Indaver Rivenhall IWMF DCO

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

OTHER DOCUMENTS [PINS Ref: EN0101038]

FLOOD RISK ASSESSMENT

Document Reference: EN0101038/APP/7.2

Revision Number 1.0

APFP Regulation 5(2)(e)

November 2023
Indaver Rivenhall Ltd

Leading the field in sustainable waste management.

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Acronyms and Abbreviations

CC	Climate Change
DCO	Development Consent Order
DTM	Digital Terrain Model
EA	Environment Agency
EfW	Energy from Waste
FGT	Flue Gas Treatment
FRA	Flood Risk Assessment
IWMF	Integrated Waste Management Facility
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
m aOD	meters above Ordnance Datum
MW	Megawatts
NGR	National Grid Reference
NPPF	National Planning Policy Framework
NSIP	Nationally Significant Infrastructure Project
PPG	Planning Practice Guidelines
SoS	Secretary of State
SPZ	Source Protection Zone
WWTP	Waste Water Treatment Plant

1.0 Executive Summary

1.1.1 This **Flood Risk Assessment ('FRA') (Doc Ref 7.2)** has been prepared on behalf of Indaver Rivenhall Ltd ('the Applicant') in support of an application ('the Application') for a Development Consent Order ('DCO') to be granted for the extension of the electrical generating capacity of the Rivenhall Integrated Waste Management Facility ('IWMF') ('the Proposed Development'). The Rivenhall IWMF is currently under construction pursuant to planning permission granted by Essex County Council, referred to as the 'Consented Scheme'.

1.1.2 This **FRA** report has been prepared in accordance with the advice and requirements prescribed in current best practice documents relating to management of flood risk in development, published by the Construction Industry Research and Information Association (CIRIA)[1], and British Standard BS85333. Regard has been had to the Overarching National Policy Statement (EN-1) ('NPS EN-1') with regard to flood risk, as well as relevant national and local planning policy.

1.1.3 This Site is not located close to any fluvial or tidal flood sources. The Consented Scheme is however located within an area of former quarrying with the platform set below much of the surrounding land. Surface water and groundwater runoff from some surrounding areas will drain through or towards the IWMF. The drainage systems that form part of the Consented Scheme, and which will not be amended by the Proposed Development, have been designed to reflect this with drainage installed into the cut faces around the IWMF and two water management lagoons created. A pumped discharge from these lagoons to the River Blackwater at or below greenfield rates will be established to manage the water levels within the lagoons.

1.1.4 A range of potential sources of flooding including tidal, fluvial, sewers and water mains and from infrastructure failure were screened and it was concluded that the Site is located in Flood Zone 1 and that, given the proposed scheme design and the previously agreed drainage systems, the risk of flooding from all sources will be low. As such the Consented Scheme is considered acceptable in flood risk and would pass the Sequential Test and the Exception Test if they applied. The carrying out of the Proposed Development will have no effect on flood risk as compared to the Consented Scheme, either within the Site or elsewhere.

1 CIRIA Report C624, Development and flood risk: guidance for the construction industry

2.0 Introduction

2.1 Background

2.1.1 This **Flood Risk Assessment ('FRA') (Doc Ref 7.2)** has been prepared on behalf of Indaver Rivenhall Ltd ('the Applicant') in support of an application ('the Application') for a Development Consent Order ('DCO') to be granted for the extension of the electrical generating capacity of the Rivenhall Integrated Waste Management Facility ('IWMF') ('the Proposed Development').

2.1.2 The Rivenhall IWMF is currently under construction pursuant planning permission granted by Essex County Council in 2016 under section 73 of the Town and Country Planning Act 1990 (as amended).[2]

2.1.3 The Consented Scheme is expected to become operational in 2025. Further information on the Consented Scheme is set out in the **Environmental Statement ('ES') Volume 1, Chapter 2: Existing Site and Consented Scheme (Doc Ref 6.1)**. The full planning history of the Rivenhall IWMF is set out in the **Planning Statement (Doc Ref 7.1)**.

2.1.4 This DCO application seeks to allow the IWMF to generate more than 50 megawatts of electricity. This would be carried out through engineering operations to either: (1) replace restricted turbine inlet control valves installed as part of the Consented Scheme with unrestricted turbine inlet control valves; or (2) install unrestricted turbine inlet control valves. It relates to internal works only and will otherwise not change anything about the Consented Scheme, including how surface water is managed, water consumption and water discharge. Further information on the Proposed Development is contained in the **Environmental Statement ('ES') Volume 1, Chapter 3: Proposed Development and Construction (Doc Ref 6.1)** and the **Planning Statement (Doc Ref 7.1)**.

2.1.5 The Proposed Development falls under the definition of a Nationally Significant Infrastructure Project ('NSIP') within Sections 14(1)(a) of the Planning Act 2008 ('PA 2008'), being the extension of an onshore electricity generating station in England with an extended capacity of more than 50MW.

2.1.6 This **FRA** has been prepared under the direction of a Technical Director of Hydrology at SLR who specialises in flood risk and associated planning matters. Reporting has been completed in accordance with guidance presented within the National Planning Policy Framework[3] ('NPPF') and its associated Planning Practice Guidance[4] ('PPG'), taking due account of

2 Reference ESS/34/15/BTE, dated 26/02/2016.

3 Revised National Planning Policy Framework: Communities and Local Government (March 2012, Updated September 2023)

4 Planning Practice Guidance, Flood Risk and Coastal Change: Communities and Local Government (March 2014, Updated August 2022)

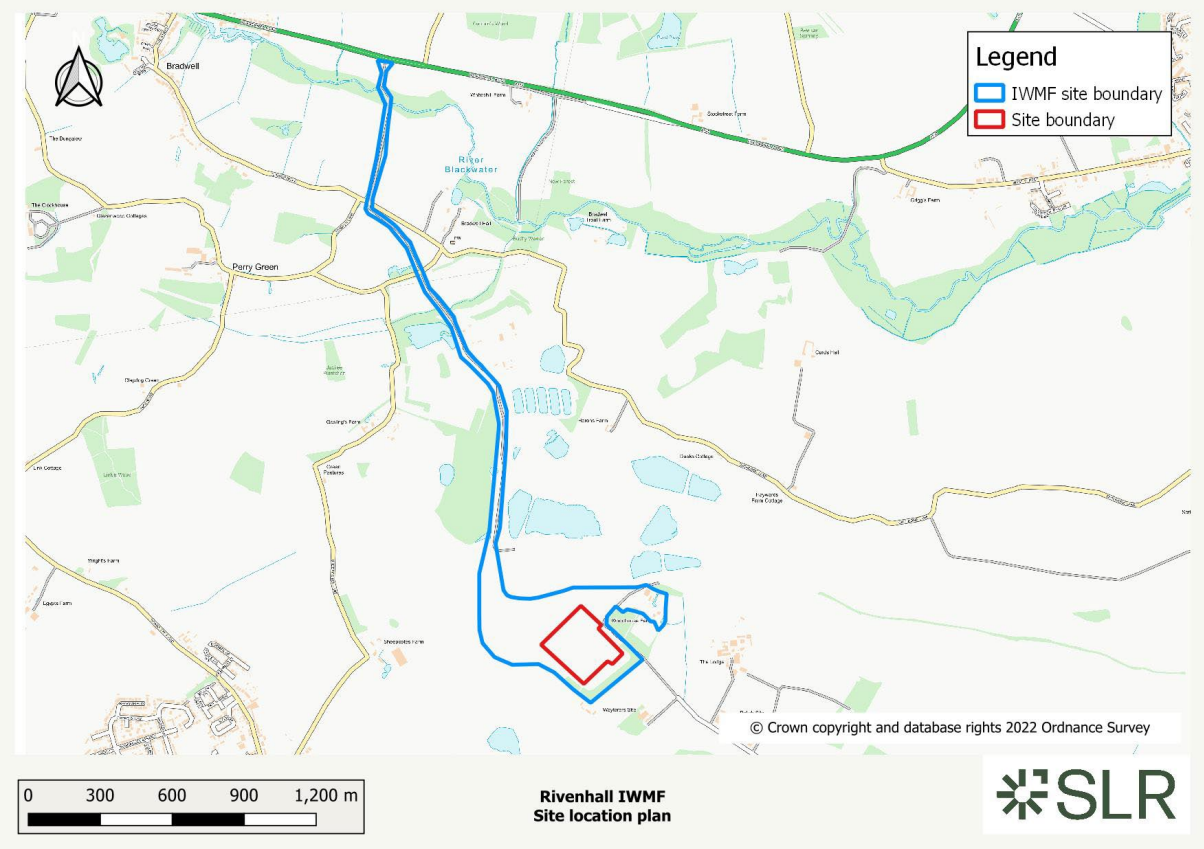
current best practice documents relating to the assessment of flood risk published by the British Standards Institution BS8533[5] and local planning policies.

2.2 Site location

2.2.1 The application Site covers an area of approximately 5.46 ha and is centred at National Grid Reference ('NGR') TL822204. A location plan is provided in Figure 2-1.

2.2.2 The Site is located 2.5 km southeast of the village of Bradwell. The IWMF is located in the southeastern corner of an existing area of quarrying operations with the Site itself forming part of the area that has previously been quarried.

Figure 2-1: Site location plan



5 BS8533:2017, Assessing and managing flood risk in development: Code of Practice (2nd Edition, December 2017)

2.3 Administrative context

2.3.1 As the generating capacity of the proposed development exceeds 50 MW, it is classified as a NSIP which requires a DCO to be granted by the Secretary of State ('SoS') for Energy Security and Net Zero.

2.3.2 Essex County Council are the planning authority in relation to the IWMF as it relates to waste development. Essex County Council are also the Lead Local Flood Authority ('LLFA') for the area.

3.0 Site details

3.1.1 The Site is located within an area that has previously been quarried. Satellite imagery, predating the start of construction on the Site, is provided in Figure 3-1.

Figure 3-1: Satellite imagery

3.2 Topography

3.2.1 Topographic data from on and around the Site, gathered using Light Detection and Ranging ('LiDAR') aerial photogrammetric techniques, has been downloaded from the Environment Agency ('EA') open data website[6] and is included as Figure 3-2. The data is the 1-metre Digital Terrain Model ('DTM') which excludes building surfaces and other built environment features.

3.2.2 The LiDAR survey indicates that the predominant slope direction locally is towards the north towards the River Blackwater, which is located 1.6 km to the north of the proposed IWMF at an elevation of approximately 27.8 m above Ordnance Datum ('m aOD').

3.2.3 Levels at the Site at the time of the LiDAR survey were approximately 49.0 m aOD, however the proposed development platform has now been lowered

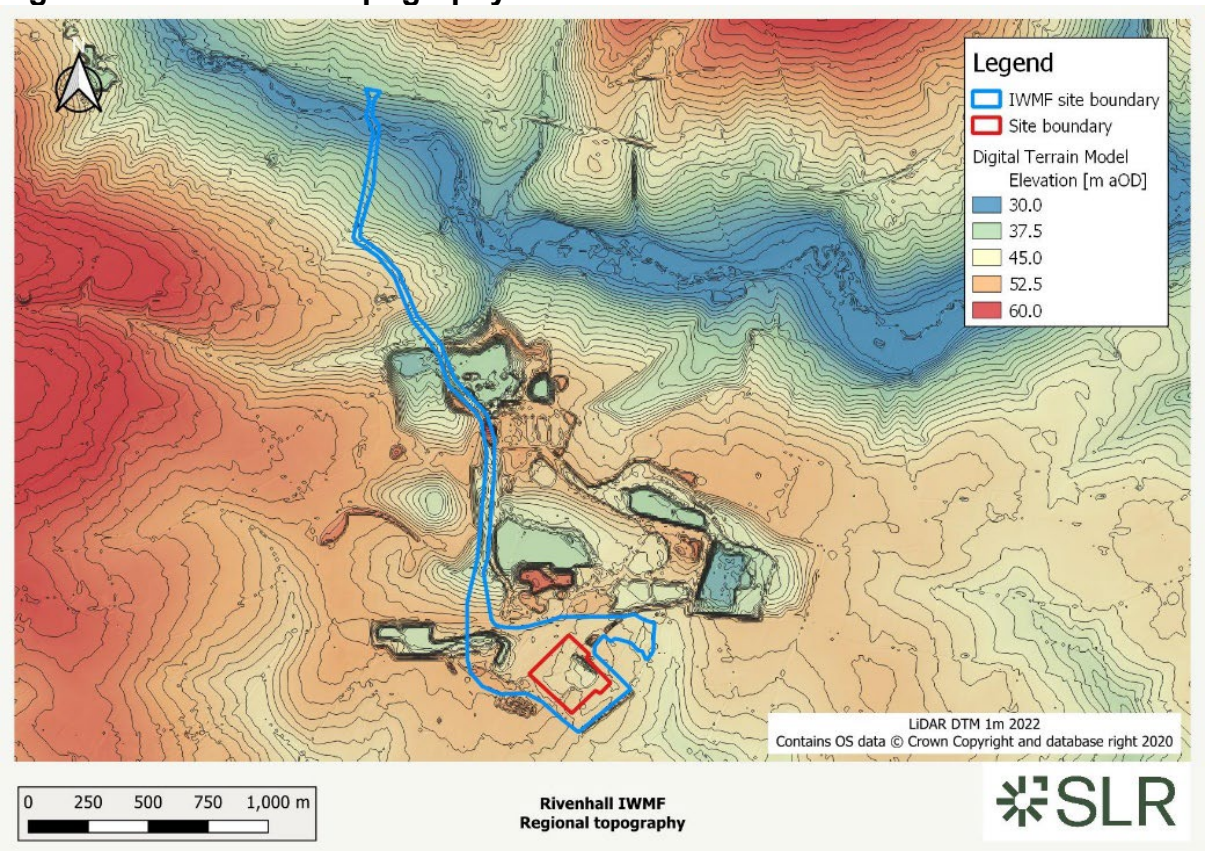
6 Environment Agency open data website. Available at: http://environment.data.gov.uk

to 35 m aOD with a small area set at 30 m aOD. As a result of ground between the proposed IWMF and the river being at an elevation of around 45 m aOD, there is no direct route for gravity discharge away from the Site to the river.

3.2.4 There is an area of higher elevated land located to the west of the Site that slopes in an easterly direction (towards the Site) from an elevation of approximately 64.0 m aOD about 2.1 km to the east of the Site.

3.2.5 There is a topographical ridge approximately 250 m to the south of the Site, aligned with the southwestern boundary of the proposed development. To the south of this ridge the ground slopes in a southerly direction towards an unnamed tributary of the River Blackwater. Land to the east of the IWMF site slopes towards the east and another tributary that flows south to the River Blackwater.

Figure 3-2: Local Topography



3.3 Hydrology

3.3.1 The River Blackwater flows in an easterly direction past the Site approximately 1.6 km to the north of the proposed IWMF before turning towards the south, approximately 3.6 km east of the Site. At the closest point (where the access road crosses the river) the upstream catchment of the

River Blackwater is estimated to be 159 km^2 consisting of predominantly rural areas plus the northeast of Braintree and some small villages. [7]

3.3.2 To the south of the Site (both southwest and southeast) there are two unnamed tributaries of the River Blackwater. These flow southwards away from the Site towards the River Blackwater.

3.3.3 While small ditches and operational lagoon associated with quarrying are present nearby there are no other significant water features within the vicinity of the Site.

3.4 Geology

3.4.1 The geology and hydrogeology at the IWMF site are well understood as a consequence of numerous site investigations. Golder (2008)[8] reports that the Site was originally underlain by Boulder Clay (Glacial Till) and Quaternary drift deposits (sand and gravel), which in turn lay above London Clay.

3.4.2 The Glacial Till consists of pale brown buff sandy clay with chalk fragments and forms the overburden at the Site. The sands and gravels are derived from fluvial glacial deposits and are the mineral reserve exploited by the sand and gravel workings locally. The London Clay is a stiff blue grey clay although it is noted that the surface of the London Clay is weathered and is described as silty clay with some gravel. Golder (2008) reports that published data sources suggest up to 69.0 m of London Clay may be present beneath the Site.

3.4.3 The base of the sand and gravel / top of the London Clay in the area of the Site was typically recorded at between 33.0 m aOD and 36.0 m aOD. The creation of the development platform therefore exposed the London Clay on the Site and created cut face through the overlying superficial deposits to the northwest, southwest and southeast.

3.5 Hydrogeology

3.5.1 The bedrock (London Clay) is designated as unproductive[9] aquifer system, which is defined as *"rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow".*

3.5.2 The Glacial Till is designated as a Secondary (undifferentiated) Aquifer. These are defined as *"rock deposits with variable permeability and storage properties".* They support water supplies at a local scale rather than strategic

7 FEH Webservice, https://fehweb.ceh.ac.uk

8 Golder Associates. 2008. Rivenhall Airfield eRCF. Ground & Surface Water Assessment. Chapter 6. Version A.1

9 Magic Map Application, managed by Natural England, delivered by Landmark. Available at: https://magic.defra.gov.uk/MagicMap.aspx

scale (such as for private supplies) and remain important for rivers, wetlands and lakes.

3.5.3 Groundwater is present in the sand and gravels and is perched above the London Clay and has been proven by the Site investigation to not be confined by the overlying Glacial Till.

3.5.4 The depth of groundwater above the London Clay was reported by Golder (2008) to range between 1.0 m and 3.5 m (i.e., the saturated water depth). This will however clearly have been altered by the subsequent earthworks and changes in site elevations with groundwater now from the cut faces into drainage systems around the periphery of the IWMF.

3.5.5 The Site is located within an outer (Zone 3) Source Protection Zone ('SPZ') associated with groundwater abstractions.

3.6 Site drainage

3.6.1 The drainage and water use strategy for the Consented Scheme includes two surface water collection lagoons.

3.6.2 Upper Lagoon has been developed as part of the Consented Scheme and is situated approximately 40 m north-west of the Site. It provides storm water attenuation for the IWMF and has been constructed to receive and control rainfall and surface water runoff as well as small amounts of groundwater from the operation of the Consented Scheme. The construction and use of this lagoon would not be changed by the Proposed Development.

3.6.3 Where necessary discharge from Upper Lagoon will be directed to a larger water body called New Fields Lagoon which has been developed as part of the restoration of the adjacent quarry. During wet periods, it will also receive runoff from a significant catchment that incorporates current quarrying operations and adjacent greenfield and restored areas. Excess water within New Fields Lagoon will be pumped and discharged northwards to discharge into a small ditch that drains into the River Blackwater.

4.0 Planning policy and guidance

4.1 Proposal summary

4.1.1 Development Consent is sought for the extension of an onshore generating station in England (i.e., the IWMF), which, when extended, would have the capacity to generate more than 50 MW of electricity. The Proposed Development is a NSIP under Sections 14(1)(a), 15(1) and 15(2) to (c) of the Planning Act 2008. Development consent for the construction of an NSIP requires the grant of a DCO.

4.1.2 The Proposed Development would involve works to the steam inlet control valves of the Energy from Waste ('EfW') plant to enable the generating capacity to exceed 50MW by either removing mechanical limitations of the inlet control valves, or by installing unrestricted inlet control valves. Each option would enable the EfW plant to generate over 50MW of electricity through increasing the maximum amount of steam that reaches the turbine installed as part of the Consented Scheme. The option taken forward is dependent on the timing of the granting of the DCO relative to the installation and commissioning phases of the Consented Scheme. Further information on the Proposed Development is provided in the **Environmental Statement Volume 1, Chapter 3: Proposed Development and Construction (Doc Ref 6.1)**.

4.1.3 Under the development types detailed in Annex 3 of NPPF, this development would be considered as *"essential utility infrastructure"* and would be an *"essential infrastructure"* development type.

4.1.4 The Consented Scheme is expected to become operational in 2025. The IWMF has been designed to operate for 40 years (2025 to 2065).

4.2 National Planning Policy

4.2.1 This FRA report has been completed in accordance with the guidance presented in the NPPF and with reference to PPG4. Consideration is also made to the Overarching National Policy Statement for Energy[10] and, in particular, Section 5.7 which relates to flood risk and Section 4.9 which relates to climate change adaptation.

4.2.2 Within this, paragraph 5.7.5 sets out the minimum requirements for FRAs and states that they should:

- *"be proportionate to the risk and appropriate to the scale, nature and location of the project;*
- *consider the risk of flooding arising from the project in addition to the risk of flooding to the project;*

10 Overarching National Policy Statement for Energy (EN-1), Department of Energy and Climate Change, July 2011, https://assets.publishing.service.gov.uk/media/5a79522de5274a2acd18bd53/1938-overarching-nps-for-energy-en1.pdf

- *take the impacts of climate change into account, clearly stating the development lifetime over which the assessment has been made;*
- *be undertaken by competent people, as early as possible in the process of preparing the proposal;*
- *consider both the potential adverse and beneficial effects of flood risk management infrastructure, including raised defences, flow channels, flood storage areas and other artificial features, together with the consequences of their failure;*
- *consider the vulnerability of those using the site, including arrangements for safe access;*
- *consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made;*
- *consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes;*
- *include the assessment of the remaining (known as 'residual') risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular project;*
- *consider how the ability of water to soak into the ground may change with development, along with how the proposed layout of the project may affect drainage systems;*
- *consider if there is a need to be safe and remain operational during a worst case flood event over the development's lifetime; and*
- *be supported by appropriate data and information, including historical information on previous events."*

4.3 Local Planning Policy

4.3.1 The Braintree District Local Plan

4.3.1.1 The Braintree District Local Plan[11] provides a planning framework for how the district will develop and grow between now and 2033. The key policy from that plan, as relevant to this report is detailed below.

Policy LPP 74: Flooding Risk and Surface Water Drainage

4.3.1.2 *"Where development must be located in an area of higher flood risk, it must be designed to be flood resilient and resistant and safe for its users for the*

11 The Braintree District Local Plan (2013 – 2033). Adopted July 2022. Available at: https://www.braintree.gov.uk/downloads/file/3553/local-plan-2033-s1-and-s2-pdf-minus-maps

lifetime of the development, taking climate change and the vulnerability of the residents into account."

4.3.1.3 *"New development shall be located on Flood Zone 1 or areas with the lowest probability of flooding, taking climate change into account, and will not increase flood risk elsewhere. Any proposals for new development (except water compatible uses) within Flood Zones 2 and 3a will be required to provide sufficient evidence for the Council to assess whether the requirements of the sequential test and exception test have been satisfied, taking climate change into account. Where development must be located in an area of higher flood risk, it must be designed to be flood resilient and resistant and safe for its users for the lifetime of the development, taking climate change and the vulnerability of any residents into account."*

4.3.1.4 *"For developments within Flood Zones 2 and 3, and for developments elsewhere involving sites of 1 ha or more, development proposals must be accompanied by a site-specific Flood Risk Assessment which meets the requirements of the NPPF and Planning Practice Guidance. Flood Risk Assessments submitted must take into account an assessment of flood risk across the life of the development taking climate change into account by using the most up to date allowances available."*

4.3.1.5 *"For all developments (excluding minor developments and change of use) proposed in Flood Zone 2 or 3, a Flood Warning and Evacuation Plan should be prepared."*

4.3.1.6 *"For developments located in areas at risk of fluvial flooding, safe access/egress must be provided for new development as follows in order of preference:*

a. *Safe dry route for people and vehicles*
b. *Safe dry route for people*
c. *If a. is not possible a route for people where the flood hazard is low and should not cause risk to people*
d. *If a-c is not possible planning permission will not usually be granted."*

4.3.1.7 *"All new development in Flood Zones 2 and 3 should not adversely affect flood routing and thereby increase flood risk elsewhere."*

4.3.1.8 *"All new development in Flood Zones 2 and 3 must not result in a net loss of flood storage capacity. Where possible opportunities must be sought to achieve an increase in floodplain storage."*

4.3.1.9 *"All More Vulnerable and Highly Vulnerable development within Flood Zones 2 and 3 should set finished floor levels 300mm above the known or*

modelled 1 in 100 annual probability (1% AEP) flood level including an allowance for climate change."

4.3.1.10 *"In areas at risk of flooding at low depths (<0.3m), flood resistance measures should be considered as part of the design and in areas at risk of frequent or prolonged flooding, flood resilience measures should also be included."*

4.3.1.11 *"Where applicable proposals for new development should:*

- *Demonstrate that the scheme does not have an adverse impact on any watercourse, floodplain or flood defence*
- *Not impede access to flood defence and management facilities*
- *Demonstrate that the cumulative impact of development would not have a significant effect on local flood storage capacity or flood flows*
- *Where appropriate opportunities may be taken to reduce wider flood risk issues by removing development from the floodplain through land swapping*
- *Where applicable retain at least an 8m wide undeveloped buffer strip alongside Main Rivers, or at least a 3m buffer strip on at least one side of an Ordinary Watercourse, and explore opportunities for riverside restoration*
- *Ensure there is no adverse impact on the operational functions of any existing flood defence infrastructure and new development should not be positioned in areas which would be in an area of hazard should defences fail."*

4.3.1.12 *"Where the development site would benefit from the construction of Flood Management Infrastructure such as Flood Alleviation Schemes, appropriate financial contributions will be sought."*

4.3.2 The Essex and Southend-on-Sea Waste Local Plan

4.3.2.1 The Essex and Southend-on-Sea Waste Local Plan[12] was adopted July 2017 and provides a framework for the provision of waste services across the county through to 2032.

4.3.2.2 The plan notes (at paragraph 9.42) that;

"In general terms, waste treatment (excluding landfill or the management of hazardous waste) is defined as a 'less vulnerable' land-use in the NPPF; therefore, it may be compatible in Flood Zones 2 and 3a (subject to certain conditions). A 'sequential test', as set out in the NPPF, is applied to new developments to steer these to areas with the lowest probability of flooding."

12 The Essex and Southend-on-Sea Waste Local Plan, Southend of Sea Borough Council and Essex County Council, Adopted July 2017, https://www.essex.gov.uk/sites/default/files/migration_data/files/assets.ctfassets.net/knkzaf64jx5x/5MMZ5nNFmOClpF56igb0Jc/e6f7ab4cba4ed1198c67b87be7b375e7/waste-local-plan-2017-compressed.pdf

4.3.2.3 In addition, key policy requirements from the plan, as relevant to this assessment are detailed below.

Policy 11 - Mitigating and Adapting to Climate Change

"2. Proposals for waste management development will only be permitted where:

a. there would not be an unacceptable risk of flooding on site or elsewhere as a result of impediment to the flow of storage or surface water, as demonstrated by a Flood Risk Assessment, where required by the National Planning Policy Framework.

b. existing and proposed flood defences are protected and there is no interference with the ability of responsible bodies to carry out flood defence works and maintenance where applicable

c. there would not be an unacceptable risk to the quantity and quality of surface and ground waters, or impediment to groundwater flow."

4.4 Flood Zone Classification

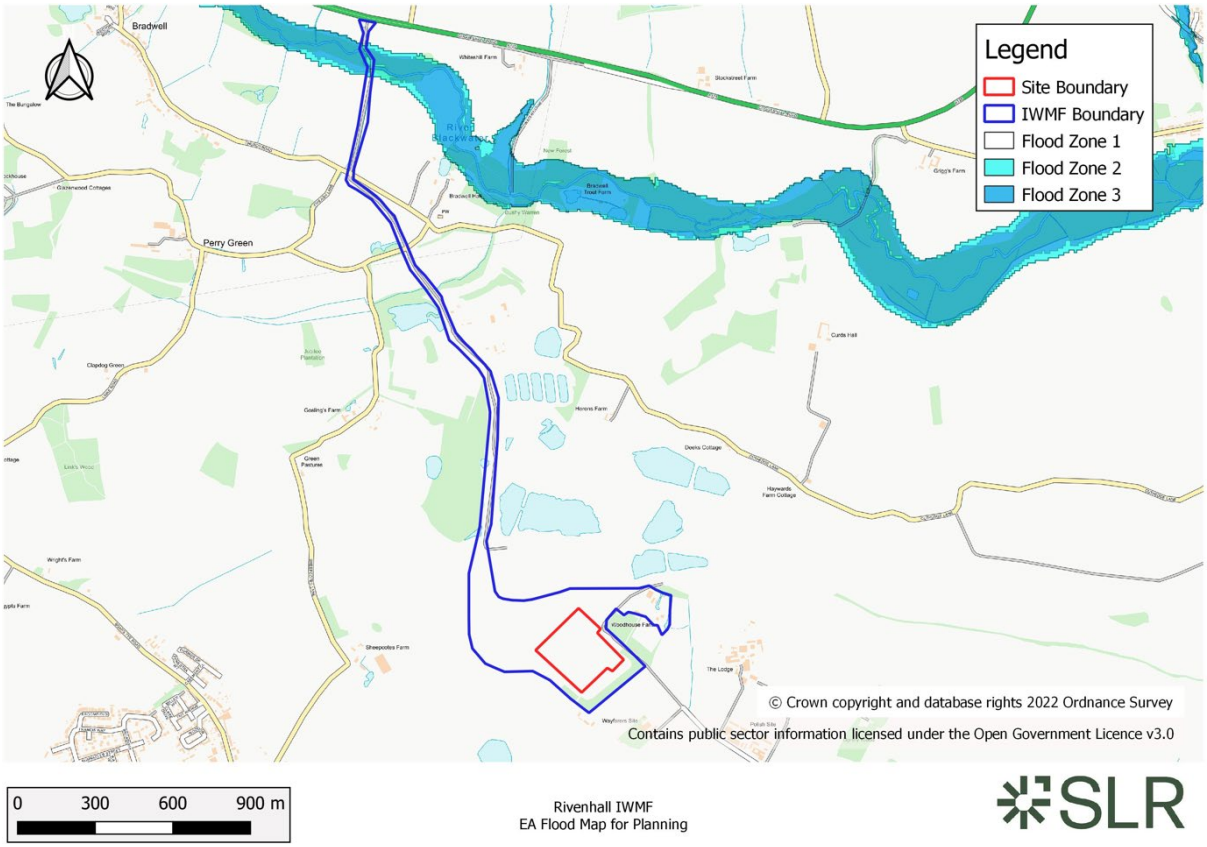
4.4.1 The definition of Environmental Agency ('EA') flood zones is provided in PPG Table 1: Flood Zones:

- *Zone 1 - Low Probability* (Flood Zone 1) is defined as land which could be at risk of flooding from fluvial or tidal flood events with less than 0.1% annual exceedance probability (AEP) (1 in 1,000 year) i.e., considered to be at 'low probability' of flooding.
- *Zone 2 - Medium Probability* (Flood Zone 2) is defined as land which could be at risk of flooding with an annual exceedance probability between 1% (1 in 100 year) and 0.1% (1 in 1,000 year) from fluvial sources and between 0.5% (1 in 200 year) and 0.1% (1 in 1,000 year) from tidal sources i.e., considered to be at 'medium probability' of flooding.
- *Zone 3a - High Probability* (Flood Zone 3a) is defined as land which could be at risk of flooding with an annual exceedance probability greater than 1% (1 in 100 year) from fluvial sources and greater than 0.5% (1 in 200 year) from tidal sources i.e., considered to be at 'high probability' of flooding.
- *Zone 3b - the Functional Floodplain* (Flood Zone 3b) is defined as land where water has to flow or be stored in times of flood. Local Planning Authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain in agreement with the Environment Agency. In the absence of definitive information, it is often defined as land that would flood with an AEP of 3.3% (1:30 year) or greater, with any existing flood risk management infrastructure operating effectively.

4.4.1.1 In assessing the boundary between Flood Zones 1, 2 and 3, the protection afforded by any flood defence structures, and other local circumstances, is not considered by the EA.

4.4.1.2 Based upon the Environment Agency Flood Map for Planning[13] (Figure 4-1), the Site is located in Flood Zone 1.

Figure 4-1: EA Flood Map for Planning



4.4.2 Flood Risk Compatibility

4.4.2.1 The Proposed Development is located across Flood Zone 1 and, as detailed in Section 4.1, the Consented Scheme is classified within Annex 3 of the NPPF as an '*Essential Infrastructure*' development type.

4.4.2.2 PPG Table 3: Flood risk vulnerability and flood zone 'compatibility' (reproduced as Table 4-1) confirms that, with respect to flood risk, *'Essential Infrastructure'* development types are considered appropriate in Flood Zones

13 Flood Map for Planning, https://flood-map-for-planning.service.gov.uk/ (Accessed April 2023)

1 and 2, as well as Flood Zones 3a and 3b, provided that the Exception Test is passed.

Table 4-1: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification (PPG Table 2)		Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone (PPG Table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	Exception Test Required	✓	✓	✓
	Zone 3a†	Exception Test Required	x	Exception Test Required	✓	✓
	Zone 3b* (functional floodplain)	Exception Test Required	x	x	x	✓

Key:

✓ Development is appropriate

x Development should not be permitted

† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

* In Flood Zone 3b (functional floodplain) essential infrastructure that has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows and not increase flood risk elsewhere.

4.4.3 Sequential Test

4.4.3.1 With reference to the NPPF, the Sequential Test gives preference to locating new development in areas that are at lowest risk of flooding.

4.4.3.2 In paragraph 162 of the NPPF the Sequential Test sets out that:

"*Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding.*"

4.4.3.3 Paragraph 161 confirms that this process should take into account;

"all sources of flood risk and the current and future impacts of climate change".

4.4.3.4 The Sequential Test is not relevant to the DCO as the Consented Scheme is already both allocated, permitted and under construction.

4.4.3.5 This assessment confirms the Site is subject to low levels of flood risk from all sources considered and will remain at low risk throughout its lifetime. As such, if it did apply, the Sequential Test would be passed.

4.5 Climate Change

4.5.1.1 The EA has issued guidance on the impacts of climate change on flood risk in the UK[14] to support the NPPF. This advice sets out that peak rainfall intensity, sea level, peak river flow, offshore wind speed and extreme wave heights are all expected to increase in the future as a result of climate change.

4.5.1.2 PPG recommends that considerations for future climate change are included in FRA's for proposed developments.

4.5.1.3 As discussed in detail in Section 5.2.2, flood risk from tidal sources (and therefore wind speed and waves heights) are not of relevance in this area. As such the consideration of climate change in this assessment is limited to potential changes in peak river flow and rainfall intensity.

4.5.2 Peak Fluvial Flows

4.5.2.1 Peak River Flow Allowances, published by the EA for the Essex Management Catchment, are presented in Table 4-2. This shows the anticipated changes to peak fluvial flow rates.

Table 4-2: Peak River Flow Allowances

Management Catchment	Allowance Category	2020s	2050s	2080s
Essex Management Catchment	Central	7 %	8%	25 %
	Higher Central	13 %	16 %	38 %
	Upper End	27 %	37 %	72 %

4.5.2.2 Guidance states that for *'Essential Infrastructure'* development located in Flood Zone 1 the "higher central" allowance should be considered. For the

14 Environment Agency, Flood Risk Assessments: Climate change allowances, February 2016 (Updated May 2022), https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

40-year anticipated lifetime of development, up until 2065, this equates to maximum uplift in peak fluvial flow of 38 %.

4.5.3 Peak Rainfall Intensity

4.5.3.1 Peak Rainfall Intensity Allowances, published by the Environment Agency for the Combined Essex Management Catchment, are presented in Table 4-3. This shows the anticipated changes to extreme rainfall intensity or depth.

Table 4-3: Peak Rainfall Allowance

Management Catchment	Annual Exceedance Rainfall Event	Allowance	2050s	2070s
Combined Essex Management Catchment	3.3%	Upper End	35%	35%
		Central	20%	20%
	1%	Upper End	45%	40%
		Central	20%	25%

4.5.3.2 Guidance states that flood risk assessments should assess the 'Upper End' allowances to understand the range of impact for the 1% annual exceedance event. For the 40-year anticipated lifetime of development, up until 2065, this equates to maximum uplift in rainfall intensity of 45%.

5.0 Potential Sources of flooding

5.1 Methodology and best practice

5.1.1.1 This **FRA** has been prepared in accordance with the advice and requirements prescribed in current best practice documents relating to management of flood risk in development, published by the Construction Industry Research and Information Association (CIRIA)[15], and British Standard BS85333.

5.1.1.2 A screening study has been completed to identify whether there are any potential sources of flooding at the Site which may warrant further consideration. If required, any potential significant flooding issues identified in the screening study are then considered in subsequent sections of this assessment.

5.2 Screening study

5.2.1.1 Potential sources of flooding include:

- Flooding from the sea or tidal flooding;
- Flooding from rivers or fluvial flooding;
- Flooding from surface water and overland flow;
- Flooding from groundwater;
- Flooding from sewers;
- Flooding from reservoirs, canals, and other artificial sources; and
- Flooding from infrastructure failure.

5.2.1.2 The flood risk from each of these potential sources is discussed below and summarised in Table 5-1.

5.2.2 Flooding from the Sea or Tidal Flooding

5.2.2.1 The Site is remote from the sea. Therefore, the risk of flooding from the sea or tidal flooding is considered very low and is not discussed further.

5.2.3 Flooding from Rivers or Fluvial Flooding

5.2.3.1 As shown in Figure 4-1 the Site is located in Flood Zone 1, indicating that the annual probability of fluvial flooding at the Site less than 0.1%. The Site is approximately 1.5 km from the nearest Flood Zone 2 boundary. There is

15 CIRIA Report C624, Development and flood risk: guidance for the construction industry

no current flood management at the Site, and no historical information to indicate that the Site has been subject to fluvial flooding.

5.2.3.2 The risk of fluvial flooding is, therefore, considered low and this is unlikely to change in the future as a result of changes associated with climate change. Fluvial flooding is therefore not discussed further.

5.2.4 Flooding from Surface Water and Overland Flow

5.2.4.1 The Consented Scheme is set into the ground to reduce the visual impacts. As such, local groundwater and surface water will progress towards the Site as it is at or close to a local topographic low.

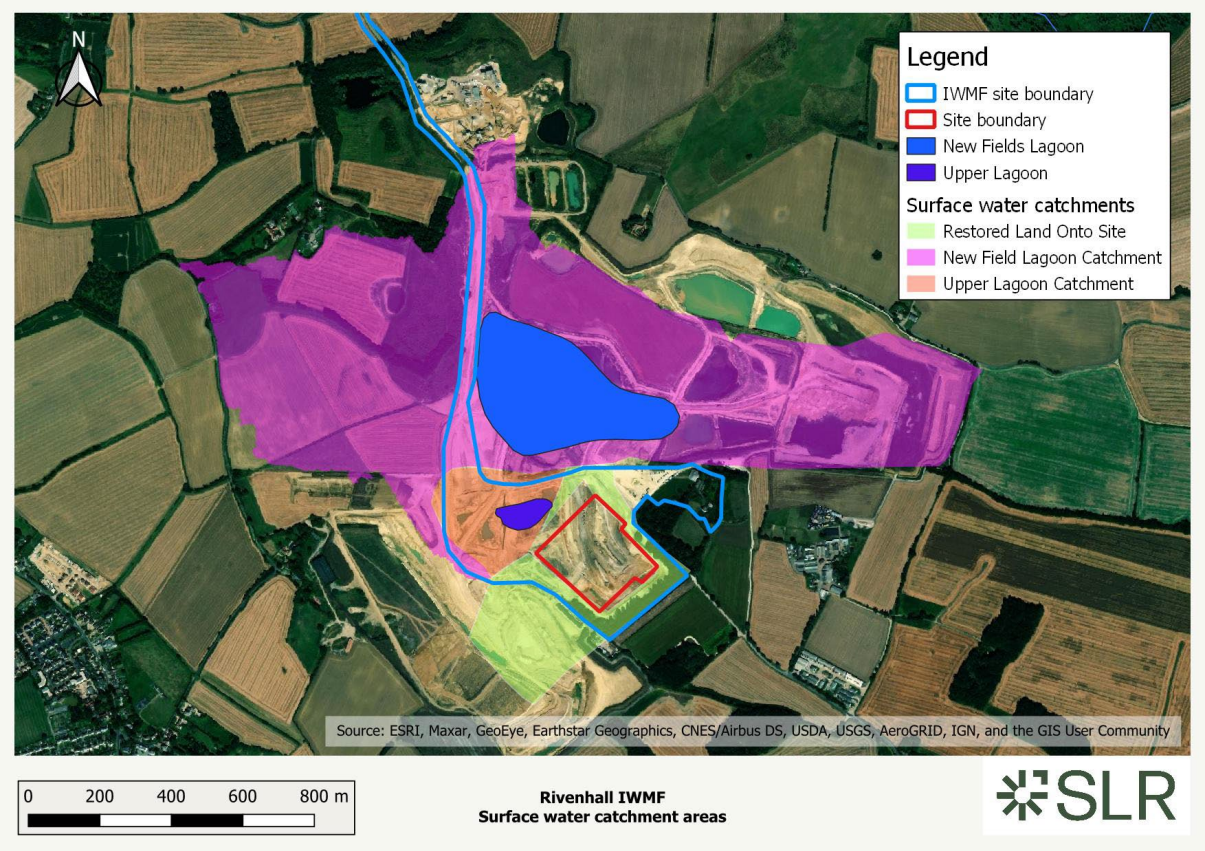
5.2.4.2 Two water management lagoons are being created, one located to the west of the Site called Upper Lagoon and one located further to the north called New Field Lagoon. A pumped discharge towards the River Blackwater will be established to manage the water levels within the lagoons.

5.2.4.3 A water balance study was undertaken by SLR Consulting Limited in September 2021 to inform the disposal of water from the IWMF site into the River Blackwater. An extract from this study showing the catchment areas is shown in Figure 5-1.

5.2.4.4 Surface water catchment areas were delineated based on publicly available terrain models created from LiDAR data supplemented with the restoration contours for the quarry. The mapping indicates that the majority of flows draining towards the site will be intercepted by either New Field Lagoon or

Upper Lagoon. A residual area of greenfield and restored land draining directly onto the Site does however exist and covers an area of 3.13 ha.

Figure 5-1: Surface water catchment areas



5.2.4.5 Detailed drainage design for the Consented Scheme was undertaken by Fichtner Consulting Engineers Limited in 2021[16]. Given that the Proposed Development relates only to the internal plant of the EfW component within the IMWF, it would not change the drainage strategy for the Consented Scheme.

5.2.4.6 Key aspects of the surface water management strategy as pertinent to this assessment are:

- Clean rainwater from the IWMF, along with runoff from the upgradient greenfield catchment and small quantities of groundwater collected from the cut faces will be collected and pumped into Upper Lagoon. Capacity exists with Upper Lagoon to receive and control these flows with water then pumped to New Fields Lagoon at greenfield rates.
- New Field Lagoon will receive flows from the IWMF and also runoff from a wider catchment (see Figure 5-1) that includes and area of current

16 Drawing S3188-8220-0005, Main Site, Temp Surface Water Drainage to Lower Plateau, Rivenhall IWMF Site Development Works, Fichtner Consulting Engineers Limited, April 2021

quarrying operations that will ultimately be restored. Capacity exists within New Fields Lagoon to accommodate these flows for long duration storms and extreme extended winter conditions.

- From New Fields Lagoon water will be pumped northwards into a ditch that drains to the River Blackwater at a maximum rate of 20l/s. This is considerable lower than the QBAR greenfield runoff for the contributing catchment.
- It is proposed that three pump sets are to be provided (duty, assist and standby). As the standby pump serves as a backup to replace a "non-working" pump within a set, this further mitigates the risk of flooding in the event of a pump failure.

5.2.4.7 With the implementation of the proposed drainage design, the residual risk of surface water flooding will be low. The approved storm water drainage design accounts for climate change in line with current guidance and therefore changes in rainfall severity associated with climate change will not alter this conclusion.

5.2.5 Flooding from Groundwater

5.2.5.1 Groundwater flooding can be defined as flooding caused by the emergence of water originating from subsurface strata. Groundwater flooding can occur where sites are located on permeable ground. After a prolonged period of rainfall and groundwater recharge, a considerable rise in the water table can result in inundation for extended periods of time.

5.2.5.2 As discussed in Section 3.4, the Site is entirely underlain by a bedrock geology of the largely impermeable London Clay Formation, and therefore groundwater flow within the bedrock is considered unlikely. The platform of the Proposed Development does however cut through the more permeable superficial deposits within which shallow groundwater is known to flow.

5.2.5.3 The water balance study undertaken by SLR Consulting Limited in September 2021[17] estimated the groundwater catchment draining onto the site (Figure 5-2) and the peak flow that could reasonably be derived from this under extreme extended wet winter conditions.

5.2.5.4 The retaining wall on the cut faces around the IWMF have been constructed with a soil-nailed structure with gabion basket facing. This is permeable and will allow groundwater to flow through and collect within drainage pipe situated at the base of the wall. This groundwater, together with any surface

17 SLR Consulting Limited. September 2021. Rivenhall GoldSim Model

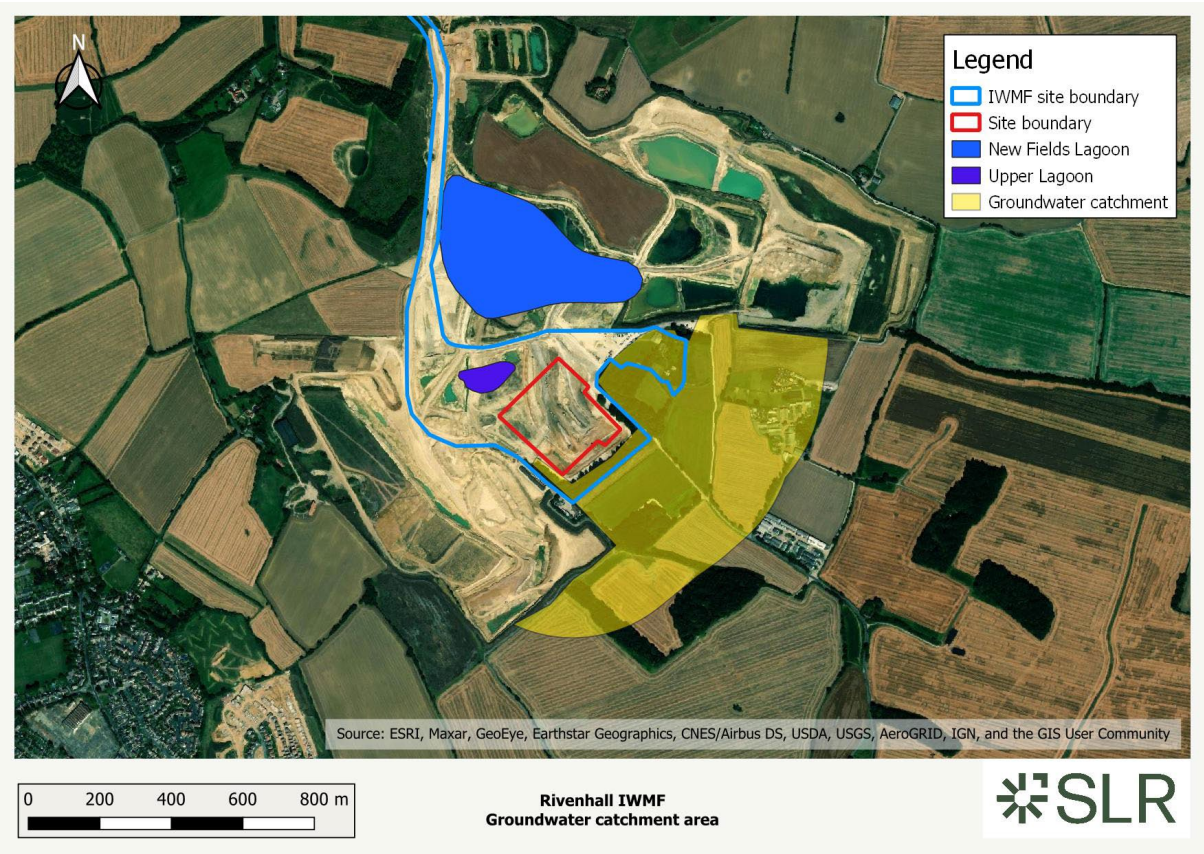
water runoff, will be collected via a series of channels at a sump and pumped to the Upper Lagoon.

5.2.5.5 From the lagoons the groundwater will be pumped, along with the surface water runoff, towards the River Blackwater at below greenfield rates. The water balance modelling confirmed that the capacity of New Field Lagoon is sufficient to provide storage for longer duration storms / extreme seasonal variations.

5.2.5.6 This system for managing groundwater inflows is part of the existing Consented Scheme.

5.2.5.7 Considering the above, the residual risk to groundwater flooding is low and is not considered further.

Figure 5-2: Groundwater catchment



5.2.6 Flooding from Sewers and Water Mains

5.2.6.1 There are no pre-existing adopted sewers and water mains located at- or in proximity to- the Site. Therefore, flooding due to sewers or water mains is very unlikely and is not discussed further.

5.2.7 Flooding from Reservoirs, Canals and Other Artificial Sources

5.2.7.1 With reference to EA Mapping[18], the Site does not lie within the flood extent of a reservoir breach scenario. The risk of flooding from reservoirs, canals and other artificial sources is, therefore, considered very low and is not discussed further.

5.2.7.2 The surface water lagoons proposed to the west and north of the Site, namely, Upper Lagoon and New Field Lagoon, respectively, will be designed and constructed in accordance with CIRIA Guidance[19] and, where required, the Reservoirs Act[20] and the Flood and Water Management Act[21].

5.2.7.3 Therefore, with proper mitigation and management, residual flood risks to the Proposed Development and off-site areas are expected to be low.

5.2.7.4 There are no other artificial sources of flooding at or near the Site.

5.2.8 Flooding from Infrastructure Failure

5.2.8.1 The Site does not benefit from local flood defences. The risk of flooding from infrastructure failure is therefore very low and is not considered further.

5.2.9 Flood screening summary

5.2.9.1 Table 5-1 summarises the flood screening assessment.

Table 5-1: Potential Risk Posed by Flooding Sources

Source	Flood Risk Identified at Site?
Sea or Tidal Flooding	No
Rivers or Fluvial Flooding	No
Surface Water and Overland Flow	No
Groundwater	No
Sewers and Water Mains	No
Reservoirs, Canals and other Artificial Sources	No

18 Environment Agency Risk of Flooding from Reservoirs - Maximum Extent Flood Map

19 Design of Flood Storage Reservoirs. CIRIA Report B14, 1993 and Small Embankment Reservoirs, CIRIA Report 161, 1996.

20 Reservoirs Act 1975

21 Flood and Water Management Act 2010

Source	Flood Risk Identified at Site?
Infrastructure Failure	No

6.0 Conclusions

6.1.1 SLR has been appointed by Indaver Rivenhall Limited to prepare a FRA in support of a Development Consent Order application relating to increasing the generating capacity of the Integrated Waste Management Facility at the former World War II airfield in Essex.

6.1.2 This Site is not located close to any fluvial or tidal flood sources. The Consented Scheme is however located within an area of former quarrying with the platform set below much of the surrounding land. Surface water and groundwater runoff from some surrounding areas will drain through or towards the IWMF. The drainage systems that form part of the Consented Scheme, and which will not be amended by the Proposed Development, have been designed to reflect this with drainage installed into the cut faces around the IWMF and two water management lagoons created. A pumped discharge from these lagoons to the River Blackwater at or below greenfield rates will be established to manage the water levels within the lagoons.

6.1.3 These systems have been designed to accommodate extreme flows. Modelling demonstrates that they will be sufficient to manage all potential flow from both short extreme storm and longer extended / seasonal wet rainfall events. This includes for potential changes in rainfall severity associated with climate change.

6.1.4 Flood risk has been assessed in line with BS85335 and NPS EN-1, also taking account of national planning policy and guidance and potential changes associated with climate change.

6.1.5 A range of potential sources of flooding including tidal, fluvial, sewers and water mains and from infrastructure failure were screened and it was concluded that the Site is located in Flood Zone 1 and that, given the Consented Scheme's drainage systems, the risk of flooding from all sources will be **low**.

6.1.6 The Proposed Development involves no changes to the approved drainage systems that form part of the Consented Scheme and will not lead to any increase in flood risk either within the Site or elsewhere. As such the scheme is considered acceptable in flood risk terms and would pass the Sequential Test and the Exception Test if they applied.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