RETFORD CIRCULAR ECONOMY PROJECT

VOLUME 1

9. HYDROLOGY, HYDROGEOLOGY AND FLOOD RISK

FEBRUARY 2023

9 HYDROLOGY, HYDROGEOLOGY, AND FLOOD RISK

9.1 INTRODUCTION

This Chapter of the Environmental Statement (ES) evaluates the effects of the Proposed Development on the water environment, specifically Hydrology, Hydrogeology, and Flood Risk, within and surrounding the Proposed Development site (the Site).

The Proposed Development is described in **Volume 1**, **Chapter 5: Project Description**

This Chapter includes the following elements:

- Legislation, Policy and Guidance;
- Assessment Methodology and Significance Criteria;
- Baseline Conditions;
- Assessment of likely Effects;
- Mitigation measures and Residual Effects;
- Cumulative Effect Assessment;
- Summary of likely Effects; and
- Statement of Significance.

This Chapter of the EIA Report is supported by the following figures in, presented in Volume 2:

- Figure 9.1: Core Study Area;
- Figure 9.2: Wider Study Area; and
- Figure 9.3: Site Drainage Plan
- Figure 9.4: Schematic Cross Section of an Excavation.

and the following Appendices in **Volume 3, ES Appendices**

- Appendix 9.1: Water Environmental Management Plan (WEMP)
- Appendix 9.2: Flood Risk Assessment (FRA)
- Appendix 9.3: Drainage Management Plan

9.2 LEGISLATION, POLICY AND GUIDANCE

9.2.1 Legislation

The following legislation has been considered in preparation of the assessment

- The Environmental Protection Act 1990[1] and Part 2A (the Contaminated Land Regime)
- Water Resources Act 1991[2]
- The Land Drainage Act 1991[3];
- The Water Act 2003[4];
- Environmental Permitting Regulations (England and Wales) 2016[5]
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017[6];

[1] https://www.legislation.gov.uk/ukpga/1990/43/contents
[2] https://www.legislation.gov.uk/ukpga/1991/57/section/107
[3] https://www.legislation.gov.uk/ukpga/1991/59/contents
[4] https://www.legislation.gov.uk/ukpga/2003/37/contents
[5] https://www.legislation.gov.uk/uksi/2016/1154/made
[6] https://www.legislation.gov.uk/uksi/2016/1154/made

9.2.2 Policy

The following national and local policy has been considered in preparation of this assessment:

- National Planning Policy Framework 2021
- Draft Bassetlaw Local Plan, November 2027
- Bassetlaw District Level 2 Strategic Flood Risk Assessment draft report, JBA Consulting, April 2021

9.2.3 Guidance

The following documents have been considered in preparation of the assessment:

- Pollution Prevention for Business[8];
- Discharges to surface water and groundwater: environmental permits[9];
- Apply for a water abstraction and impoundment license[10];
- Safeguarding our Soils: A Strategy for England[11];
- The Construction Industry Research and Information Association (CIRIA) (2015), Environmental Good Practice on Site (C741)[12];
- CIRIA (2001), Control of Water Pollution from Construction Sites (C532) [13]; and
- CIRIA (2015), The SuDS Manual (C753) [14].

9.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

9.3.1 Scoping Responses and Consultations

A scoping report was submitted to Nottinghamshire County Council (NCC) in October 2022, which was then sent to relevant organisations for consultation. Responses relevant to the water environment are presented in **Table 9.1.**

Table 9.1: Scoping and Consultation Response

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
Nottinghamshire County Council	4th November 2022	The applicant is strongly advised to review the detailed response and survey requests and recommendations from Nottinghamshire Wildlife Trust, which is appended. One of their concerns is that there are extensive wetland areas and habitats which extend beyond 2km and are dependent on complex local	Study area extends to 10km from the Site boundary for the downstream water receptors.

[7] https://www.bassetlaw.gov.uk/media/6023/draft-bassetlaw-local-plan-2020-full-version.pdf
[8] https://www.gov.uk/guidance/pollution-prevention-for-businesses
[9] https://www.gov.uk/guidance/discharges-to-surface-water-and-groundwater-environmental-permits#apply-for-a-standard-rules-permit (Accessed 10/11/2022)
[10] https://www.gov.uk/guidance/water-management-apply-for-a-water-abstraction-or-impoundment-licence#before-you-apply (Accessed 10/11/2022)
[11] https://www.gov.uk/government/publications/safeguarding-our-soils-a-strategy-for-england (Accessed 10/11/2022).
[12] https://www.ciria.org/Training/Training_courses/Environmental_good_practice_on_site.aspx (Accessed 10/11/2022)
[13] https://www.ciria.org/ProductExcerpts/C532.aspx (Accessed 10/11/2022)
[14] https://www.ciria.org/ProductExcerpts/tbyb_c753.aspx (Accessed 10/11/2022)

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		hydrological and hydrogeological pathways.	
	4th November 2022	Extraction of PFA, leading to a reduced landform could be beneficial to flood risk management in the area, bringing the land back into the floodplain. However, these works could also open up new flood flow routes to nearby land and properties (currently proposed to be scoped out). A Flood Risk Assessment is therefore required to demonstrate that the proposals do not lead to increasing flood risk elsewhere. This may require hydraulic modelling work to be undertaken. Surface water management should similarly ensure flood risk is not increased elsewhere. Groundwater is sensitive as part of the Principal bedrock aquifer. The EA advise that they are satisfied with the scope of the proposed ES but emphasise the licensing requirements should dewatering be required.	A flood risk assessment addressing all potential sources of flooding has been undertaken, and is included in Volume 3, Appendix 9.2. PFA embankment levels would be no lower than the 1% AEP peak flood level plus 20% climate change (derived from the River Idle Hydraulic Modelling Report (2020)) and an allowance for freeboard, ensuring that the works would not alter the flood regime of the River Idle or introduce flow pathways that could adversely affect flood risk to neighbouring properties and land. Potential impacts to groundwater have been assessed in Section 9.5. Mitigation is included in the design of the Proposed Development (Section 9.7) and also in the Outline WEMP which can be found in Volume 3, Appendix 9.1. An application for an abstraction license for dewatering is currently in progress and should be prepared and submitted subject to a pre-Application meeting with the EA. In the event that an abstraction licence is not granted then, as an alternative to dewatering, material below the water table would be wet worked.
	NCC LLFA 14th October 2022	Given the proposed scale of the Proposed Development to satisfy the National Planning Policy Framework (NPPF) further details would need to be submitted to support any application. Paragraph 163 of the NPPF requires that applications in Flood Zone 2, 3 and in Flood Zone 1 over 1 hectare should be accompanied by a site-specific flood risk assessment (FRA), reviewing the potential flood risks to the Proposed Development from all sources. An FRA is vital if	A flood risk assessment has been undertaken, included in Volume 3, Appendix 9.2 EA modelled data from the 2020 River Idle Flood Study shows the Site is not at risk of flooding up to, and including, the 0.1 % AEP event, therefore located in Flood Zone 1 and not Flood Zone 2, as mapped using the historical flood outlines of 1947 and 1977. As such the Sequential and Exception test need not be applied as the Site is already located in the lowest risk of flooding.

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		the local planning authority is to make an informed planning decision. It is noted that the Site lies partially in Flood Zone 2, and as such the Environment Agency should be consulted as this falls under their remit.	
	NCC LLFA 14th October 2022	As LLFA, we would also require details of the proposed surface water drainage strategy for the Proposed Development to ensure that proposals do not increase flood risk off-site.	An outline drainage plan is provided in Section 9.7.2 and a Drainage Management Plan is included in Volume 3, Appendix 9.3; the latter incudes a comprehensive drainage design concept. A planning condition is anticipated to require more detailed surface water drainage proposals before construction commences, as is standard practice.
	NCC Ecology 6th October 2022	Impacts on the adjacent Sutton and Lound Gravel Pits SSSI will be one of the key issues which needs to be considered.	Study area extends to 10km from the Site boundary for the downstream water receptors and therefore includes the Sutton and Lound Gravel Pits SSSI. Assessment of impacts is detailed in Section 9.5.
Nottinghamshire Wildlife Trust	21st October 2022	Describe the methods of hydrological restoration, substrate preparation, plant establishment, plant type and form, provenance of material, establishment maintenance and long-term aftercare.	An indicative Restoration Landscape Masterplan (**Figure 7.12**) is provided and can be found in **Volume 2**. Further details of the restoration are in Appendix 8.5: Outline Restoration Strategy
Environment Agency	07 October 2022	If the land levels are lowered, the Site may become floodplain once again. This is a possible benefit of the Proposed Development; increasing the size and hydrological connectivity of the River Idle's floodplain may benefit downstream communities by reducing flood risk elsewhere. However, it is important that the works do not introduce new flow routes to third party land and properties. The EIA Scoping Report (para 8.3.2) states that the nearby receptors are not hydrologically connected to the River Idle but lowering the ground levels may	A flood risk assessment addressing all potential sources of flooding has been undertaken, and is included in Volume 3, Appendix 9.2. PFA embankment levels would be no lower than the 1% AEP peak flood level plus 20% climate change (derived from the River Idle Hydraulic Modelling Report (2020)) and an allowance for freeboard, ensuring that the works would not alter the flood regime of the River Idle or introduce flow pathways that could adversely affect flood risk to neighbouring properties and land.

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		create new hydrological connections between the river and local land and properties. A flood risk assessment will be required to demonstrate that any extraction or restoration works, or new structures, do not increase flood risk elsewhere (taking account of climate change) If significant lowering of ground levels is proposed, the applicant may need to undertake new hydraulic modelling to ensure flood risk is not increased off-Site in the relevant flood scenarios. When the Site is restored the potential to improve flood risk management in the area should be examined by the operator/developer. Ground levels should not be changed in a manner that alters the flood regime to the detriment of others.	
Environment Agency	07 October 2022	From a controlled waters protection perspective, we are satisfied with the scope of the proposed Environmental Impact Assessment. We have already held discussions with the applicant regarding their plans and they appear to have incorporated our comments made during these discussions. We would like to reiterate that the applicant must ensure they are compliant with water abstraction licensing requirements for any dewatering that is proposed.	The permit application for the dewatering abstraction is currently in progress and will be prepared and submitted subject to a pre-application meeting with the EA. In the event that an abstraction licence is not granted then, as an alternative to dewatering, material below the water table would be wet worked.
Environment Agency	Email 25th May 2021	The EA would need to be consulted on the water management plan which should include: • How phases of the Proposed Development will impact on drainage	An outline WEMP is provided in Volume 3, Appendix 9.1. It is expected that more detailed matters relating to water management would be conditioned and as such the Applicant would seek further advice and consultation with the EA in the development of a detailed WEMP.

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		• The storage of materials and associated runoff • How the Site drainage will be collected and treated prior to discharge off site • If groundwater will need to be pumped, how this will be managed and where it would be discharged • Water quality monitoring ad flow monitoring on and off Site. An Environmental permit will be required for any water discharge activities including discharge of site drainage.	The permit applications are currently being considered. As part of the discharge consent a risk assessment would be undertaken to determine appropriate limits for potential contaminants of concern with the discharge to the soakaway.
Natural England	Email 19th October 2022	Assessment should take account of risks of water pollution and how these can be managed or reduced including strategic solutions for nutrient neutrality of diffuse water pollution plans to address the impacts of elevated nutrient levels.	Risk to groundwater and surface water quality are included in the assessment of likely effects, Section 9.5. with mitigation provided in Section 9.7. Limits for discharge concentrations of potential contaminants of concern to soakaway would be determined as part of the discharge consent in agreement with the EA; however, notwithstanding this, a Drainage Management Plan has been submitted as part of the ES (Appendix 9.3).

9.3.2 Scope of Assessment

The key issues for the assessment of potential hydrological effects relating to the Proposed Development include short-term (construction) and long-term (operation and decommissioning).

9.3.3 Study Area / Survey Area

The study areas in this assessment are receptor specific. The hydrology and hydrogeology core study areas are shown in **Volume 2, Figure 9.1.**

The core study area is 2 km from the Site boundary and has been defined to assess the potential effects on private or public water supplies. A wider study area of 10 km from the Site is also reviewed to assess potential effects on the downstream water environment and is shown in **Volume 2, Figure 9.2**. At distances greater than 10 km within upland catchments, it is considered the Proposed Development would be unlikely to contribute to a hydrological effect, in terms of chemical or sedimentation effects, due to dilution and attenuation of potentially polluting chemicals.

Cumulative effects related to hydrology, hydrogeology and flood risk are assessed in the context of other developments within 5 km of the Site. Cumulative effects in this context are generally related to effects such as multiple developments or abstractions being constructed within proximity to one another. 5 km is therefore considered to be the conceivable maximum distance that these effects may occur.

9.3.4 Baseline Survey Methodology

The following sources of information have been used to inform the baseline description set out in this Chapter:

- Ordnance Survey raster 1:25,000 mapping;
- ADA Representing Drainage Water Level and Flood Risk Management Authorities (2014-2021) Internal Drainage Boards Map[15];
- Environment Agency Catchment Data Explorer[16];
- DEFRA Magic Map Application[17];
- BGS Geology viewer[18];
- BGS GeoIndex Onshore;[19]
- National River Flow Archive (NRFA);[20]
- Flood Map for Planning;
- Meteorological Office Rainfall Data;
- Consultation with the Environment Agency (EA), Anglian Water, Severn Trent Water and Bassetlaw District Council;
- SLR Consulting (2021) Lound PFA Ground Investigation Report, Version No 2, SLR Ref 416.11943.00001;
- 41 SLR Consulting (2021) Lound PFA Tip – Groundwater Abstraction Due Diligence, SLR Ref 422-11943-00002; and
- SLR Consulting (2021) Lound PFA Ground Investigation Report, Version No 2, SLR Ref 416.11943.00001

9.3.5 Methodology for the Assessment of Effects

The methodology adopted for the assessment of likely effects (both beneficial and adverse) arising from the Proposed Development on the water environment adopts the following approach:

- Estimation of the magnitude of the impact;
- Estimation of the importance of the receptor and its sensitivity to the impact concerned' and
- Assessment of the significance of the impact based on the likely magnitude of the impact and the importance/sensitivity of the receptor.

9.3.5.1 Sensitivity of Receptors

The sensitivity of the baseline conditions, including the importance of environmental features on or near to the Site or the sensitivity of potentially affected receptors, will be assessed in line with best practice guidance, legislation, statutory designations, and professional judgement.

The initial consideration of sensitivity of a receptor/asset to an effect reflects the level of importance assigned to it.

[15] Available at: Internal Drainage Boards Map - Association of Drainage Authorities (ada.org.uk)
[16] https://environment.data.gov.uk/ctatchment-planning
[17] https://magic.defra.gov.uk/
[18] https://geologyviewer.bgs.ac.uk
[19] https://mapapps2.bgs.ac.uk/geoindex/home.html
[20] https://nrfa.ceh.ac.uk/data/search

Table 9.2 details the framework for determining the sensitivity of receptors.

Table 9.2: Framework for Determining Sensitivity of Receptors

Sensitivity of Receptor	Definition
Very High	The receptor has little or no ability to absorb change without fundamentally altering its present character, and/ or is of very high environmental value, or of international importance. e.g., watercourse with a Q95flow > 1m3/s, SPZ1 within a Principal aquifer, essential infrastructure of highly vulnerable development, SPA, SAC or Ramsar site.
High	The receptor has low ability to absorb change without fundamentally altering its present character and is of national importance e.g., Principal aquifer, private water supply or watercourse with a Q95flow < $1m^3/s$ or SSSI
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, has some tourism, recreational or socio-economic value and/or is of regional importance e.g., watercourse with no permanent base flow, abstraction for non-potable use, Secondary A aquifer, Local Nature Reserve.
Low	The receptor is tolerant of change and/or is of little tourism, recreational or socio-economic value E.g., surface water or agricultural drain, spring with no potable end use, Secondary B or undifferentiated aquifer
Negligible	The receptor is resistant to change and/ or is of little tourism, recreational or socio-economic value. E.g., non-aquifer

9.3.5.2 Magnitude of Change

The magnitude of potential effects will be identified through consideration of the Proposed Development, the degree of change to baseline conditions predicted as a result of the Proposed Development, the duration and reversibility of an effect and professional judgement, best practice guidance and legislation.

In determining the magnitude of effect, the values of the asset affected are first defined. This provides the baseline against which the magnitude of change can be assessed; the magnitude of effect being proportional to the degree of change in the asset's baseline value.

The criteria for assessing the magnitude of an effect are presented in **Table 9.3.**

Table 9.3: Framework for Determining Magnitude of Effects

Magnitude of Effects	Definition
High	Total loss or major alteration (beneficial or adverse) of the receptor(s)
Medium	Loss of, or alteration to (beneficial or adverse), one or more key elements of the receptor(s).
Low	Slight alteration (beneficial or adverse) of the receptor(s).
Negligible	Barely perceptible alteration (beneficial or adverse) of the receptor(s)

9.3.5.3 Significance of Effects

The sensitivity of the asset and the magnitude of the predicted change will be used as a guide, in addition to professional judgement, to predict the significance of the likely effects. **Table 9.4** summarises guideline criteria for assessing the significance of effects.

Table 9.4: Framework for Assessment of the Significance of Effects

	Sensitivity of Resource or Receptor

Magnitude of Impact	Very High	High	Medium	Low	Negligible
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

Effects predicted to be of major or moderate significance are considered to be 'significant' in the context of the EIA Regulations and are shaded in light grey in the above table.

Effects can be beneficial or adverse and these are specified where applicable in the assessment within this Chapter.

For assessing significance, consideration is given to the national, regional and local baseline situation. The magnitude of the impact is determined in proportion to the area of impact relevant to each receptor.

9.3.6 Assessment Limitations

All data considered necessary to identify and assess the potential significant effects resulting from the Proposed Development was available and was used in the assessment reported in this Chapter.

9.4 BASELINE CONDITIONS

9.4.1 Geology

A more detailed description of the geology is provided in **Chapter 10, Ground Conditions**.

The British Geological Survey (BGS) Geoindex maps[21] indicates the Site is underlain by sand and gravel River Terrace deposits across most of the Site, with alluvium comprised of clay, silt, sand and gravel to the north-east. As the River Terrace deposits have been worked, they are not present extensively onsite[22]. The superficial deposits are underlain by pebbly sandstone of the Chester Formation. Historical names for the Chester Formation include the Bunter Sandstone Formation and Bunter Pebble Beds.

A review of the BGS borehole data showed information from several boreholes was available within the Site boundary or immediately adjacent. as detailed in **Table 9.5.**

Table 9.5 Review of Available BGS Borehole Logs in Surrounding Area

Borehole ID	Grid Reference	Location relative to Site	Geological Strata	Comment
SK68SE109	468790 384400	Approximately 150 m west of the Site.	0 – 2.7m Rough gravel (terrace deposits) 2.7 – 3.3m Sand (terrace deposits) 3.3 – 42.4m Sandstone (Bunter Pebble Beds)	Groundwater stuck at 1.3m.

[21] BGS (undated) GeoIndex Onshore [Online] Available at: GeoIndex - British Geological Survey (bgs.ac.uk)
[22] SLR Consulting (2021) Lound PFA Ground Investigation Report, Version No 2, SLR Ref 416.11943.00001

Borehole ID	Grid Reference	Location relative to Site	Geological Strata	Comment
SK68NE55	469232 385201	Approximately 75 m north of the Site.	0 – 0.4m Brown sandy Topsoil 0.4 – 0.9m Sand 0.9 – 2.1m Sand	Slow water seepage at 1.1m. Pit terminated due to excessive collapse.
SK68NE54	469805 385237	Onsite to north	0 – 0.35m Brown sandy Topsoil 0.35 – 1.6m Sand 1.6 – 2.0m Clay 2.0 – 3.0m Sand & Gravel with cobbles of sandstone	Slow water inflow at 2.3m.
SK68SE44	468902 383945	Onsite to south	0 – 196.9m Triassic Bunter Sandstone 196.9 – 212.7 Permian Upper Marl	Deeper core to prove coal seams.

The Site consists of former PFA disposal lagoons which have been reinstated to poor quality grazing land for pastoral farming, with a thin layer of topsoil overlying the PFA averaging 0.3m thickness for most of the Site[23]. The superficial deposits were only present intermittently during ground investigations.

An intrusive ground investigation by SLR Consulting (SLR) found the underlying conditions to consist of topsoil, PFA and sandstone of the Chester Formation. Occasional bands of sand and gravel were observed overlying the sandstone which were considered to be unworked River Terrace Deposits. The Site was drilled to a maximum depth of 18m bgl, with the depth determined by proving at least 1m of underlying Chester Formation. The sandstone was observed at depths between 2.45m bgl and 16.1m bgl, with shallower bedrock present to the east of the Site, along with a decrease in PFA thickness.

The Site is split between 'Low-Rise' to the east (7.5 – 11m AOD) and 'High-Rose' to the centre and west (17 – 19m AOD). There is significant variation in PFA thickness between 'high rise' and 'low rise' with an average PFA thickness of 13.4m and 3.6m respectively. Groundwater was encountered across the Site at typically 8-10m bgl in the High-Rise and 2-3m bgl in the Low-Rise. Groundwater levels indicated that the water table within the PFA is similar to the surrounding aquifer suggesting hydraulic continuity. SLR also advised following the ground investigation[24] that the underlying Chester Formation is recorded to depths of at least 137m bgl.

9.4.2 Hydrology

Ordnance Survey raster 1:25,000 mapping shows there are no mapped watercourses within the Site boundary, with the nearest Water Framework Directive (WFD) classified watercourse being the River Idle located immediately to the east of the Site boundary and flows from south to north[25]. The wider area is extensively drained with several lagoons, waterbodies, including Wetland Lakes (fishing lakes) approximately 100m north of the Site, and canals, with two drains present onsite, one to the south-west, the other to the north. The Site is shown to be located within the operational boundary of an

[23] SLR Consulting (2021) Lound PFA Ground Investigation Report, Version No 2, SLR Ref 416.11943.00001
[24] SLR Consulting (2021) Lound PFA Tip – Groundwater Abstraction Due Diligence, SLR Ref 422-11943-00002
[25] Environment Agency (2021) Catchment Data Explorer [Online] Available at: England | Catchment Data Explorer

Internal Drainage Board (IDB) - the Isle of Axholme and North Nottinghamshire Water Level Management Board[26].

The Environment Agency 'Catchment Data Explorer' shows the south of the Site lies within the 'Idle (from Maun/Poulter to Tiln)' waterbody catchment (ID GB104028058091) with a classification of Moderate ecological status. It fails the chemical status due to mercury and its compounds and polybrominated diphenyl ethers (PBDE). Reasons for not achieving good (RNAG) status include macrophytes and phytobenthos combined and phosphate concentrations due to transport drainage, poor nutrient management, poor livestock management and sewage discharge. The hydrological regime does not support 'good' due to surface water and groundwater abstractions.

The north of the Site lies within the 'Idle (from Tiln to Ryton) waterbody catchment (ID GB104028058092) with a classification of Moderate ecological status. It fails the chemical status due to concentrations of benzo(a)pyrene, mercury and its compounds, perfluorooctane sulphonate (PFOS) and PBDE. Reasons for not achieving good (RNAG) status include macrophytes and phytobenthos combined and phosphate concentrations due to transport drainage, poor soil management, and sewage discharge. The hydrological regime does not support 'good' due to surface water and groundwater abstractions.

During consultation the EA responded on the 25th May 2021 and noted that the River Idle is required to improve from moderate to good status by 2027, however, it is being impaired by the impact of water quality, particularly phosphate on macrophytes. The Idle and Torne catchment is currently closed for new consumptive abstractions due to over abstraction within the catchment[27].

Available flow rates show that the mean flow rate of the River Idle at Mattersey, down gradient of the Site, was 2.402m^3/s (1982 -2021).[28] There is no available flow rate data of the River Idle upgradient of the Site, but mean flow rate of the River Poulter at Twyford Bridge, at its confluence with the River Idle is 0.661m^3/s (1961-2021).[29]

The Site lies within the Idle and Torne management catchment within the wider Humber River Basin District. The catchment is a medium priority area for sediment issues, medium priority area for phosphate issues, a high priority area for Flood Risk Management and a Countryside Stewardship water quality medium priority area. The Site is also located within the River Idle from River Ryton to River Trent surface Nitrate Vulnerable Zone (S335).

The Site is not located within a Drinking Water Protected Area (Surface Water).

Consultation with the EA[30], Bassetlaw District Council[31] and Anglian Water[32] was undertaken regarding any records they may have of private or public surface water abstractions within 2km of the Site boundary.

The EA have provided details of the following surface water abstractions:

- One registered to the Nottinghamshire Wildlife Trust at the Idle Valley Rural Learning Centre, approximately 150m east of the Site for fish/canoe pass;

[26] ADA Representing Drainage Water Level and Flood Risk Management Authorities (2014-2021) Internal Drainage Boards Map. Available at: Internal Drainage Boards Map - Association of Drainage Authorities (ada.org.uk)
[27] Lound Ash Extraction – Environment Agency Consultation April to May 2021
[28] NRFA Station Mean Flow Data for 28015 - Idle at Mattersey (ceh.ac.uk)
[29] NRFA Station Mean Flow Data for 28036 - Poulter at Twyford Bridge (ceh.ac.uk)
[30] Consultation commenced 28th April 2021
[31] Consultation commenced 16th July 2021
[32] Consultation commenced 14th September 2021

- One registered to Fred Walter & Sons for abstraction from a reach of the River Idle as it flows past the Site for spray irrigation and storage, maximum daily quantity 2,200m^3, maximum annual quantity 75,200m^3; and
- Two registered to Tiln Farms Ltd for abstraction from a reach of the River Idle as it flows past the Site for spray irrigation (storage) (maximum daily quantity 3,000m^3, maximum annual quantity 230,000m^3) and direct trickle and spray irrigation (maximum daily quantity 3,000m^3, maximum annual quantity 130,000m^3).

The abstraction locations are presented on **Figure 9.2** in **Volume 2**.

9.4.3 Hydrogeology

The Environment Agency 'Catchment Data Explorer' shows the Site is within the wider Humber groundwater body and the Idle Torne-Permo-Triassic Sandstone Nottinghamshire and Doncaster waterbody (GB40401G31500) with an overall status of Poor due to poor nutrient management, poor livestock management, groundwater abstraction and groundwater resource impacts.

Information provided by the Environment Agency available on DEFRA's Magic Map viewer shows the Site does not lie within a Drinking Water Safeguard Zone for Groundwater. The Site, however, does lie within a Zone III total catchment Source Protection Zone.

The DEFRA Magic Map confirms that underlying the Site is a Principal bedrock aquifer (likely attributed to the underlying Chester Formation) and Secondary A superficial aquifer (likely attributed to the River Terrace Gravels and Alluvium). The groundwater vulnerability classification is stated as Medium – High.

The BGS Geoindex 1:625,000 Hydrogeology map shows the entire Site lies within a 'Highly productive aquifer' which is described as 'Principal sandstone aquifer up to 600 m thick and yielding up to 125 L/s'. Quality is reported as 'good but hard and becomes saline beneath confining Mercia Mudstone'. The direction of groundwater flow within the area is not known.

Both the Chester Formation and River Terrace deposits have high intergranular flows, with regional testing producing typical permeabilities of 0.73 - 5.5 m/day and 0.078 - 5.2 m/day respectively. PFA deposits typically record permeabilities of between 8.6x10-8-0.17 m/day. Slug tests undertaken onsite by SLR have confirmed that PFA has a low hydraulic conductivity of between approximately 1.2E-3 to 7.88E-3m/day, whilst the hydraulic conductivity of the sandstone is much higher at between 2.15 and 6.86m/day.

Monthly groundwater monitoring at three locations within the PFA and two at the perimeter is ongoing and tested for metals, PAHs[33], VOCs [34] SVOCs[35] and a range of inorganic parameters. With respect to organic compounds, laboratory results from samples taken between April 2022 and November 2022 show only minor detections within the samples taken from locations within the PFA and no exceedances of the Environmental Quality Standard (EQS) protective of freshwater. Metal concentrations show exceedances of the appropriate EQS for arsenic, boron, nickel and vanadium broadly consistently across all three locations within the PFA. Sporadic exceedances of mercury, copper, cadmium and manganese are also detected within the PFA. It should be noted that the laboratory limit of detection for cadmium and mercury was higher than the EQS. Further details of the groundwater quality can be found in Chapter10, Ground Conditions. Ammoniacal nitrogen concentrations are highly variable across all three locations within the PFA with concentrations ranging from <0.03 to 4.27 with the highest

[33] Poly Aromatic Hydrocarbons
[34] Volatile Organic Compounds
[35] Semi Volatile Organic Compounds

concentrations being found in the central area of the site. Ammoniacal nitrogen concentrations within the two perimeter wells was found to range from 1.26 to 2.89mg/l.

Groundwater strikes during the SLR GI indicated that depth to groundwater was typically 2-4m bgl across the low rise (north eastern) end of the Site, and approximately 8-10m bgl across the high rise (south western) end. Groundwater levels taken from boundary wells indicate that groundwater levels within the PFA and surrounding superficial deposits are similar, suggesting hydraulic continuity between the two. Groundwater flow direction is not known, but the natural direction is likely to be southeast towards the River Idle.

Following a request to the EA for all available groundwater elevation information within 2km of the Site a data set was received of depth to groundwater records[36] at Wetlands Lakes, immediately north of the Site, indicating groundwater is typically 2.5 – 3.5m bgl.

Consultation has been undertaken with Bassetlaw District Council requesting information on Private Water Supplies (PWS) within 2 km of the Proposed Development.

Bassetlaw District Council's consultant drainage engineer responded that there were no private water supplies in the area.

A response from the Anglian Water Abstraction Licensing Manager in the Water Resources department stated that they could not provide information on private abstractors. They did confirm however, that there are two Anglian Water Public Water Supply sources, Everton and Retford, in the surrounding area. They advised that another public abstraction in the area likely belonged to Severn Trent Water.

The EA provided information on two groundwater abstractions within 2km of the Site as follows:

- One registered to Sutton Garage Ad Ltd approximately 200m north of the Site, for process water. Maximum daily abstraction quantity 250m^3 and maximum annual quantity 35,500m^3; and
- One registered to Powell Farms, approximately 770m northwest of the Site, for spray irrigation. Maximum daily abstraction quantity 1,045m^3 and maximum annual quantity 62,737m^3

Both of these abstractions are from the 'Blythe Unit'. The location of these abstractions is presented on **Figure 9.2** in **Volume 2**.

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Both of these abstractions are from the 'Blythe Unit'. The location of these abstractions is presented on **Figure 9.2** in **Volume 2**.

Hydrological and Hydrogeological Receptors

As mentioned previously, the Site is situated within an area of rural agricultural land and is generally flat and low lying. The Site is raised with vegetated banks and largely

[36] Records for monthly monitoring 2000 – 2021 for provided by the EA WETLANDS-NEW (Station 8056GW) on the 29th November 2022

comprises improved grassland, which is used as poor-quality grazing land, with broadleaved woodland at the Site boundary.

Groundwater dependant terrestrial ecosystems (GWDTE) have not been identified as part of the ecology Phase 1 walkover, with the habitats of the area summarised in Chapter 8, Ecology.

The statutory designated sites relating to water within the wider 10 km Study Area, have been identified through the use DEFRA Magic Map datasets. The statutory designations that are considered hydrologically connected to the Proposed Development are listed in **Table 9.6**.

Statutory designations which were identified within the 10 km Study Area but were deemed not hydrologically connected to the Proposed Development are listed in **Table 9.7.**

Table 9.6: Statutory Designated Sites hydrologically connected to the Proposed Development (within 10 km)

Designated Site	Distance from Proposed Development	Qualifying Interest	Hydrological Connection to Proposed Development
Sutton and Lound Gravel Pits SSSI	Onsite	Aggregations of non-breeding birds (Gadwall, Anas stepera, variety of passage species) and assemblages of breeding birds	Designation located onsite.
River Idle Washlands SSSI	Approx. 7.9 km north	Assemblages of breeding birds (Lowland damp grasslands), aggregations of non-breeding birds (Bewick's swan), floodplain fen (lowland) and lowland wet neutral grassland	Located downstream of the Proposed Development, on banks of River Idle.
Misson Line Bank SSSI	Approx. 9.8 km north	Eutrophic lakes, lowland fens, lowland mixed deciduous woodland and standing waters	Located downstream of the Proposed Development, on banks of River Idle.

Table 9.7: Statutory Designated Sites not hydrologically connected to the Proposed Development (within 10 km)

Designated Site	Distance from Proposed Development	Qualifying Interest	Reason for scoping out of assessment
Chesterfield Canal SSSI	Approx 2.3km east	Standing open water and canals	Hydrologically disconnected by River Idle
Mattersey Hill Marsh SSSI	Approx 2.8km north west	Lowland wetland including basin fen, valley fen, floodplain fen, waterfringe gen, spring/flush fen and raised bog lag	Located upstream of the Proposed Development
Clarborough Tunnel SSSI	Approx 4.5km south east	Lowland calcareous grassland	Hydrologically disconnected by River Idle
Castle Hill Wood SSSI	Approx 5.0km south east	Lowland mixed deciduous woodland	Located upstream and hydrologically

Designated Site	Distance from Proposed Development	Qualifying Interest	Reason for scoping out of assessment
			disconnected by River Idle
Scrooby Top Quarry SSSI	Approx 5.4km north west	Non-Marine Permian Triassic	Located upstream of the Proposed Development
Barrowhill Sandpit SSSI	Approx 6km north	Lowland dry acid grassland	Located upstream of the Proposed Development
Gamston & Eaton Woods & Roadside Verges SSSI	Approx 6.5km south east	Lowland neutral grassland and lowland mixed deciduous woodland	Located upstream and hydrologically disconnected by River Idle
Clumber Park SSSI	Approx 6.9km south west	Assemblages of breeding birds (lowland open waters and their margins, woodland), Invert. Assemblage (heartwood decay, bark and sapwood decay, fungal fruiting body), lowland dry acid grassland, lowland dry heath, lowland neutral grassland, lowland wetland and wet woodland	Located upstream of the Proposed Development
Treswell Wood SSSI	Approx 7.5km south east	Lowland mixed deciduous woodland	Located upstream and hydrologically disconnected by River Idle
Ashton's Meadow SSSI	Approx 9.5km south east	Lowland neutral grassland	Located upstream and hydrologically disconnected by River Idle

9.4.4 Flooding

A standalone Flood Risk Assessment (FRA) has been prepared and is presented in **Volume 3, Appendix 9.2**.

A flood risk assessment has been completed for the Proposed Development covering all sources of flooding including:

- Fluvial
- Tidal
- Pluvial (surface water)
- Groundwater; and
- Reservoir flooding (in the event of a dam failure or breach) and
- Sewers and highway drains

Volume 3, Appendix 9.2 gives a full account of the methodology adopted, sources of data, analysis of the data and the assessment of potential impacts.

The conclusions of the assessment are as follows:

Fluvial

The EA provided the River Idle Hydraulic Modelling Report (2020) and associated modelled flood level results for a range of return periods through the product request service.

As the Proposed Development is classed as Less Vulnerable, as per Annex 3: Flood risk vulnerability classification: of the National Planning Policy Framework and, would have an operational lifetime of approximately 25 years, the Central band for the 2050's is assessed as the appropriate climate change allowance.

The revised 'flood risk assessments: climate change allowance' peak river flow allowances for the Idle and Torne Management Catchment for the 2050s is 12 %. The lowest climate change allowance simulated in the 2020 update of the River Idle model is 20 % and therefore significantly above the Central allowance, meaning this assessment takes a conservative approach to flood risk.

Based on close inspection of the flood level results of the EA flood model, the Site is not at risk up to, and including, the 1 % AEP event plus 20 % climate change and the 0.1 % AEP event.

As such, the Sequential and Exception tests are passed i.e., the Site is located in the lowest zone of flood risk, as per EA Flood Risk and Coastal Change Guidance.

Tidal

The Site is located inland and the River Idle is not a tidally influenced watercourse within the vicinity of the Site.

Therefore, the risk of tidal flooding to the Proposed Development would be Negligible.

Pluvial (surface water) flooding

Minor isolated areas are mapped to be at risk of surface water flooding from the 33 % AEP and 1 % AEP events.

With active surface water management, there would be limited potential for transfer of surface water offsite. Therefore, onsite operations would be at limited risk meaning the risk of pluvial flooding would be Negligible.

Groundwater

In accordance with the drainage disposal hierarchy outlined in the CIRIA SuDS Manual (C753), it is proposed that, subject to an abstraction licence being granted, the discharge of dewatering from active areas of the Site would l be via pumping to settling and soakaway ponds, the latter to be constructed in LR Phase 1 and LR Phase 2 along the southern boundary of the site by excavating through the PFA and into the underlying sandstone.

If an abstraction licence is not granted then, as an alternative to dewatering, the material below the water table would be worked wet.

As such, the risk of groundwater flooding would be Negligible.

Reservoir flooding

The EA flood risk from reservoirs map, indicates the Site itself is not modelled to flood should there be a breach or failure at a nearby reservoir both when river levels are normal and when there is a combination of flooding from rivers and a reservoir breach. The areas surrounding the Site are however modelled to flood in the event of a reservoir breach.

The risk of flooding from reservoirs would be reduced through regular maintenance by the operating authority, with reservoirs in the UK having an extremely good safety record with no incidents resulting in the loss of life since 1925.

The Reservoirs Act 1975 requires all large reservoirs to be regularly inspected and supervised by reservoir panel engineers.

As such, the residual risk of flooding associated with reservoirs would be Negligible.

Sewers and Highway Drains

The Site is located on a built-up PFA deposit which is not served by highways or utilities drainage.

As such, the risk of flooding from sewers and drains would be Negligible.

9.4.5 Drainage

Currently the majority of the Site is undeveloped. In these areas a component of rainfall will infiltrate the soft landscaping followed by either vertical downwards migration to groundwater in the PFA or plant uptake. It is likely that groundwater flow across the Site would support a component of baseflow to the River Idle. The PFA has a low permeability and there would therefore also be a component of rainfall that comprises surface water run-off.

The southern end of the Site (Bellmoor Industrial Estate – Area C), proposed to comprise the Main Processing Site, is covered by hardstanding. Currently surface water here is managed by an existing underground drain that discharges to a tributary of the River Idle via three outfalls and has its own drainage system. Foul water is discharged to a septic tank. The Breedon batching plant, also on the industrial estate has a settlement pond to manage all surface and process water.

Example of current outfall to tributary of the River Idle

9.5 ASSESSMENT OF LIKELY EFFECTS

The Conceptual Site Model (CSM) is a representation of the potential pollutant linkages arising from the construction, operation and decommissioning of the Proposed Development. The CSM identifies the source (of impact), a pathway and a potential receptor. An effect can only occur if all three components are present, creating an impact linkage between the source and the receptor. **Table 9.8** provides a tabular representation of the CSM.

Table 9.8 Source-pathway-receptor linkage

Project Activity	Potential Source	Potential Pathway	Potential Receptor
Accidental spillages including via refuelling, washing, leakages	Hydrocarbons	Surface water runoff could provide a pathway to surface water. Infiltration could result in vertical migration into the underlying groundwater.	River Idle and down gradient receptors including nearby SSSIs. Private water abstractions, SPZ3, Superficial deposits and Chester Sandstone aquifer
Excavation, land clearance, stockpiles, material movement	Increased sediment loads	Site runoff containing elevated suspended sediment levels.	River Idle and down gradient receptors including nearby SSSIs.
Dewatering of excavation	Dewatering of excavation	Reduction in groundwater levels leading to reduced baseflow to surface water receptors and potential reduced levels within surface waters	River Idle and down gradient receptors including nearby SSSIs. Private water abstractions, SPZ3, Superficial deposits and Chester Sandstone aquifer
Discharge of dewatering water	PFA within the dewatering water	Dewatering water containing PFA or other contaminants being discharged to ground or surface water. Abstracted water would include PFA leachate, rainwater and abstracted water within the excavation.	River Idle and down gradient receptors including nearby SSSIs. Private water abstractions, SPZ3, Superficial deposits and Chester Sandstone aquifer
Excavation of PFA	PFA within the ground/excavation	Leachate from the PFA, rainfall and potential flow of groundwater into the excavation could result in site flooding and impact quality and quantity of surface water and other receptors.	River Idle and down gradient receptors including nearby SSSIs. Private water abstractions, SPZ3, Superficial deposits and Chester Sandstone aquifer
Construction and operation of Processing Areas (Areas A&C)	Increased hardstanding	Increased surface water runoff may lead to increased erosion of the River Idle and impact groundwater and surface water quality	River Idle and down gradient receptors including nearby SSSIs. Private water abstractions, SPZ3, Superficial deposits and Chester Sandstone aquifer
Construction and operation of Main Processing Site (Area C)	Increased contaminant concentrations in surface water run-off	Surface water run-off in this area may include PFA, oils or other contaminants.	River Idle and down gradient receptors including nearby SSSIs. Private water

Project Activity	Potential Source	Potential Pathway	Potential Receptor
			abstractions, SPZ3, Superficial deposits and Chester Sandstone aquifer
Construction and operation of new haulage road	Increased hardstanding with potential contamination in surface water run-off. Traffic may spread PFA or other potential contaminants along road surface.	Surface water run-off from haulage roads may impact surface water and groundwater quality.	River Idle and down gradient receptors including nearby SSSIs. Private water abstractions, SPZ3, Superficial deposits and Chester Sandstone aquifer
Change in topography	Change in topography	Change in the contributing surface water catchment area.	Surrounding ecological receptors.

The CSM identifies the potential linkages between the Proposed Development and surrounding receptors however it does not predict the likelihood of them being created.

9.5.1 Construction Effects

Through the CSM the following potential effects have been identified during construction:

- Potential chemical pollution of surface water and groundwater from accidental chemicals spills from fuel or chemical storage, refuelling, washing or leakages from plant onsite;
- Potential chemical pollution of surface water and groundwater from chemical spills or dusts from infrastructure construction, including concrete; and
- Potential sediment/erosion of surface water courses from construction of hardstanding.

9.5.2 Operational Effects

Through the CSM the following potential effects have been identified during operation:

- Potential impact to water quality of surface water and groundwater from accidental chemicals spills from fuel or chemical storage, refuelling, washing or leakages from plant onsite;
- Potential impact to water quality of surface water and groundwater due to leaching/mobilisation of pollutants from the PFA lagoons during excavation, even if no dewatering is undertaken. This would as a result of changes in drainage across the Site resulting in the discharge of runoff that has been in contact with PFA or other potential contaminants on the ground surface;
- Potential impact to water quality of surface water and groundwater due to discharge of abstracted groundwater from the excavations if dewatering is undertaken;
- Potential erosion/sedimentation of surface waters from excavated materials and stockpiles onsite, loading and transport of materials across the Site, processing of waste at conveyor and processing site, dewatering of PFA lagoons;
- Reduced flow to surface water features due to dewatering during excavation if dewatering is undertaken;

- Changes in flow and quality of flow to surface water features due to increased hard standing and changes in site drainage;
- Reduced groundwater elevations due to dewatering during excavation if dewatering is undertaken;
- Potential impact to groundwater quality from infiltration of contaminated surface water run-off
- Reduced infiltration to groundwater due to increased hard standing and changes in site drainage; and
- Indirect impact on water quality or quantity at the designated sites or groundwater abstractions downgradient of the Site due to impacts on groundwater or surface water.

Table 9.9 presents the approximate radius of influence for different drawdowns due to abstraction within the PFA and sandstone based on initial Sichardt equation calculations, using the hydraulic conductivity values determined from the onsite slug tests. It can be seen that based on these initial calculations, the radius of influence of abstraction within the sandstone should not significantly impact water levels within the River Idle or other nearby ecological receptors such as the Wetland lakes to the north.

Table 9.9 Radius of Influence for Different Drawdowns

Parameter		**Value Used**		**Source**
Sandstone hydraulic conductivity (m/day)		2.47 – 3.94		Based on slug test data for GW2 located in the vicinity of the potential soakaway location
PFA Hydraulic Conductivity (m/day)		0.005		Based on slug test results in PFA
Radius of Influence (m)	Drawdown (m)	PFA	Sandstone	Calculated based on Sichardt using K values in determined from slug tests
	1	0.72	17.75	
	2	1.44	35.5	
	3	2.17	53.24	
	4	2.89	70.99	
	5	3.61	88.74	
	6	4.33	106.49	

9.5.3 Restoration Effects

The restoration of the Site comprises a series of phases whereby restoration follows extraction activities progressively throughout the operation of the Proposed Development. It is proposed to provide a new and permanent network of unlined field ditches as the Site is progressively restored draining to the proposed wet meadow areas and, ultimately, the existing drain adjacent to the Low-Rise (likely on the northern boundary of the Site). These ditches are shown on the Restoration Landscape Masterplan, **Volume 2, Figure 7.12.** The ditches would be separated from any ongoing operational areas.

The outline design concept is presented in **Volume 3, Appendix 8.5**, Outline Restoration Strategy, but is ecology led. The following potential effects have been identified:

- Removal of the PFA through the operation of the Proposed Development may result in improved groundwater quality at the Site;

- Change to hydrogeological response and drainage pathways across the Site due to changes in topography and habitat; and
- Change to the active flood plain due to changes in topography.

9.6 CUMULATIVE EFFECTS ASSESSMENT

The appropriate scale for considering cumulative development depends on the nature of the potential effect. There are considered in turn, for each category of potential effect.

There are a number of development sites, either consented or in the planning process. Those summarised in **Table 9.10** are located within a 3km radius of the Site.

None of these are considered to result in a cumulative effect on the water environment with respect to water quality and water resources.

Table 9.10 Cumulative Sites

Reference No	Development	Approximate Distance and direction from the Site	Comment
17/00931/FUL	Erect Four Holiday Lodges, Single Storey Building for Fish Welfare/Reception/Equipment Store	0.1 km west of the Site	Minor development and would not impact flood risk, groundwater or surface water flow at Site. Planning condition includes condition for further details on foul and surface water disposal from site.
SITE HS7	Planning permission for Phase 1 comprising 196 dwellings and 11.11ha of employment/employment. A further 305 dwellings on 11.15 ha is proposed.	0.38 km southwest of the Site	Flood management scheme including SuDS would be included. Proposed Development is located at the southern end of the Site away from the main excavation areas.
17/01509/FUL	Engineering Operations to Sub-Divide Lake into Four Smaller Lakes	1.09 km north of the Site	Proposed Development is unlikely to make significant changes to flood risk, groundwater or surface water flow.
20/01405/FUL	Tiln Farm: Installation and Operation of a Solar Farm.	1.2km east of the Site	Flood risk assessment has been undertaken to ensure no changes from the Proposed Development and Proposed Development is hydraulically separated from the Site by the River Idle
19/00157/SCR	Residential development (171 Dwellings) with associated infrastructure – Screening opinion	2.25km southeast of the Site	Proposed Development is hydraulically separated from the Site by River Idle and at a distance unlikely to result in cumulative impact

9.7 MITIGATION AND RESIDUAL EFFECTS

9.7.1 Embedded Mitigation

Measures to avoid or reduce potential effects on sensitive receptors have been incorporated into the design of the Proposed Development ('embedded mitigation'). This includes 'mitigation by design' whereby aspects of the Proposed Development have been designed/re-designed to avoid or reduce effects. Embedded mitigation is taken into

consideration when undertaking the assessment of significant effects. If significant effects are predicted further mitigation is detailed.

9.7.2 Site Drainage

As part of the embedded mitigation, drainage would be managed to ensure no significant impacts to surface water and groundwater quality and flow from changes to the Site drainage.

As stated in the Strategic FRA for Bassetlaw District Council[37] '*drainage from the site should be via a sustainable drainage system that aligns with the CIRIA Suds Manual and non-statutory technical guidance. The hierarchy of drainage options should be infiltration, discharge to watercourse and finally discharge to sewer subject to the approval of the statutory utility. If infiltration is not to be used on the site, justification should be provided including the results of infiltration tests'*

Figure 9.3 in **Volume 2** presents the location of the main components of the Site drainage. Each component is discussed in further detail below.

9.7.2.1 Groundwater Drainage

Excavation Areas

The Site may generate significant quantities of water through active dewatering of groundwater in addition to surface water flows through runoff and direct rainfall.

Initially inflow volumes would be relatively low due to the low permeability of the PFA, however once the excavation reaches the base of the PFA / top of the underlying sandstones the volumes would potentially be significantly higher due to groundwater upwelling from sandstone. Dewatering would be achieved by excavating base ditches at the bottom of the wet face, to collect groundwater. This would then travel into a sump, where the top water would be removed allowing the remaining silt laden water to settle within the main dig. A schematic cross section of this system is presented in **Figure 9.4, Volume 2**.

It is proposed that the discharge of dewatering from active areas of the Site would be via pumping to settlement ponds and soakaway, the latter to be constructed in year 3 (in LR P1 and LR P2) along the southern boundary of the Site by excavating through the PFA and into the underlying sandstone. To help with water management it is proposed that any soakaway would comprise at least 3 separate ponds (to allow for sediment removal from one whilst maintaining discharge from others). The primary settlement would be positioned on an area adjacent to the soakaway ponds with overflow to the soakaway ponds by gravity. The proposed location of the settlement ponds and soakaway is presented on **Figure 9.3** in **Volume 2**.

Preliminary sizing of the soakaways has considered the potential rainfall-runoff volumes from the active area including direct rainfall to the bench below groundwater level and potentially runoff from higher extraction benches. Where necessary bunds would be constructed around the perimeter of the active area in order to segregate overland flows (clean water) from surrounding grassland areas from the water in the active excavation. Currently surface water would infiltrate and runoff, and the surface water scheme would look to maintain this passive drainage approach.

Additional slug testing would be carried out in the sandstone boreholes on the Site to validate the hydraulic conductivity values assumed in the assessment of infiltration rates from the proposed groundwater soakaway. Consideration would also be given to the potential volumes of leachate and runoff from areas of hardstanding at the Processing Areas (1-3) where material is stockpiled temporarily prior to screening and onward

[37] Strategic Flood Risk Assessment for Bassetlaw District Council Final Report, January 2019

transport to the Main Processing Site. It is envisaged that this water would be intercepted by a system of sealed cut-off drains and collected in a sump where the top water would be pumped to the primary settlement ponds. During HR Phase 1, it is envisaged that an initial settlement pond and soakaway may be established within the main dig area prior to construction of the primary settlement and soakaway ponds to allow discharge of settled leachate to groundwater by infiltration. However, the more likely scenario is that the Applicant would avoid any groundwater abstraction until the main settlement and soakaway ponds are constructed.

The Site is located in a catchment that is currently closed to consumptive abstraction due to over abstraction. If de-watering is required to extract the PFA the drainage has been designed so that the water would be returned to ground via settlement ponds and soakaway to ensure the abstraction is non consumptive.

In the event that an abstraction licence is not granted then, as an alternative to dewatering, material below the water table would be wet worked.

9.7.2.2 Surface Water Drainage

Main Processing Site

The Main Processing Site would be constructed within the footprint of the existing Bellmoor Industrial Estate and, subject to a detailed condition survey and potential modifications, would utilise the same drainage system that outfalls to an unnamed watercourse, which is a tributary of the River Idle.

A review of Severn Trent asset drawings for the road system in the immediate vicinity of the Site did not identify any existing surface water or foul sewers and it is therefore proposed to improve the existing outfalls and use these to discharge clean "non-contact" water to the tributary of the River Idle. All water that has come into contact with PFA (for example, leachate draining from material stockpile areas or any water from PFA drying) would be intercepted by a cut-off drainage system and directed to a settlement pond and then discharge point at the Main Processing Site and/or to the settlement and soakaway ponds within the extraction area (Area A).

If required, additional below ground storage and interceptors would be retrofitted into the existing drainage system to ensure that there would be no adverse impact on the quality and quantity of drainage entering the receiving watercourse.

Processing Areas 1-3

Development of the settlement ponds and soakaways is anticipated to be completed in year 3 (in LR P1 and LP P 2). Prior to this, excavation of the PFA would be above the water table and surface water runoff would be pumped to the Main Processing Site (Area C) to be discharged through the existing system. The more detailed assessment of the condition and capacity of the existing system, to be undertaken as part of the detailed design for the main dig dewatering system, would confirm whether this is practicable. If not, alternative arrangements, such as the construction of a temporary settlement pond within the main dig (Area A), would be made on order to discharge this water.

On completion of the main settlement ponds and soakaways, and for the entire operation of the Processing Areas 1-3, depending on extraction phase, direct rainfall and runoff from temporary stockpiles would be intercepted by the leachate management system described the groundwater drainage system described in **Section 9.7.2.1**.

Roof drainage from buildings would be managed in a separate system and pumped directly to soakaway or recycled for use elsewhere.

It is anticipated that the runoff volumes generated from these areas would be insignificant in comparison to dewatering volumes and could therefore be pumped directly to the soakaway ponds/discharge. Further, more detailed assessment of the

runoff volume in a 1 in 100-year storm plus allowance for climate change would however be undertaken as the design of the dewatering system is refined to confirm this, and if necessary additional attenuation would be provided within the stormwater system to balance flows.

Extraction Areas

Direct rainfall and run-off from active areas would be managed through the dewatering system described in the groundwater drainage system described in **Section 9.7.2.1**.

Haulage Roads

It is anticipated that the haul roads would be constructed using a mixture of compacted material including sandstone won from excavation within the working area and imported clean material that is deemed suitable for road construction. This material would be placed in layers and compacted. The surface of the haul road would be unsealed and therefore is considered to be semi-permeable. It is therefore likely that there would be a proportion of surface runoff in an extreme storm event that would exceed the greenfield runoff rate. This excess volume would be stored in an unlined ditch system running parallel to the haul road. Runoff from the road surface in an extreme storm event would flow over the edge of the road and into the ditch system. If upon further, more detailed analysis of the haul road drainage there is deemed to be a requirement to control potential sediment runoff, then there is scope to incorporate semi-permeable check dams to encourage ponding and settlement within the ditch system.

A number of mitigation measures would be put in place to avoid cross contamination of surface runoff by traffic using the haul road:

- Wheel wash on the Main Processing Site and mobile jetwash. This would ensure debris from the Main Processing Site is not deposited on the haulage road by traffic; and
- Dust management to ensure that PFA dust would not be blown onto the haulage road. Details of the dust management is provided in **Chapter 13, Air Quality.**

9.7.3 Restored Areas

It is proposed to provide a new and permanent network of unlined field ditches as the Site is progressively restored. The ditch network would have a gentle flow from north to south across the Site, and to the northeast, where water would join the wider hydrological network. Ditches are a Nottinghamshire Priority Habitat. Within the restoration strategy they would aid drainage of the restored landform and act as field boundaries in the wet grassland areas. Additionally, they would provide a mechanism for water level management, such as seasonal flooding of the wet grassland. These ditches are shown on the Restoration Landscape Masterplan (**Volume 2, Figure 7.12**).

9.7.3.1 Additional Water Management

PFA Moisture

The PFA would be dried at the Main processing Site to ensure that moisture content is reduced to 1% or less. The amount of moisture taken from the PFA would depend on the time of year and whether the PFA was excavated above or below the groundwater level. During the temporary optimisation works (estimated at between 6 to 24 months) testing would be undertaken to determine the quality of the moisture removed. Currently it is envisaged that vapour from the drying process would be condensed and discharged to the site drainage system; however, if concentrations within the condensate water are sufficiently low the moisture may be discharged to atmosphere. This would be determined

by, amongst other things, the environmental permit and discharge consent applications that are ongoing.

Offices and Welfare Facilities

Foul water from the offices and welfare facilities would be discharged to the existing septic tank on the Bellmoor Industrial Estate subject to a detailed conditions survey.

Following consultation with the EA, and further site work to validate onsite infiltration rates a detailed drainage plan would be produced. SuDS and drainage discharges would be applied for through an application to Nottinghamshire County Council and Bassetlaw District Council following further consultation.

9.7.4 Water Environmental Management Plan (WEMP)

The WEMP (**Volume 3, Appendix 9.1**) is included as part of the embedded development design. The WEMP comprises methods of work which are established and effective measures that the Applicant would be committed to throughout the Proposed Development consent and would follow good practice in all aspects of construction, operation, and restoration. This would be approved by the local planning authority in consultation with the EA prior to the commencement of the construction phase.

The WEMP also sets out measures to be employed to avoid or mitigate potential pollution for all phases of the Proposed Development, and also includes an Incident Plan to be followed should a pollution event occur. This plan would be produced following consultation and agreement with EA and all appropriate personnel working on the construction site would be trained in its use.

Specific mitigation measures during construction and operation would include:

- Potentially contaminating chemicals would be stored appropriately in designated areas within the construction compound onsite to prevent any accidental spills;
- All vehicles and plant would be supplied with an appropriately sized spill kit(s) and plant with drip pans to contain minor spills;
- Regular vehicle and plant checks would be conducted (through daily checklists) to ensure minimal potential for fuel or oil leaks to occur;
- Where maintenance of machinery is required, it would take place offsite if possible. If maintenance is required onsite, it would be conducted on suitable absorbent spill pads with drip pans;
- Construction compounds would have a bunded area underlain by impermeable ground membrane layer. The bunded area would have 110% capacity to attenuate stored liquids;
- Any concrete pours would be planned and specific procedures adopted in accordance with CIRIA C532;
- Any dewatering works would only be undertaken under permit and following a hydrogeological assessment including the consideration of impacts on other groundwater abstractions, surface water courses and SSSIs. To prevent effects on groundwater flows and quality mitigation measures such as the installation of cut off structures would be used as required;
- Discharge of water into ponds during reinstatement works must not cause further erosion and energy dissipation measures should be emplaced;
- Discharge of water into the soakaway ponds would be subject to a discharge consent. As part of this consent, and in agreement with the EA, appropriate limits for potential contaminants of concern would be set in order to protect the surface water and SSSI receptors. To determine the appropriate limits a more detailed risk assessment, which may include hydrogeological modelling, would be undertaken;

- Regular monitoring of the discharge from the settlement pond to the soakaway would be undertaken to ensure compliance with discharge consent limits; Material would be stored in bunded areas and would be compacted and covered to prevent wind whipping;
- Topsoil would be separated from underlying PFA prior to being stockpiled;
- Topsoil would be replaced on top of excavation during restoration works to allow reseeding;
- All stockpiled and bunded material would be stored at least 20 m from any artificial drains and waterbodies to reduce wash-off of sediments;
- Exposed ground, stockpiles and bunds should be regularly inspected to ensure erosion of material is not taking place;
- Exposed ground would be open for as short a time as practicable with the area excavated and restored in phases to ensure this;
- If run-off of sediment is observed onsite, measures such as silt fencing and settlement ponds would be employed;
- Articulated trucks used to transport material would be covered/enclosed to prevent escape of material;
- A surface monitoring programme would be established prior to the construction phases of the Proposed Development and agreed with the EA. This would include visual inspections and surface water sampling; and
- A groundwater monitoring programme would be established prior to the construction phase of the Proposed Development and agreed with the EA (the Applicant has already installed 5x monitoring boreholes).

Although the WEMP is currently outline, it would evolve to take account of consultee feedback and detailed design, there is sufficient confidence in the effectiveness of the measures set out in the WEMP for them to be treated as part of the Proposed Development for the purposes of this assessment. Measures and procedures outlined in the WEMP would be adopted and incorporated into a single working document to be agreed with statutory consultees and the planning authority following consent by way of an appropriately worded planning condition.

Accordingly, the assessment of significance of effects of the Proposed Development are considered assuming the inclusion of the WEMP as standard embedded mitigation procedure.

9.8 SUMMARY OF EFFECTS

Table 9.11 provides a summary of effects from construction and operation as detailed within this chapter. Potential effects from changes to flood risk have not been included in this table.

Table 9.11: Summary of Effects

Receptor (sensitivity)	Potential Effect	Magnitude of impact with embedded mitigation	Justification	Significance of Effect	Additional Mitigation Proposed	Residual Significance
Construction Phase						
River Idle (very high)	Water quality	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill response plan to ensure no pollution impact to the River Idle. This would include measures during concrete preparation to ensure no concrete enters the watercourse.	Minor, negative	None	Minor, negative
River Idle (very high)	Increased surface run-off which could lead to erosion and sedimentation	Negligible	CEMP/WEMP would ensure measures to prevent sedimentation of the River Idle. Site drainage measures and SuDs would be designed to prevent increased surface runoff to River Idle.	Minor, negative	None	Minor, negative
Superficial deposits Secondary A aquifer (high)	Chemical pollution	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill response plan and drainage design would ensure no pollution impact to the superficial deposits.	Minor, negative	None	Minor, negative
Chester Sandstone Principal aquifer – includes SPZ3 and	Chemical pollution	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill	Minor, negative	None	Minor, negative

Receptor (sensitivity)	Potential Effect	Magnitude of impact with embedded mitigation	Justification	Significance of Effect	Additional Mitigation Proposed	Residual Significance
private water abstractions (high)			response plan and drainage design would ensure no pollution impact to the Chester Sandstone.			
Sutton and Lound Gravel Pits SSSI (very high)	Chemical Pollution	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill response plan and drainage design would ensure no pollution of superficial deposits due to spillages or leakages.	Minor, negative	None	Minor, negative
Sutton and Lound Gravel Pits SSSI (very high)	Water flow	Negligible	Site drainage measures and SuDs would be designed to maintain natural site drainage as much as possible and therefore negligible impact on water quantity/flow at the SSSI.	Minor, negative	None	Minor, negative
River Idle Washlands SSSI (very high)	Chemical Pollution	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill response plan and drainage design would ensure no pollution of superficial deposits due to spillages or leakages.	Minor, negative	None	Minor, negative
River Idle Washlands SSSI (very high)	Water flow	Negligible	Site drainage measures and SuDs would be designed to maintain natural site drainage as	Minor, negative	None	Minor, negative

Receptor (sensitivity)	Potential Effect	Magnitude of impact with embedded mitigation	Justification	Significance of Effect	Additional Mitigation Proposed	Residual Significance
			much as possible and therefore negligible impact on water quantity/flow at the SSSI.			
Mission Line Bank SSSI (very high)	Chemical Pollution	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill response plan and drainage design would ensure no pollution of superficial deposits due to spillages or leakages.	Minor, negative	None	Minor, negative
Mission Line Bank SSSI (very high)	Water flow	Negligible	Site drainage measures and SuDs would be designed to maintain natural site drainage as much as possible and therefore negligible impact on water quantity/flow at the SSSI.	Minor, negative	None	Minor, negative
Adjacent ecological Wetland lakes (medium)	Chemical Pollution	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill response plan and drainage design would ensure no pollution of offsite ecological receptors due to spillages or leakages.	Negligible	None	Negligible
Adjacent ecological Wetland lakes (medium)	Water flow	Negligible	Site drainage measures and SuDs would be designed to maintain	Negligible	None	Negligible

Receptor (sensitivity)	Potential Effect	Magnitude of impact with embedded mitigation	Justification	Significance of Effect	Additional Mitigation Proposed	Residual Significance
			natural site drainage as much as possible and therefore negligible impact on water quantity/flow at the receptors.			
Operational Phase						
River Idle (very high)	Water quality	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill response plan and drainage design to ensure no pollution impact to the River Idle. A regular groundwater and surface water monitoring regime would be established throughout the lifetime of the Proposed Development. Monitoring of discharge from the settlement pond to the soakaway would be undertaken to ensure that discharge consent limits are not exceeded. If exceedances are noted additional treatment would be required.	Minor, negative	None	Minor, negative
River Idle (very high)	Sedimentation/erosion	Negligible	Surface water runoff captured by site drainage system and subject to a testing	Minor, negative	None	Minor, negative

Receptor (sensitivity)	Potential Effect	Magnitude of impact with embedded mitigation	Justification	Significance of Effect	Additional Mitigation Proposed	Residual Significance
			regime. Site drainage measures and SuDs would be designed to maintain natural site drainage as much as possible and reduce sedimentation/erosion of the River Idle			
River Idle (very high)	Water quantity	Negligible	If dewatering is required hydrogeological modelling would be undertaken to determine potential abstraction effects. If required, mitigation such as cut-off walls, would ensure no impact to the River Idle water quantity and flow.	Minor, negative	None	Minor, negative
Chester Sandstone Principal aquifer – includes SPZ3 and private water abstractions (high)	Water quality	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill response plan and drainage design would ensure no pollution impact to groundwater. A regular groundwater and surface water monitoring regime would be established throughout the lifetime of the Proposed Development. Monitoring of discharge from the settlement pond to the soakaway would be	Minor, negative	None	Minor, negative

Receptor (sensitivity)	Potential Effect	Magnitude of impact with embedded mitigation	Justification	Significance of Effect	Additional Mitigation Proposed	Residual Significance
			undertaken to ensure that discharge consent limits are not exceeded. If exceedances are noted additional treatment would be required.			
Chester Sandstone Principal aquifer – includes SPZ3 and private water abstractions (high)	Water quantity	Negligible	Site drainage measures and SuDs would be designed to maintain natural site drainage and infiltration as much as possible. If dewatering is required further hydrogeological modelling would be undertaken to refine potential abstraction effects as part of the permitting application. If required, mitigation such as cut-off walls would ensure no impact to groundwater elevations outside of the excavated area.	Minor, negative	None	Minor, negative
Sutton and Lound Gravel Pits SSSI (very high)	Water quality	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill response plan and drainage design would ensure no pollution impact to the SSSI. A regular groundwater and surface water monitoring regime would be	Minor, negative	None	Minor, negative

Receptor (sensitivity)	Potential Effect	Magnitude of impact with embedded mitigation	Justification	Significance of Effect	Additional Mitigation Proposed	Residual Significance
			established throughout the lifetime of the Proposed Development. Monitoring of discharge from the settlement pond to the soakaway would be undertaken to ensure that discharge consent limits are not exceeded. If exceedances are noted additional treatment would be required.			
Sutton and Lound Gravel Pits SSSI (very high)	Water quantity	Negligible	Site drainage measures and SuDs would be designed to maintain natural site drainage and infiltration as much as possible. If dewatering is required hydrogeological modelling would be undertaken as part of the permit application to refine potential abstraction effects. If required, mitigation such as cut-off walls would ensure no impact to groundwater elevations outside of the excavated area and therefore no impact to the SSSI.	Minor, negative	None	Minor, negative
River Idle Washlands SSSI	Water quality	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill response plan and	Minor, negative	None	Minor, negative

Receptor (sensitivity)	Potential Effect	Magnitude of impact with embedded mitigation	Justification	Significance of Effect	Additional Mitigation Proposed	Residual Significance
			drainage design would ensure no pollution impact to the SSSI. A regular groundwater and surface water monitoring regime would be established throughout the lifetime of the Proposed Development. Monitoring of discharge from the settlement pond to the soakaway would be undertaken to ensure that discharge consent limits are not exceeded. If exceedances are noted additional treatment would be required.			
River Idle Washlands SSSI	Water quantity	Negligible	Site drainage measures and SuDs would be designed to maintain natural site drainage and infiltration as much as possible. If dewatering is required further hydrogeological modelling would be undertaken as part of the permit application to refine potential abstraction effects. If required, mitigation such as cut-off walls would ensure no impact to groundwater elevations	Minor, negative	None	Minor, negative

Receptor (sensitivity)	Potential Effect	Magnitude of impact with embedded mitigation	Justification	Significance of Effect	Additional Mitigation Proposed	Residual Significance
			outside of the excavated area and therefore no impact to the SSSI.			
Mission Line Bank SSSI (very high)	Water quality	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill response plan and drainage design would ensure no pollution impact to the SSSI. Monitoring of discharge from the settlement pond to the soakaway would be undertaken to ensure that discharge consent limits are not exceeded. If exceedances are noted additional treatment would be required.	Minor, negative	None	Minor, negative
Mission Line Bank SSSI (very high)	Water quantity	Negligible	Site drainage measures and SuDs would be designed to maintain natural site drainage and infiltration as much as possible. If dewatering was required further hydrogeological modelling would be undertaken as part of the permit application, to refine potential abstraction effects. If required mitigation such as cut-off walls would ensure no impact to	Minor, negative	None	Minor, negative

Receptor (sensitivity)	Potential Effect	Magnitude of impact with embedded mitigation	Justification	Significance of Effect	Additional Mitigation Proposed	Residual Significance
			groundwater elevations outside of the excavated area and therefore no impact to the SSSI.			
Adjacent ecological Wetland lakes (medium)	Water quality	Negligible	CEMP/WEMP would ensure minimal spillage and a good spill response plan and drainage design would ensure no pollution impact to the receptor. Monitoring of discharge from the settlement pond to the soakaway would be undertaken to ensure that discharge consent limits are not exceeded. If exceedances are noted additional treatment would be required.	Negligible	None	Negligible
Adjacent ecological Wetland lakes (medium)	Water quantity	Negligible	Site drainage measures and SuDs would be designed to maintain natural site drainage and infiltration as much as possible. If dewatering was required further hydrogeological modelling would be undertaken as part of the permit application, to refine potential abstraction effects. If required mitigation such as cut-off walls would	Negligible	None	Negligible

Receptor (sensitivity)	Potential Effect	Magnitude of impact with embedded mitigation	Justification	Significance of Effect	Additional Mitigation Proposed	Residual Significance
			ensure no impact to groundwater elevations outside of the excavated area and therefore no impact to the receptor.			

9.8.1 Summary of Restoration Effects

There are no predicted significant impacts to surface water, groundwater or flood risk from the restoration of the Site. It is proposed to provide a new and permanent network of unlined field ditches as the Site is progressively restored. The ditch network would have a gentle flow from north to south across the Site, and to the northeast, where water would join the wider hydrological network. Ditches are a Nottinghamshire Priority Habitat. Within the restoration strategy they would aid drainage of the restored landform and act as field boundaries in wet grassland. Additionally, they would provide a mechanism for water level management, such as seasonal flooding of wet grassland. These ditches are shown on the Restoration Landscape Masterplan, **Figure 7.12, Volume 2.** The surface water catchment and natural groundwater elevations would not be altered by the restoration of the Site and there would therefore be no significant effects to water flow to offsite receptors. However further hydrological assessment will be undertaken when refining the Restoration Plan to ensure no impacts to offsite receptors and to ensure that Site drainage can support the habitats and ecology created.

9.8.2 Summary of Cumulative Effects

No cumulative effects have been identified.

9.9 STATEMENT OF SIGNIFICANCE

No significant effects in terms of the EIA Regulations are predicted on hydrology, hydrogeology and flood risk during the construction, operation or decommissioning phases of the Proposed Development with the implementation of the embedded mitigation measures set out in **Section 9.7**.

As part of the abstraction permit application a hydrogeological assessment would be undertaken to determine the potential impact from dewatering. Once completed any significant effects on hydrology, hydrogeology and flood risk would be identified and additional mitigation measures incorporated into the WEMP/CEMP.

In support of the water discharge permit application a hydrogeological risk assessment would be undertaken to determine the appropriate concentration limits for potential contaminants of concern which would be agreed with the EA, and, if required, potential water treatment options prior to discharge.

Any dewatering would be undertaken under an abstraction permit, with the appropriate information and mitigation being provided as part of that process. In the event that an abstraction licence is not granted then, as an alternative to dewatering, material below the water table as previously discussed, would be wet worked.