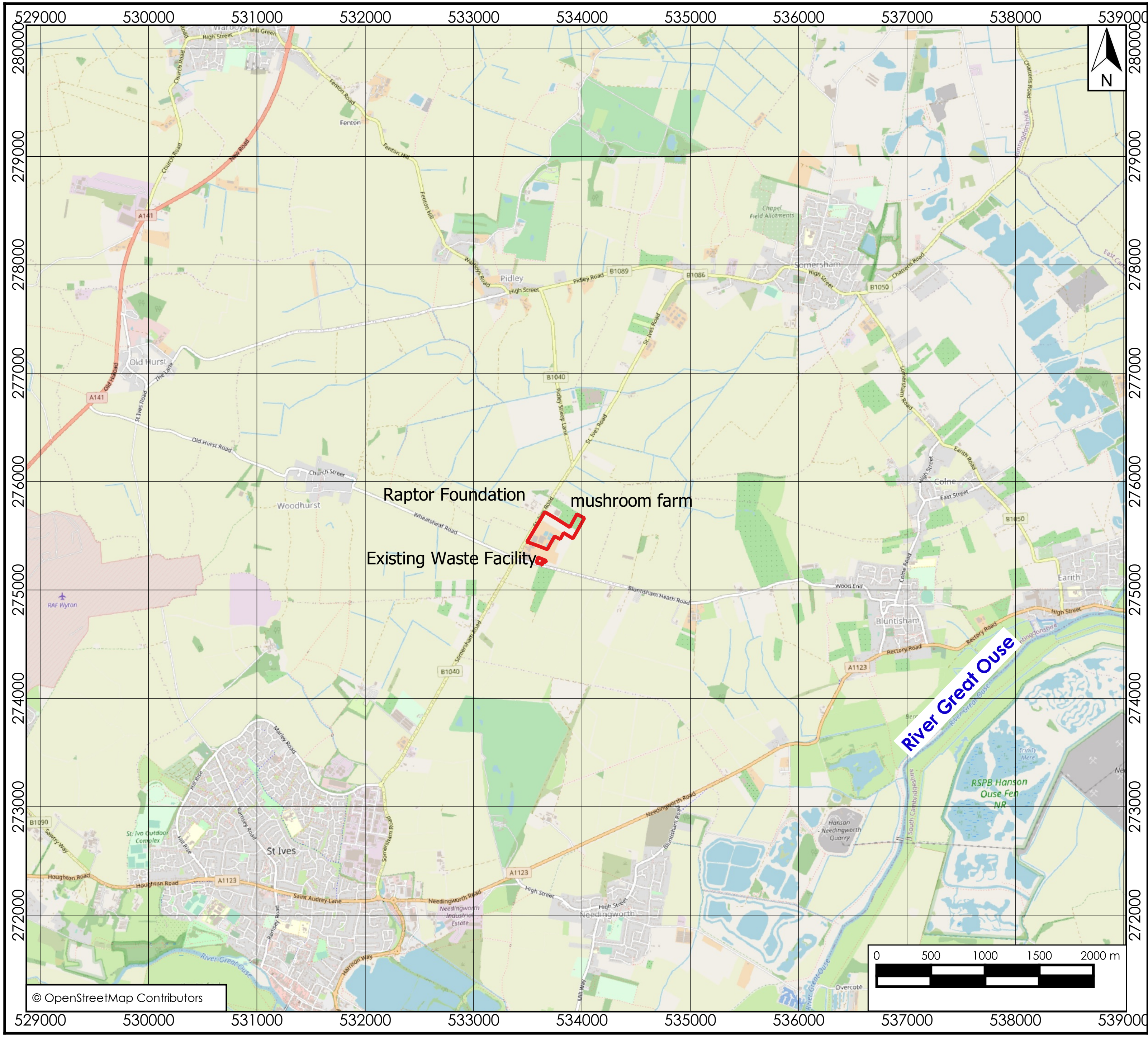
The new clean water lagoon will be fitted with a pipe outlet to control licensed discharges. The clean water lagoon will also require an emergency overflow crest to direct water into the ditch at the northwest corner of the site during events in excess of the design storm event. In the unlikely event of such overflow, the flooding potential to properties along the B1086 road immediately downstream and to the north of the site is unlikely of sufficient depth to exceed property thresholds.

A more detailed design of the water management system may be required at a later stage of planning. This could reduce lagoon storage requirements by assuming the lagoons are limited to managing on-site flood risk. Whilst the storage created in kerbed hardstanding areas between buildings provides additional storage to manage off-site flood risk.

The proposed drainage strategy of water containment and re-use complies with national, regional and local policies regarding development planning and flood risk. The design criteria for the proposed drainage system conforms with Cambridgeshire County Council's Surface Water Drainage Guidance for Developers (Nov 2019).

It is considered that the development satisfies the flood risk requirements of the NPPF, associated technical guidance and local policy by not being at risk of flooding and not leading to an increase in flood risk to external areas.

DRAWINGS



Legend

Application Boundary

Scale correct at A4

Client	Envar Composting Ltd
Title	Site Location
Project	Dry AD Facility and Waste Incinerator, The Heath, Woodhurst

Drawing	3050/FRA/01	Version	1
Date	May-21	Scale	1:50000

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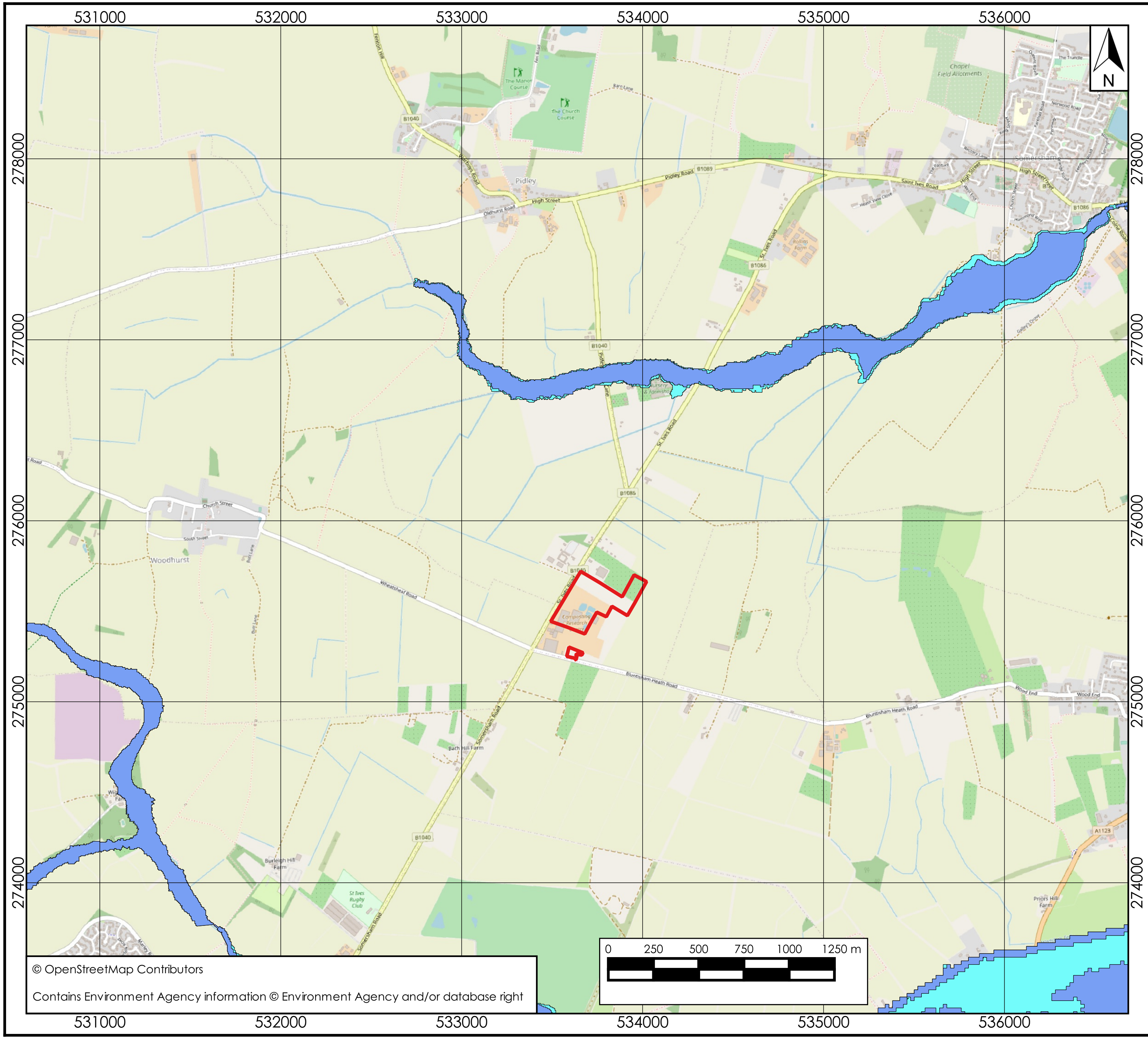

Legend

- Application Boundary
- Flood Zone 2
- Flood Zone 3

Scale correct at A4

Client	Envar Composting Ltd
Title	Fluvial Flood Risk
Project	Dry AD Facility and Waste Incinerator, The Heath, Woodhurst

Drawing	3050/FRA/02	Version	1
Date	May-21	Scale	1:30000

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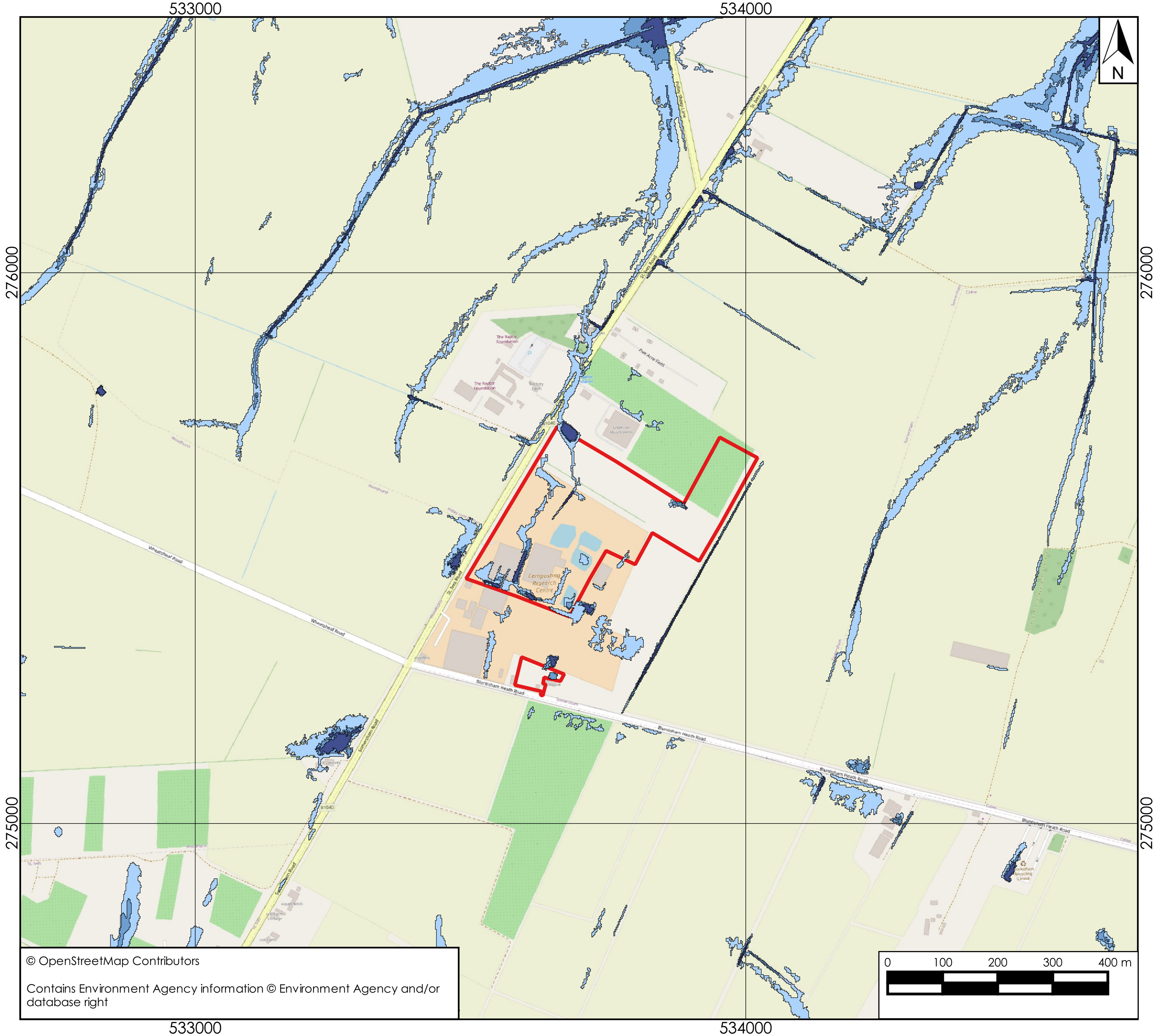

Legend

- Application Boundary

Risk of Surface Water Flooding

- 1 in 30
- 1 in 100
- 1 in 1000

Scale correct at A4

Client	Envar Composting Ltd
Title	Surface Water Flood Risk
Project	Dry AD Facility and Waste Incinerator, The Heath, Woodhurst
Drawing	3050/FRA/03
Version	1
Date	May-21
Scale	1:10000

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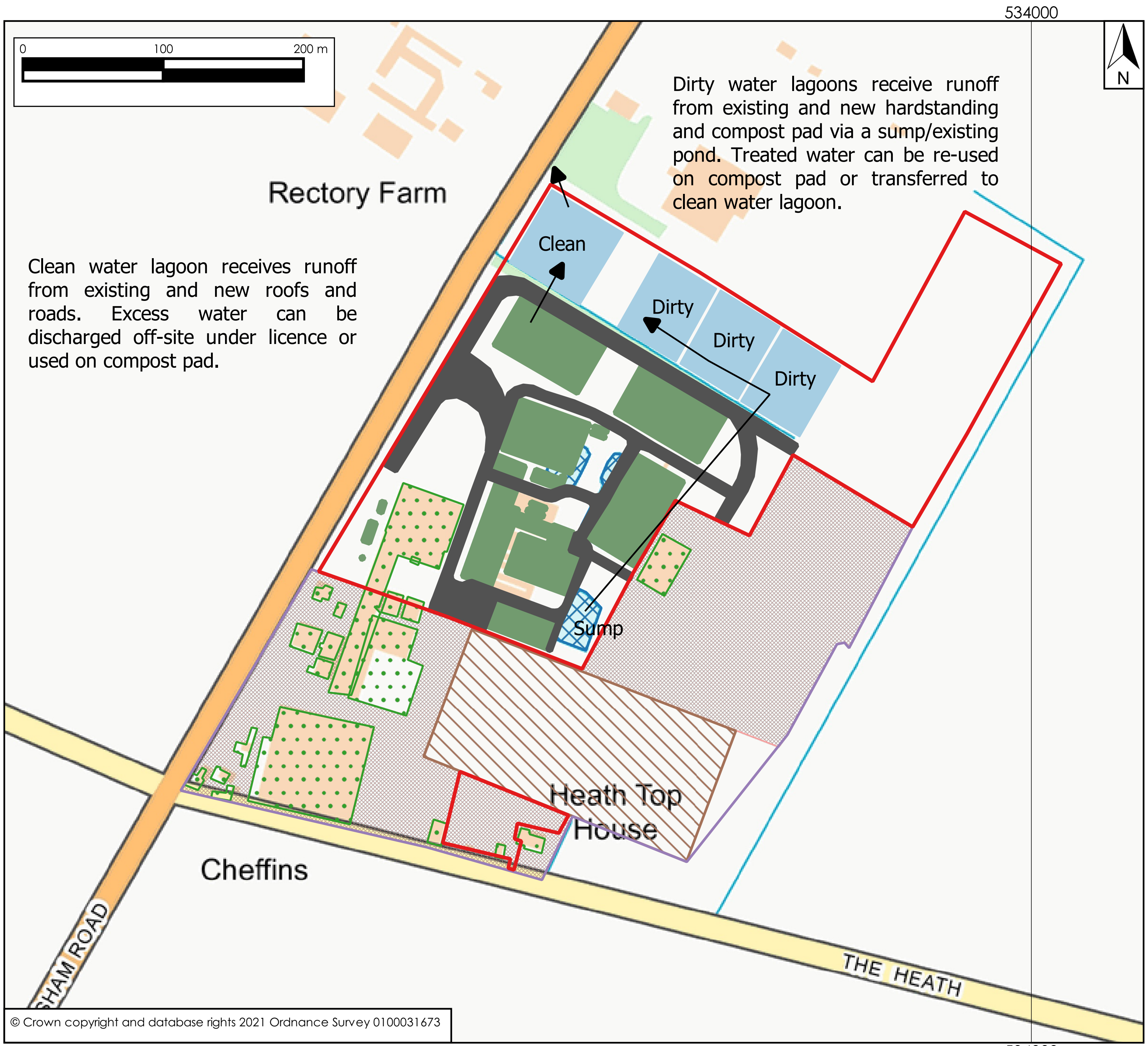

Legend

- Application Boundary
- Existing Lagoons
- Existing Buildings
- Existing Compost Pad
- Existing Hardstanding
- New Lagoon
- New Road
- New Buildings
- New Hardstanding

Scale correct at A4

Client	Envar Composting Ltd
Title	Stormwater Management Concept
Project	Dry AD Facility and Waste Incinerator, The Heath, Woodhurst
Drawing	3050/FRA/04
Version	1
Date	May - 21
Scale	1:4000

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APPENDIX 3050/FRA/A1

Proposed site layout

KEY

- Planning Application Boundary
  Area Measurement for Area 1: 86003.1597 sqm / 8.600316 ha
  Area Measurement for Area 2: 3165.1826 sqm / 0.316518 ha
  Grid Reference: X 533706 Y 275446 (centre)
  Postcode: PE28 3BS
- Land Ownership Boundary
- Land with Existing Planning Permission

Rev	Description	Initial	Date
03	Planning application boundary amended. Land with existing planning permission added.	KD	26/04/21
02	Planning application boundary amended to the north & east.	KD	31/03/21
01	Planning application boundary amended to the east.	KD	15/03/21

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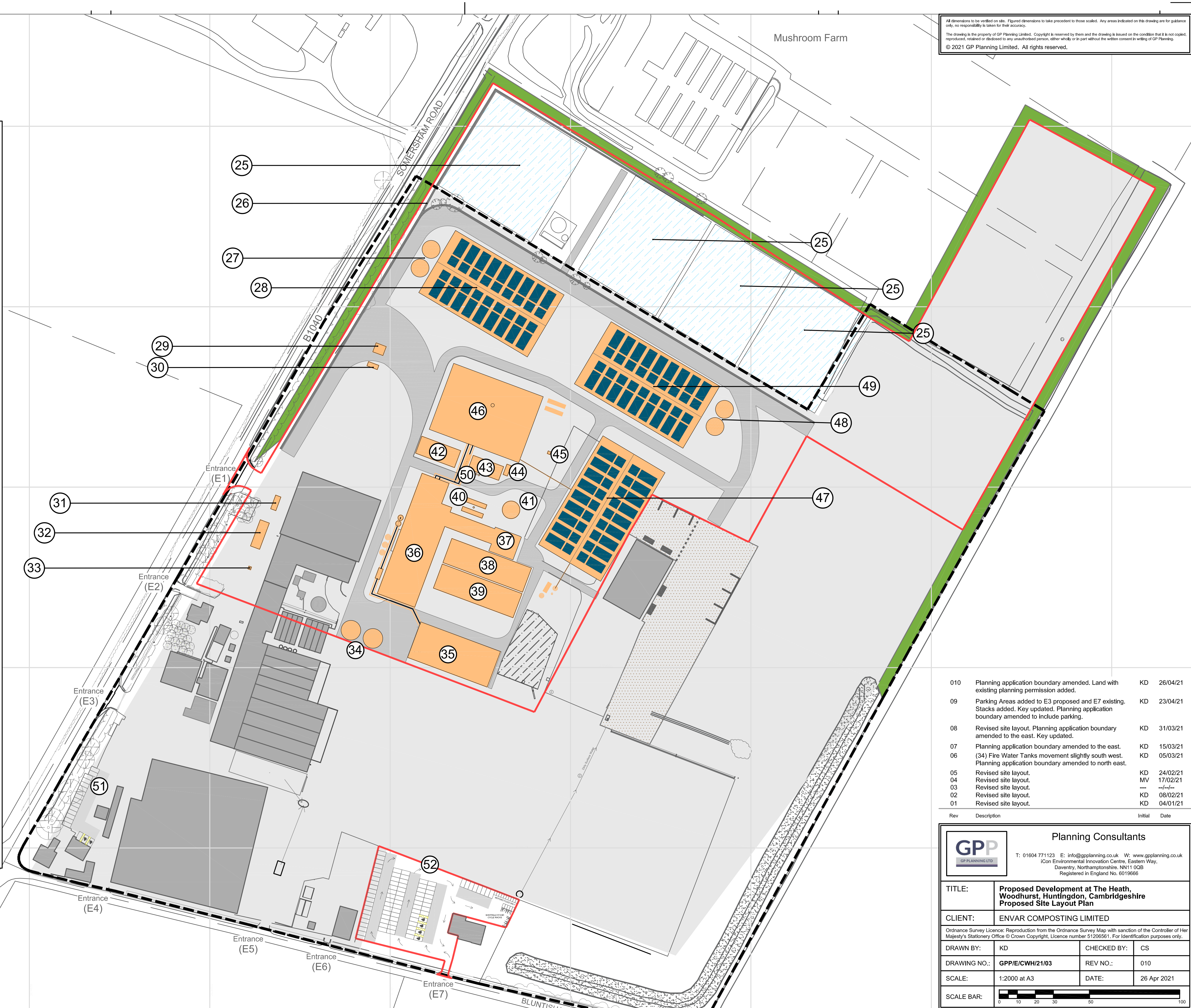
Registered in England No. 6019666

TITLE:	**Proposed Development at The Heath, Woodhurst, Huntingdon, Cambridgeshire Site Location Plan**		
CLIENT:	ENVAR		
Ordnance Survey Licence: Reproduction from the Ordnance Survey Map with sanction of the Controller of Her Majesty's Stationery Office © Crown Copyright, Licence number 51206561. For identification purposes only.			
DRAWN BY:	KD	CHECKED BY:	CS
DRAWING NO.:	GPP/E/CWH/21/01	REV NO.:	03
SCALE:	1:1250 at A1	DATE:	24 Feb 2021
SCALE BAR:	0 10 20 30 50 100		

ORIGINAL A1 SIZE SHEET

KEY

- (25) Surface Water Lagoon
- (26) Footpath
- (27) Fire Water Tanks
- (28) Waste Transfer Building with Roof Solar Panels
- (29) CNG Filling Station
- (30) HP Compressor
- (31) Grid Entry Unit
- (32) Propane Storage
- (33) Emergency Flare
- (34) Fire Water Tank / Emergency Leachate Storage
- (35) Biofilter
- (36) AD Building
- (37) Dried Digestate Storage Area
- (38) Digester
- (39) Digester
- (40) CHP and Stack
- (41) Biogas Storage
- (42) Biomethane Storage
- (43) BUG
- (44) Gas Boiler
- (45) Emergency Flare
- (46) Healthcare Waste ERF and Stack
- (47) Pellet Fertiliser Production Facility Building
- (48) ETP
- (49) Biomass Building with Roof Solar Panels
- (50) 2 x Stacks
- (51) Existing Parking
- (52) Proposed Parking



Rev	Description	Initial	Date
010	Planning application boundary amended. Land with existing planning permission added.	KD	26/04/21
09	Parking Areas added to E3 proposed and E7 existing. Stacks added. Key updated. Planning application boundary amended to include parking.	KD	23/04/21
08	Revised site layout. Planning application boundary amended to the east. Key updated.	KD	31/03/21
07	Planning application boundary amended to the east.	KD	15/03/21
06	(34) Fire Water Tanks movement slightly south west. Planning application boundary amended to north east.	KD	05/03/21
05	Revised site layout.	KD	24/02/21
04	Revised site layout.	MV	17/02/21
03	Revised site layout.	---	--/--/--
02	Revised site layout.	KD	08/02/21
01	Revised site layout.	KD	04/01/21

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iCon Environmental Innovation Centre, Eastern Way,
Daventry, Northamptonshire. NN11 0QB
Registered in England No. 6019666

TITLE:	Proposed Development at The Heath, Woodhurst, Huntingdon, Cambridgeshire Proposed Site Layout Plan		
CLIENT:	ENVAR COMPOSTING LIMITED		
DRAWN BY:	KD	CHECKED BY:	CS
DRAWING NO.:	GPP/E/CWH/21/03	REV NO.:	010
SCALE:	1:2000 at A3	DATE:	26 Apr 2021
SCALE BAR:	0 10 20 30 50 100		

ORIGINAL A3 SIZE SHEET

APPENDIX 3050/FRA/A2

Approved surface water drainage scheme, reference H_5005_17_CW_C1

NOTES

1. DRAWING IS BASED ON GP PLANNING CONSULTANTS PLAN, REF:GPP-E-H-17-02, DATED: APRIL 2017.

2. DRAINAGE DETAILS TAKEN FROM JENKINS AND POTTER PLAN, REF: 23213, DATED: MAY 2017.

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- BUILDINGS
- IMPERMEABLE PAVEMENT WITH SEALED DRAINAGE
- HARDSTANDING
- UNMADE GROUND
- HARVESTED WATER
- DIRTY SURFACE WATER
- FOUL WATER
- CONTAMINATED DIRTY WATER BY ANIMAL PRODUCTS
- TREATED WATER
- MANHOLE

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ENVAR COMPOSTING FACILITY

EP VARIATION

SURFACE WATER PLAN

DRAWING 003

Scale	Date
1:2000 @ A3	NOVEMBER 2017

Surface Water Management at Envar Composting Ltd

Application to discharge planning conditions 18 & 19 in relation to consent H/05005/17/CW

The site has a long history of organic waste management from its origins as a mushroom compost producer in the 1960s to currently one of the largest In Vessel Composting (IVC) facilities in the UK. The land take for the waste activities is some 11 hectares within a land holding of 18.5 hectares.

There are 3 water storage lagoons and a water treatment plant on site as detailed further in this report. Plus a separate lagoon for storing rainwater from the roofs of site buildings and treated water from the on-site treatment plant.

Consent has now been granted to expand the type and volume of wastes permitted at the site from the previous permission of food and green waste composting only.

This document is the application to discharge the planning condition for surface and foul water drainage.
For clarity there is no foul discharge, all foul services drain to Cess Pits which are emptied as required and taken for appropriate permitted disposal.

The additional consent involves an increase of just 4,500m2 of hard surface area.

It is also important to stress that all environmental aspects are controlled by the EA permit EPR/GP3930DF/V003. In addition the site has its own treatment plant for leachate and a discharge consent; permit number PRCNF/18042. Discussions with the senior drainage officer at CCC and with the senior EA officer for the site have confirmed that given the site is fully permitted with conditions on surface and leachate management the planning condition is something of a duplication.

For the avoidance of doubt the details below demonstrate the site is fully controlled in terms of surface and leachate water.

The Envar surface water plan dated November 2017 attached as part of this application shows how the current site drainage works and that the relatively small increase in surface area is easily accommodated.

As can be seen on the plan a large part of the site is unmade ground and no waste activities take place on these areas which are in essence no different from surrounding fields and therefore not relevant for this application.

The site buildings have a total roof area of c10,000m2, roof water is collected and used as site process water. Roof water from screening shed flows to the ditch as shown on the plan but future plans will divert this into tanks for site use. Any excess rain water not used for site purposes will be diverted to lagoon 4 as shown on the plan. Site water is taken from lagoon 4 and only in very wet periods will water discharge to ditch from lagoon 4.

All outside areas where waste activities take place are on sealed impermeable pavement and water runoff from these is considered ‘dirty’ and needs to be treated. Water flows into Lagoon 1, 2 and 3, then goes through the treatment plant which discharges to ditch under a discharge consent of up to 100m^3 per day.

Prior to the planning approval the site had some 25,000m^2 of exposed sealed surface which if compared to a car park would indeed generate a significant runoff in the event of significant rainfall.
However as can be seen on the plan approximately 20,000m^2 of this area is covered in maturing compost (shown as compost windrows on the plan)

Compost is extremely absorbent and during the stabilising phase on the pad uses significant volumes of clean water which is taken from lagoon 4. The compost operation is a continuous process with sanitised compost coming out from the IVC in batches every few days, formed into windrows, turned regularly on the pad taking approximately 8 weeks to convert the input material into product and dispatched off site on a regular basis. The site processes some 100,000 tonnes per annum so the compost area is always full.
In reality there is minimal runoff from the compost pad but to provide an adequate safeguard, area calculations are based on 50% of the covered area, in other words 20,000m^2 of pad covered in compost is equivalent to 10,000m^2 of open sealed surface. The remaining area of surface is therefore 5,000m^2.This gives us a total area of surface of 15,000m^2 from which water runoff is managed through the lagoons and treatment plant.

Taking into account an extreme rain event for this location for say 60mm of rain in a 48 hour period would generate a volume of 15,000 * 0.060 = 1,125m^3, capacity of lagoons is 5,855m^3 thus showing there is plenty of capacity.
It is worth stating the site in its current form has never had any issues with surface water management despite some significant rain events in recent years.

Current Area

Area m2	Rain fall m3	Volume m3
15,000	0.060	900

Effect of additional surface

Area m2	Rain fall m3	Volume m3
1,000	0.060	60
5,000	0.060	300

As can be seen from the table for current surface area for a 60mm rain event some 900m^3 can be expected to flow into the lagoons. For clarity and as shown on the plan surface water flows into lagoon 1 which is linked to lagoon 2 and then finally into lagoon 3 which is then pumped as required through the treatment plant.
Obviously each additional open area of 1,000m^2 generates 60m^3 and therefore the additional 5,000m^2 would in this extreme scenario generate 300m^3.

Historic site data indicates that 100mm of rainfall in one month is an unusually wet month and only occasionally has there been 15mm or more in one day. Taking into account extreme weather events, climate chaos (change) 60mm would be an extreme event and if this did happen there would be catastrophic flooding across the region!

The current management system maintains the lagoons with minimal water levels to ensure sufficient buffering capacity in wet periods. The water treatment plant can process up to 100m^3 per day. As can be seen from table below total storage capacity is 5,855m^3.
On a day to day basis the lagoons are maintained at no more than 50% of their capacity which therefore provides storage for an additional c2,800m^3 which is more than enough for an extreme wet period. See table below.

Lagoon capacity for ‘dirty’ water

	Length m	Width m	Lagoon area (1/2 depth) m2	Lagoon depth	Storage depth	Lagoon capacity m3
Lagoon 1	28	20	560	3.0	2.25	1,260
Lagoon 2	30	24	720	3.0	2.25	1,620
Total 1+2						**2,880**
Lagoon 3	36	19	684	5.1	4.35	2,975
Totals						**5,855**

Water flows from 1 & 2 to 3 which then leads to the treatment plant and is discharged at a rate of up to 100m^3 per day to ditch as shown on the plan under a discharge consent.

Lagoon 4 clean water

Clean water lagoon has a capacity of 3,500m^3

As previously stated the area of roofs across various buildings is some 10,000m^2 albeit currently roof water from the screening plant building goes straight into the ditch as shown on the plan, reaming roof water is directed into tanks for use on site or discharged into the surface water lagoon. Water from this lagoon is used for site process water, site procedures aim to keep the lagoon about 50% full to ensure a good supply for site operations and minimise the use of mains water. In the event of the lagoon becoming close to maximum capacity water would be released gradually into the ditch system.

It is important to stress this is an unlikely event as the site has a very high demand for water.

Summary

This is an existing waste site that has had no history of flooding as a compost site, current proposals are for minimal new surfaced areas (less than 20% increase) with the majority of new waste activities taking place within buildings. It is clear that existing measures and infrastructure are sufficient to manage an extreme rain event in light of climate change in so far as it is possible to predict extreme events. Given the site has never experienced more than 30mm of rain in a 48 hour period or indeed 100mm in a month a figure of 60mm in 48 hours builds in significant safeguard factor.

Envar Composting December 2017

APPENDIX 3050/FRA/A3

Surface run-off calculations

Greenfield Runoff Estimate for Pre-Development Area = Discharge Constraint

Institute of hydrology report no. 124 (IH124)

$$Q_{BAR(rural)} = 0.00108AREA^{0.89}SAAR^{1.17}SOIL^{2.17}$$

Where:

$Q_{BAR(rural)}$	mean annual flood (return period 2.3 years) (m^3/s)
AREA	catchment area (km^2)
SAAR(4170)	standard average rainfall for the period 1941 to 1970 (mm)
SOIL	soil index

$Q_{BAR(rural)}$ can be factored by the UK Flood Studies Report regional growth curves to produce peak flood flows for any return period.

if Qo

(

Parameters		
Area	0.042340	km^2
SAAR	539	
SOIL	0.47	
FSR region	5	
Return period	2	
Growth curve factor	0.89	

Results	
QBAR(rural)	15.06 l/s
Q (1in1yr)*	12.80 l/s
QBAR(rural)	3.6 l/s/ha
Q (1in1yr)	3.0 l/s/ha
Q (1in100yr)	12.7 l/s/ha

NB: calculation based on 0.5 km2 and then scaled down to actual catchment size. The IH124 methodology is designed for sites > 0.5 km2 but can be linearly interpolated to represent smaller catchments.

Q (1in1yr)*: approximate calculation using a ratio of 0.85 (*R&D Technical Report W5-074/A Preliminary Rainfall Runoff Management For Developments. Revision D - January 2012*)

Return period (yr)	**2**	**5**	**10**	**30**	**50**	**100**	**200**
Q (l/s/ha)	3.2	4.6	5.9	9.1	10.1	12.7	15.9
Q (l/s)	**13.40**	19.42	24.84	38.39	42.61	53.60	67.15

hafrenwater environmental water management	Barkers Chambers Barker Street Shrewsbury, Shropshire SY1 1SB UK Tel: 01743 355770 www.hafrenwater.com	Client: **Envar**
Title:	Greenfield run-off rates from existing and proposed positively drained 'clean' areas	
Project:	The Heath, Dry Anaerobic Digester and Incinerator facility	
Calc Sheet:		Date: Mar-21

P:\Projects\The Heath, Woodhurst (3050)\Working\Runoff and Retention Storage - vers3/Pre-Dev IH124 clean

Greenfield Runoff Estimate for Pre-Development Area = Discharge Constraint

Institute of hydrology report no. 124 (IH124)

$$Q_{BAR(rural)} = 0.00108 AREA^{0.89} SAAR^{1.17} SOIL^{2.17}$$

Where:

$Q_{BAR(rural)}$	mean annual flood (return period 2.3 years) (m^3/s)
AREA	catchment area (km^2)
SAAR(4170)	standard average rainfall for the period 1941 to 1970 (mm)
SOIL	soil index

$Q_{BAR(rural)}$ can be factored by the UK Flood Studies Report regional growth curves to produce peak flood flows for any return period.

if Qo

Parameters	
Area	0.115670 km^2
SAAR	539
SOIL	0.47
FSR region	5
Return period	2
Growth curve factor	0.89

Results	
QBAR(rural)	41.13 l/s
Q (1in1yr)*	34.96 l/s
QBAR(rural)	3.6 l/s/ha
Q (1in1yr)	3.0 l/s/ha
Q (1in100yr)	12.7 l/s/ha

NB: calculation based on 0.5 km2 and then scaled down to actual catchment size. The IH124 methodology is designed for sites > 0.5 km2 but can be linearly interpolated to represent smaller catchments.

Q (1in1yr)*: approximate calculation using a ratio of 0.85 (*R&D Technical Report W5-074/A Preliminary Rainfall Runoff Management For Developments. Revision D - January 2012*)

Return period (yr)	**2**	**5**	**10**	**30**	**50**	**100**	**200**
Q (l/s/ha)	3.2	4.6	5.9	9.1	10.1	12.7	15.9
Q (l/s)	**36.61**	53.06	67.87	104.88	116.40	146.43	183.44

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www.hafrenwater.com

Client: **Envar**

Title: Greenfield run-off rates from existing and proposed positively drained 'dirty' areas

Project: The Heath, Dry Anaerobic Digester and Incinerator facility

Calc Sheet:

Date: Mar-21

Required Storage Retention Volume - 1-in-100-year 48hr storm + CC

	Existing and New Hardstanding {to lagoons 1,2,3}	New Roads {to new lagoon}	Existing and New Roofs {to new lagoon}	New Lagoon	Compost Pad {to lagoons 1,2,3}
Runoff Coefficient	0.75	0.80	0.90	1.00	1.00
Area Ha	0	0.9930	2.9510	0.2900	0.0000

Climate change (% rainfall increase)	40	%

IH124 Estimate of QBAR Greenfield Discharge 0.0 l/s

Groundwater Inflow Rate (-ve for Outflow) 0.0 l/s

The Rational Method to give peak flow Q_p is in

$$Q_p = 2.78\, CiA$$

Where:

C co-efficient of run-off (dimensionless)
i rainfall intensity (mm/hr)
A catchment area (Ha)

Duration	Rainfall *2	Rainfall intensity	Runoff from Hardstanding *3	Runoff from Roads *3	Runoff from Roofs *3	Runoff from Lagoons *3	Runoff from Compost Pad *3	Discharge to Watercourse *3	Net Inflow to Storage
	100 year event								
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	l/s	l/s
0.25	32.5	130.0	0	402	1344	147	0	0	1893
0.5	41.9	83.9	0	259	867	95	0	0	1221
1	51.3	51.3	0	159	530	58	0	0	746
2	65.2	32.6	0	101	337	37	0	0	474
4	79.7	19.9	0	62	206	23	0	0	290
6	87.3	14.5	0	45	150	16	0	0	212
8	91.8	11.5	0	35	119	13	0	0	167
12	97.2	8.1	0	25	84	9	0	0	118
16	100.2	6.3	0	19	65	7	0	0	91
20	102.3	5.1	0	16	53	6	0	0	74
24	103.8	4.3	0	13	45	5	0	0	63
36	106.8	3.0	0	9	31	3	0	0	43
48	108.9	2.3	0	7	23	3	0	0	33
60	110.7	1.8	0	6	19	2	0	0	27
72	112.4	1.6	0	5	16	2	0	0	23
84	114.1	1.4	0	4	14	2	0	0	20
96	115.6	1.2	0	4	12	1	0	0	18

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Client: **Envar**

Title: Runoff rates and retention volumes for new site's clean areas {including existing site drainage}

Project: The Heath, Dry Anaerobic Digester and Incinerator facility

Calc Sheet: | Date: Apr-21

Required Storage Retention Volume - 1-in-100-year 48hr storm + CC

	Existing and New Hardstanding {to lagoons 1,2,3}	New Roads {to new lagoon}	Existing and New Roofs {to new lagoon}	New Lagoons {Lagoons 1,2,3}	Compost Pad {to lagoons 1,2,3}
Runoff Coefficient	0.75	0.80	0.90	1.00	1.00
Area Ha	8.712	0	0	0.9256	1.9850

Climate change (% rainfall increase)	40	%

IH124 Estimate of QBAR Greenfield Discharge 0.0 l/s

Groundwater Inflow Rate (-ve for Outflow) 0.0 l/s

The Rational Method to give peak flow Q_p is in

$$Q_p = 2.78\ CiA$$

Where:

C co-efficient of run-off (dimensionless)
i rainfall intensity (mm/hr)
A catchment area (Ha)

Duration	Rainfall *2	Rainfall intensity	Runoff from Hardstanding *3	Runoff from Roads *3	Runoff from Roofs *3	Runoff from Lagoons *3	Runoff from Compost Pad *3	Discharge to Watercourse *3	Net Inflow to Storage
	100 year event								
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	l/s	l/s
0.25	32.5	130.0	3307	0	0	468	1005	0.0	4780
0.5	41.9	83.9	2133	0	0	302	648	0.0	3083
1	51.3	51.3	1304	0	0	185	396	0.0	1885
2	65.2	32.6	829	0	0	117	252	0.0	1198
4	79.7	19.9	507	0	0	72	154	0.0	733
6	87.3	14.5	370	0	0	52	112	0.0	535
8	91.8	11.5	292	0	0	41	89	0.0	422
12	97.2	8.1	206	0	0	29	63	0.0	298
16	100.2	6.3	159	0	0	23	48	0.0	230
20	102.3	5.1	130	0	0	18	40	0.0	188
24	103.8	4.3	110	0	0	16	33	0.0	159
36	106.8	3.0	75	0	0	11	23	0.0	109
48	108.9	2.3	58	0	0	8	18	0.0	83
60	110.7	1.8	47	0	0	7	14	0.0	68
72	112.4	1.6	40	0	0	6	12	0.0	57
84	114.1	1.4	35	0	0	5	10	0.0	50
96	115.6	1.2	31	0	0	4	9	0.0	44

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Title: Runoff rates and retention volumes for new site's dirty areas {including existing site drainage}

Project: The Heath, Dry Anaerobic Digester and Incinerator facility

Calc Sheet: Date: Apr-21

APPENDIX 3050/FRA/A4

Cambridgeshire County Council proforma

Appendix F Surface water drainage pro-forma

Applicants should complete this form and submit it to the LPA, referencing from where in their submission documents this information is taken. The proforma is supported by the DEFRA/ EA guidance on Rainfall Runoff Management. and uses the storage calculator on www.UKsuds.com. The proforma should be considered alongside other supporting SuDS Guidance, but focuses on ensuring flood risk is not made worse elsewhere. This proforma is based upon current industry standard practice.

1. Site details

Site	DRY ANAEROBIC DIGESTION FACILITY AND CLINICAL WASTE INCINERATOR
Address & post code or LPA reference	THE HEATH, WOODHURST. CAMBRIDGESHIRE. PE28 3BS
Grid Reference	TL 33406 75296
Is the existing site developed or Greenfield?	MIXED DEVELOPED AND GREENFIELD
Total Site Area served by drainage system (excluding open space) (Ha)[1]	15.9 Ha

1. The Greenfield runoff off rate from the development which is to be used for assessing the requirements for limiting discharge flow rates and attenuation storage from a site should be calculated for the area that forms the drainage network for the site whatever size of site and type of drainage technique. Please refer to the Rainfall Runoff Management document or CIRIA manual for detail on this.

2. Impermeable area

	Existing	Proposed	Difference (Proposed-Existing)	Notes for developers and Local Authorities
Impermeable area (ha)	8.2 Ha	15.9 Ha	7.7 Ha	If proposed > existing, then runoff rates and volumes will be increasing. Section 6 must be filled in. If proposed ≤ existing, then section 6 can be skipped & section 7 filled in.
Drainage Method (infiltration/sewer/watercourse)	Storage and re-use	Storage and re-use	N/A	If different from the existing, please fill in section 3. If existing drainage is by infiltration and the proposed is not, discharge volumes may increase. Fill in section 6.

Note: The proposed site (15.9 Ha) will include 7.9 ha of new low permeability surfaces which will overlap with some low permeability areas of the existing site. Therefore, the difference 7.7 ha is < 7.9 ha. The combined area will be managed by a common drainage system.

3. Proposing to discharge surface water via

	Yes	No	Evidence that this is possible	Notes for developers and Local Authorities
Infiltration				e.g. soakage tests. Section 6 (infiltration) must be filled in if infiltration is proposed.
To watercourse	Yes		Existing approved drainage scheme	e.g. Is there a watercourse nearby?
To surface water sewer				Confirmation from sewer provider that sufficient capacity exists for this connection.
Combination of above				e.g. part infiltration part discharge to sewer or watercourse. Provide evidence above.

4. Peak Discharge Rates[1]

	Existing rates (l/s)	Proposed rates (l/s)	Difference (l/s) (Proposed-Existing)	Notes for developers and Local Authorities
Greenfield QBAR	29	N/A	N/A	QBAR is approx. 1 in 2 storm event. Provide this if Section 6 (QBAR) is proposed.
1 in 1				Proposed discharge rates (with mitigation) should be no greater than existing rates for all corresponding storm events. e.g. discharging all flow from site at the existing 1 in 100 event increases flood risk during smaller events.
1 in 30	33	62	see note	
1 in 100	44	83	see note	
1 in 100 + climate change	N/A	116	see note	To mitigate for climate change the proposed 1 in 100 +CC must be no greater than the existing 1 in 100 runoff rate. If not, flood risk increases under climate change. 30% should be added to the peak rainfall intensity.

1. This is the maximum flow rate at which storm water runoff leaves the site during a particular storm event.

Note: Site can currently discharge at a licenced rate of 100 m3 /24 hours (1.4 l/s) with no stated maximum rate. It is intended to store water on site during storm events up to and including 48-hour 1 in 100-yr + 40% and subsequently re-use or discharge stored water at the licensed rate.

5. Calculate additional volumes for storage[1]

	Existing volume (m^3)	Proposed volume (m^3)	Difference (m^3) (Proposed-Existing)	Notes for developers and Local Authorities
1 in 1				Proposed discharge volumes (without mitigation) should be no greater than existing volumes for all corresponding storm events. Any increase in volume increases flood risk elsewhere. Where volumes are increased section 6 must be filled in.
1 in 30	5700	10,780	see note	
1 in 100	7600	14,370	see note	
1 in 100 + climate change	N/A	20,120	see note	To mitigate for climate change the volume discharge from site must be no greater than the existing 1 in 100 storm event. If not, flood risk increases under climate change.

1. The total volume of water leaving the development site. New hard surfaces potentially restrict the amount of storm water that can go to the ground, so this needs to be controlled so not to make flood risk worse to properties downstream.

6. Calculate attenuation storage[1]

		Notes for developers and Local Authorities
Storage Attenuation volume (Flow rate control) required to retain rates as existing (m^3)	20,120 m3 see note	Volume of water to attenuate on site if discharging at existing rates. Can't be used where discharge volumes are increasing

1. Attenuation storage is provided to enable the rate of runoff from the site into the receiving watercourse to be limited to an acceptable rate to protect against erosion and flooding downstream. The attenuation storage volume is a function of the degree of development relative to the greenfield discharge rate.

Note: Site can currently discharge at a licensed rate of 100 m3 /24 hours (200 m3 / 48 hrs) with no stated maximum rate. It is intended to continue to store water on site during storm events up to and including 48-hour 100yr +40% and re-use or discharge at licensed rate afterwards

7. How is Storm Water stored on site?[(1)]

			Notes for developers and Local Authorities
Infiltration	State the Site's Geology and known Source Protection Zones (SPZ)	Diamicton overlying mudstone bedrock	Avoid infiltrating in made ground. Infiltration rates are highly variable and refer to Environment Agency website to identify and source protection zones (SPZ)
	Are infiltration rates suitable?	Not known but likely to be very low	Infiltration rates should be no lower than $1x10^{-6}$ m/s.
	State the distance between a proposed infiltration device base and the ground water (GW) level	Not known but likely to >2m	Need 1m (min) between the base of the infiltration device & the water table to protect Groundwater quality & ensure GW doesn't enter infiltration devices. Avoid infiltration where this isn't possible.
	Were infiltration rates obtained by desk study or infiltration test?	Desk study	Infiltration rates can be estimated from desk studies at most stages of the planning system if a backup attenuation scheme is provided.
	Is the site contaminated? If yes, consider advice from others on whether infiltration can happen.	Unlikely	Water should not be infiltrated through land that is contaminated. The Environment Agency may provide bespoke advice in planning consultations for contaminated sites that should be considered.
In light of the above, is infiltration feasible?	Yes/No? If the answer is No, please identify how the storm water will be stored prior to release	No, stored in lagoons	If infiltration is not feasible how will the additional volume be stored? The applicant should then consider the following options in the next section.

1. Storage is required for the additional volume from site but also for holding back water to slow down the rate from the site. This is known as attenuation storage and long term storage. The idea is that the additional volume does not get into the watercourses, or if it does it is at an exceptionally low rate. You can either infiltrate the stored water back to ground, or if this isn't possible hold it back with on-site storage. Firstly, can infiltration work on site?

Storage requirements

The developer must confirm that either of the two methods for dealing with the amount of water that needs to be stored on site.

- **Option 1 Simple:**
  Store both the additional volume and attenuation volume in order to make a final discharge from site at QBAR (Mean annual flow rate). This is preferred if no infiltration can be made on site. This very simply satisfies the runoff rates and volume criteria.
- **Option 2 Complex:**
  If some of the additional volume of water can be infiltrated back into the ground, the remainder can be discharged at a very low rate of 2 l/sec/hectare. A combined storage calculation using the partial permissible rate of 2 l/sec/hectare and the attenuation rate used to slow the runoff from site.

		Notes for developers and Local Authorities
Please confirm what option has been chosen and how much storage is required on site.	Option1 Simple	The developer at this stage should have an idea of the site characteristics and be able to explain what the storage requirements are on site and how it will be achieved.

8. Please confirm

		Notes for developers and Local Authorities
Which SuDS measures have been used?	Above ground storage	SuDS can be adapted for most situations even where infiltration isn't feasible e.g. impermeable liners beneath some SUDS devices allows treatment but not infiltration. See CIRIA SUDS Manual C697.
Drainage system can contain in the 1 in 30 storm event without flooding	Yes	This a requirement for sewers for adoption & is good practice even where drainage system is not adopted.
Any flooding between the 1 in 30 & 1 in 100 plus climate change storm events will be safely contained on site.	Yes	Safely: not causing property flooding or posing a hazard to site users i.e. no deeper than 300mm on roads/footpaths. Flood waters must drain away at section 6 rates. Existing rates can be used where runoff volumes are not increased.
How are rates being restricted (hydrobrake etc)	Licensed discharge via suitably sized pipe	Hydrobrakes to be used where rates are between 2l/s to 5l/s. Orifices may not work below 5l/s as the pipes may block. Pipes with flows < 2l/s are prone to blockage but this can be overcome with careful product selection and SuDS design.

		Notes for developers and Local Authorities
Please confirm the owners/adopters of the SuDS throughout the development. Please list all the owners.	Envar	If these are multiple owners then a drawing illustrating exactly what features will be within each owner's remit must be submitted with this Proforma.
How are the entire SuDS to be maintained?	Yes, details to be provided at later stage of planning	If the features are to be maintained directly by the owners as stated in answer to the above question please answer yes to this question and submit the relevant maintenance schedule for each feature. If it is to be maintained by others than above please give details of each feature and the maintenance schedule. Clear details of the maintenance proposals of all element of the proposed drainage system must be provided. Poorly maintained drainage can lead to increased flooding problems in the future.

9. Evidence

Pro-forma Section	Document reference where details quoted above are taken from:	Page Number
2	FRA Report (ref 3050/FRA D1, Hafren Water, March 2021) Drawings 3050/FRA/04 & 05	
3	FRA Report (ref 3050/FRA D1, Hafren Water, March 2021) Section 2.5.2 and Appendix 3050/FRA/A2	
4	See attachment	
5	See attachment	
6	FRA Report (ref 3050/FRA D1, Hafren Water, March 2021) Section 5.2.2 and Section 5.3	
7	FRA Report (ref 3050/FRA D1, Hafren Water, March 2021) Section 2.4	

The above form should be completed using evidence from the Flood Risk Assessment where applicable, surface water drainage strategy and site plans. It should serve as a summary sheet of the drainage proposals and should clearly show that the proposed rate and volume as a result of development will not be increasing. If there is an increase in rate or volume, the rate or volume section should be completed to set out how the additional rate/volume is being dealt with.

This form is completed using factual information from the Flood Risk Assessment and Site Plans and can be used as a summary of the surface water drainage strategy on this site.

Form completed by:	P Dunn
Qualification of person responsible for signing off this pro-forma:	Hydrologist, MSc
Company:	Hafren Water
On behalf of (Client's details):	Envar
Date:	16 April 2021

Required Storage Retention Volume - 1-in-30-year 48hr storm

	Existing Hardstanding	Existing Roads	Existing Roofs	Existing Lagoons	Existing Compost Pad
Runoff Coefficient	0.75	0.80	0.90	1.00	1.00
Area Ha	4.477	0	1.4510	0.3260	1.9850

The Rational Method to give peak flow Q_p is in

$$Q_p = 2.78\ CiA$$

Where:

C co-efficient of run-off (dimensionless)
i rainfall intensity (mm/hr)
A catchment area (Ha)

Climate change (% rainfall increase)	0	%

IH124 Estimate of QBAR Greenfield Discharge	0.0	l/s
Groundwater Inflow Rate (-ve for Outflow)	0.0	l/s

Duration	Rainfall *[2]	Rainfall intensity	Runoff from Hardstanding *[3]	Runoff from Roads *[3]	Runoff from Roofs *[3]	Runoff from Lagoons *[3]	Runoff from Compost Pad *[3]	Discharge to Watercourse *[3]	Net Inflow to Storage
	30 year event								
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	l/s	l/s
0.25	24.2	96.7	903	0	351	88	534	0	1875
0.5	30.9	61.9	577	0	225	56	341	0	1199
1	37.6	37.6	351	0	136	34	207	0	728
2	47.4	23.7	221	0	86	21	131	0	459
4	57.4	14.4	134	0	52	13	79	0	278
6	62.7	10.5	98	0	38	9	58	0	203
8	66.0	8.3	77	0	30	7	46	0	160
12	70.1	5.8	55	0	21	5	32	0	113
16	72.6	4.5	42	0	16	4	25	0	88
20	74.4	3.7	35	0	14	3	21	0	72
24	75.9	3.2	30	0	11	3	17	0	61
36	79.1	2.2	21	0	8	2	12	0	43
48	81.7	1.7	16	0	6	2	9	0	33
60	84.0	1.4	13	0	5	1	8	0	27
72	86.2	1.2	11	0	4	1	7	0	23
84	88.3	1.1	10	0	4	1	6	0	20
96	90.3	0.9	9	0	3	1	5	0	18

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Client: **Envar**

Title: Runoff rates and retention volumes for existing site

Project: The Heath, Dry Anaerobic Digester and Incinerator facility

Calc Sheet: Date: Apr-21

Required Storage Retention Volume - 1-in-100-year 48hr storm

		Existing Hardstanding	Existing Roads	Existing Roofs	Existing Lagoons	Existing Compost Pad
Runoff Coefficient		0.75	0.80	0.90	1.00	1.00
Area	Ha	4.477	0	1.4510	0.3260	1.9850

The Rational Method to give peak flow Q_p is in

$$Q_p = 2.78\ CiA$$

Where:

C	co-efficient of run-off (dimensionless)
i	rainfall intensity (mm/hr)
A	catchment area (Ha)

Climate change (% rainfall increase)	0	%

	IH124 Estimate of QBAR Greenfield Discharge	0.0	l/s
	Groundwater Inflow Rate (-ve for Outflow)	0.0	l/s

	Rainfall *2	Rainfall intensity	Runoff from Hardstanding *3	Runoff from Roads *3	Runoff from Roofs *3	Runoff from Lagoons *3	Runoff from Compost Pad *3	Discharge to Watercourse *3	Net Inflow to Storage
Duration	**100 year event**								
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	l/s	l/s
0.25	32.5	130.0	1214	0	472	118	718	0	2521
0.5	41.9	83.9	783	0	305	76	463	0	1626
1	51.3	51.3	479	0	186	46	283	0	994
2	65.2	32.6	304	0	118	30	180	0	632
4	79.7	19.9	186	0	72	18	110	0	387
6	87.3	14.5	136	0	53	13	80	0	282
8	91.8	11.5	107	0	42	10	63	0	223
12	97.2	8.1	76	0	29	7	45	0	157
16	100.2	6.3	58	0	23	6	35	0	121
20	102.3	5.1	48	0	19	5	28	0	99
24	103.8	4.3	40	0	16	4	24	0	84
36	106.8	3.0	28	0	11	3	16	0	57
48	108.9	2.3	21	0	8	2	13	0	44
60	110.7	1.8	17	0	7	2	10	0	36
72	112.4	1.6	15	0	6	1	9	0	30
84	114.1	1.4	13	0	5	1	7	0	26
96	115.6	1.2	11	0	4	1	7	0	23

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Client:	**Envar**	
Title:	Runoff rates and retention volumes for existing site	
Project:	The Heath, Dry Anaerobic Digester and Incinerator facility	
Calc Sheet:		Date: Apr-21

Required Storage Retention Volume - 1-in-30-year 48hr storm

	Existing and New Hardstanding {to lagoons 1,2,3}	New Roads {to new lagoon}	Existing and New Roofs {to new lagoon}	New Lagoons	Existing Compost Pad {to lagoons 1,2,3}
Runoff Coefficient	0.75	0.80	0.90	1.00	1.00
Area Ha	8.712	0.9930	2.9510	1.2156	1.9850

Climate change (% rainfall increase)	0	%

IH124 Estimate of QBAR Greenfield Discharge	0.0	l/s
Groundwater Inflow Rate (-ve for Outflow)	0.0	l/s

The Rational Method to give peak flow Q_p is in

$$Q_p = 2.78 CiA$$

Where:

C	co-efficient of run-off (dimensionless)
i	rainfall intensity (mm/hr)
A	catchment area (Ha)

Duration	Rainfall *2	Rainfall intensity	Runoff from Hardstanding *3	Runoff from Roads *3	Runoff from Roofs *3	Runoff from Lagoons *3	Runoff from Compost Pad *3	Discharge to Watercourse *3	Net Inflow to Storage
	30 year event								
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	l/s	l/s
0.25	24.2	96.7	1757	214	714	327	534	0	3545
0.5	30.9	61.9	1124	137	457	209	341	0	2267
1	37.6	37.6	682	83	277	127	207	0	1377
2	47.4	23.7	430	52	175	80	131	0	868
4	57.4	14.4	261	32	106	49	79	0	526
6	62.7	10.5	190	23	77	35	58	0	383
8	66.0	8.3	150	18	61	28	46	0	302
12	70.1	5.8	106	13	43	20	32	0	214
16	72.6	4.5	82	10	34	15	25	0	166
20	74.4	3.7	68	8	27	13	21	0	136
24	75.9	3.2	57	7	23	11	17	0	116
36	79.1	2.2	40	5	16	7	12	0	81
48	81.7	1.7	31	4	13	6	9	0	62
60	84.0	1.4	25	3	10	5	8	0	51
72	86.2	1.2	22	3	9	4	7	0	44
84	88.3	1.1	19	2	8	4	6	0	39
96	90.3	0.9	17	2	7	3	5	0	34

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Title: Runoff rates and retention volumes for new site {including existing site drainage area}

Project: The Heath, Dry Anaerobic Digester and Incinerator facility

Calc Sheet: Date: Apr-21

Required Storage Retention Volume - 1-in-100-year 48hr storm

	Existing and New Hardstanding {to lagoons 1,2,3}	New Roads {to new lagoon}	Existing and New Roofs {to new lagoon}	New Lagoons	Existing Compost Pad {to lagoons 1,2,3}
Runoff Coefficient	0.75	0.80	0.90	1.00	1.00
Area Ha	8.712	0.9930	2.9510	1.2156	1.9850

The Rational Method to give peak flow Q_p is in

$$Q_p = 2.78\ CiA$$

Where:

C co-efficient of run-off (dimensionless)
i rainfall intensity (mm/hr)
A catchment area (Ha)

Climate change (% rainfall increase)	0	%

	IH124 Estimate of QBAR Greenfield Discharge	0.0	l/s
	Groundwater Inflow Rate (-ve for Outflow)	0.0	l/s

	Rainfall *2	Rainfall intensity	Runoff from Hardstanding *3	Runoff from Roads *3	Runoff from Roofs *3	Runoff from Lagoons *3	Runoff from Compost Pad *3	Discharge to Watercourse *3	Net Inflow to Storage
Duration	**100 year event**								
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	l/s	l/s
0.25	32.5	130.0	2362	287	960	439	718	0	4766
0.5	41.9	83.9	1524	185	619	283	463	0	3075
1	51.3	51.3	931	113	379	173	283	0	1880
2	65.2	32.6	592	72	241	110	180	0	1194
4	79.7	19.9	362	44	147	67	110	0	731
6	87.3	14.5	264	32	107	49	80	0	533
8	91.8	11.5	209	25	85	39	63	0	421
12	97.2	8.1	147	18	60	27	45	0	297
16	100.2	6.3	114	14	46	21	35	0	230
20	102.3	5.1	93	11	38	17	28	0	187
24	103.8	4.3	79	10	32	15	24	0	159
36	106.8	3.0	54	7	22	10	16	0	109
48	108.9	2.3	41	5	17	8	13	0	83
60	110.7	1.8	34	4	14	6	10	0	68
72	112.4	1.6	28	3	12	5	9	0	57
84	114.1	1.4	25	3	10	5	7	0	50
96	115.6	1.2	22	3	9	4	7	0	44

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Client: **Envar**

Title: Runoff rates and retention volumes for new site {including existing site drainage area}

Project: The Heath, Dry Anaerobic Digester and Incinerator facility

Calc Sheet: Date: Apr-21

Required Storage Retention Volume - 1-in-100-year 48hr storm + CC

	Existing and New Hardstanding	New Roads	Existing and New Roofs	New Lagoons	Existing Compost Pad
Runoff Coefficient	0.75	0.80	0.90	1.00	1.00
Area Ha	8.712	0.9930	2.9510	1.2156	1.9850

The Rational Method to give peak flow Q_p is in

$$Q_p = 2.78 CiA$$

Where:

C co-efficient of run-off (dimensionless)
i rainfall intensity (mm/hr)
A catchment area (Ha)

Climate change (% rainfall increase)	40	%

IH124 Estimate of QBAR Greenfield Discharge	0.0	l/s
Groundwater Inflow Rate (-ve for Outflow)	0.0	l/s

	Rainfall *2	Rainfall intensity	Runoff from Hardstanding *3	Runoff from Roads *3	Runoff from Roofs *3	Runoff from Lagoons *3	Runoff from Compost Pad *3	Discharge to Watercourse *3	Net Inflow to Storage
Duration	**100 year event**								
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	l/s	l/s
0.25	32.5	130.0	3307	402	1344	615	1005	0	6673
0.5	41.9	83.9	2133	259	867	397	648	0	4304
1	51.3	51.3	1304	159	530	243	396	0	2631
2	65.2	32.6	829	101	337	154	252	0	1672
4	79.7	19.9	507	62	206	94	154	0	1023
6	87.3	14.5	370	45	150	69	112	0	746
8	91.8	11.5	292	35	119	54	89	0	589
12	97.2	8.1	206	25	84	38	63	0	416
16	100.2	6.3	159	19	65	30	48	0	321
20	102.3	5.1	130	16	53	24	40	0	262
24	103.8	4.3	110	13	45	20	33	0	222
36	106.8	3.0	75	9	31	14	23	0	152
48	108.9	2.3	58	7	23	11	18	0	116
60	110.7	1.8	47	6	19	9	14	0	95
72	112.4	1.6	40	5	16	7	12	0	80
84	114.1	1.4	35	4	14	6	10	0	70
96	115.6	1.2	31	4	12	6	9	0	62

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