

Chapter 12: Ground Conditions & Contamination

12. Ground Conditions & Contamination

12.1. Introduction

12.1.1. Author

Sean Lee (MSc, BSc (Hons), FGS) at Tier Environmental Ltd.

Sean is a competent professional with 29 years of experience within the geo-environmental field, including 7 years at the Environment Agency, and has worked on various residential, commercial, industrial, infrastructure and retail projects.

12.1.2. Chapter Purpose

This chapter of the ES reports the outcome of the assessment of the likely significant ground conditions and contamination effects of the proposed development during the demolition and construction stage and completed development stage. The chapter and its supporting appendices describe the planning policy context, the assessment methodology; the baseline conditions at the application site and surroundings; the likely significant effects; the mitigation measures required to prevent, reduce or offset any significant adverse effects; the likely residual effects after these measures have been employed; and the inter-project cumulative effects.

12.1.3. Figures

All Figures are presented in Appendix 12.1.

12.1.4. Appendices

The chapter is supported by the following technical appendices in ES Volume IV:

- Appendix 12.1: Preliminary Risk Assessment (PRA) Report, Bryn Lane Wrexham; and,
- Appendix 12.2: Phosphate Assessment Technical Note.

12.2. Methodology

12.2.1. Guidance

Guidance of particular relevance to ground conditions and contamination is as set out below:

- Section 78A of Part 2A of the Environmental Protection Act of 1990 (1);
- Land Contamination Risk Management (LCRM) guidance (updated 2021) (2);
- British Standard (BS) 10175:2011 + A2:2017 Investigation of potentially contaminated sites - Code of practice (2017) (3);
- BS 5930:2015 + A1:2020 Code of practice for ground investigations (4);
- Contaminated Land: Applications in Real Environments (CL:AIRE) Definition of Waste: Development Industry Code of Practice, Version 2 (2011) (5);
- Construction Industry Research and Information Association (CIRIA) C552 ‘Contaminated Land Risk Assessment – A guide to good practice’ (2001) (6);
- Welsh Local Government Association (WLGA) & Natural Resources Wales (NRW) Development of Land Affected by Contamination, Version 3, May (2017) (7);
- Environment Agency (EA), ‘Managing and reducing land contamination: guiding principles’ (issued in March 2010 and updated in April 2016) (8);
- Welsh Government, Groundwater Protection Codes for Wales: Underground Storage Tanks (February 2017) (9);

- Association for Petroleum and Explosives Administration (APEA): Design, Construction, Modification, Maintenance and Decommissioning of Filling Stations (‘the Blue Book’) (Fourth Edition) (10); and,
- Wrexham Local Planning Policy Guidance Note 23 (updated August 2013) (11).

12.2.2. Legislation and Policy

The following national and local legislation and planning policies have been considered when undertaking the ground conditions and contamination assessment:

National Legislation and Policy:

- Water Resources Act 1991 (12);
- Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 (13);
- Water Act, 2014 (14);
- The Control of Asbestos Regulations 2012 (15);
- National Development Framework (NDF) (16);
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (17);
- Future Wales: The National Plan (2014) (18); and,
- Planning Policy Wales (2021) (19).

Local Policy:

- Wrexham Unitary Development Plan 1996-2011 (2005) (adopted Local Plan) (20); and
- Wrexham Local Development Plan 2013-2028 (emerging Local Plan) (21) – Wrexham CBC has decided not to adopt the plan at this stage, however it remains a material consideration with significant weight, as it has been found sound by a Planning Inspector.

12.2.3. Consultation

The EIA Scoping Report (**Appendix 2.1, ES Volume IV**) was submitted to Wrexham CBC on 02 November 2022. As set out in Chapter 7 of the EIA Scoping Report, a discrete Ground Conditions and Contamination chapter was proposed to be scoped out of the ES.

Wrexham CBC provided their Scoping Opinion on 02 June 2023, which advised that a contamination chapter be scoped into the ES, namely to address potential impacts to controlled waters. As such, a discrete ES chapter has been prepared.

Table 12.2.1 summarises the key EIA Scoping Opinion comments with respect to the Ground Conditions and Contamination assessment and how and where these have been addressed in the chapter.

Table 12.2.1

Comments Provided in Scoping Opinion

Scoping Comments	How addressed in the ES chapter
Wrexham CBC (April 2023)	
Groundwater and Land Contamination: NRW have advised that it would not be reasonable to scope out impacts the development may have on hydrology, particularly the underlying bedrock aquifer. NRW have therefore recommended that this matter be included within the ES.	As agreed in consultation with Wrexham CBC (and confirmed by email, dated 03 March 2023), a Ground Conditions & Contamination chapter has been included within the ES, as presented herein.



12. Ground Conditions & Contamination

Scoping Comments	How addressed in the ES chapter
Having regard to NRW's recommendations, Groundwater and Land Contamination should be included within the scope of the ES.	
Incidents/Pollution/Preventions/Water Quality: NRW have advised that the application site lies within 160 metres of Redwither Brook. This discharges into the River Clywedog, a major tributary of the River Dee.	As agreed in consultation with Wrexham CBC (and confirmed by email, dated 03 March 2023), potential contamination impacts from the proposed development in respect of water quality have been included within this Ground Conditions & Contamination chapter.
NRW note that Section 6.2. "Major Accidents and Disasters" of the EIA Scoping Report states that this topic will not require an individual chapter and further information provided by the applicant in their email of 03/03/23 proposes that the Ground Conditions ES chapter will report potential contamination impacts from the proposed development in respect of water quality (surface water and ground water resources). NRW have confirmed that they agree with this approach. The Groundwater and Land Contamination chapter of the ES should therefore clearly identify the risks assessed and mitigation proposed across the whole development.	
Natural Resources Wales (04 April 2023)	
The application site is highly sensitive with respect to groundwater. It is located within a Source Protection Zone (SPZ) 3 (an area defined around large and public potable groundwater abstraction sites); and overlies a principal bedrock aquifer. Above the bedrock the superficial aquifer is clayey Till, which is classed as a Secondary Aquifer... due to the points stated above it does not appear reasonable to scope out potential impacts that the development might have on hydrogeology, particularly the underlying bedrock aquifer... We advise that 'Ground Conditions' should be scoped into the ES. However, we acknowledge that a Preliminary Risk Assessment (PRA) may also be required or used to inform the ES.	As noted above, it was agreed in consultation with Wrexham CBC (and confirmed by email, dated 03 March 2023) that a discrete Ground Conditions and Contamination ES chapter would be prepared, as presented herein. The PRA undertaken to inform the assessment is presented in ES Volume IV, Appendix 12.1.
The application site is within 160m of Redwither Brook (Main River) which discharges to the River Clywedog, a major tributary of the River Dee. "Major Accidents and Disasters" should be scoped in, the matter should be explored within an individual chapter to clearly identify the risks assessed and mitigation proposed across the whole development.	As noted above, potential contamination impacts from the proposed development in respect of water quality, including potential impacts on the River Dee and its tributaries, have been included within this Ground Conditions & Contamination chapter.
There should be sufficient infrastructure in place to mitigate and contain any spills and a review of the site drainage and oil interceptors should be undertaken and submitted before planning permission is granted. An appropriate environmental management system (EMS) should be implemented, which addresses emergency procedures.	As summarised within ES Chapter 4: Proposed Development, as well as Section 12.6 of this chapter, the drainage strategy has been designed to mitigate potential impacts from accidental spills. As summarised within Section 12.8 of this chapter, emergency procedures will be implemented in the demolition and construction stage and completed development stage through the CEMP and Environmental Management Plan (EMP), respectively.
We note the application site is within the catchment of the River Dee and Bala Lake Special Area of Conservation (SAC). In line with our Planning Advice (July 2022), under the Habitats Regulations, Planning Authorities must consider the phosphate impact of proposed developments on water quality within SAC river catchments.	The potential phosphate impact of the proposed development on water quality within the River Dee and Bala Lake SAC catchment has been assessed within the shadow Habitat Regulations Assessment, which accompanies the planning application. The assessment of these impacts on water quality of controlled waters within the River Dee and Bala Lake SAC is presented within this chapter. The assessment of these impacts on the ecological value of the River Dee and Bala Lake SAC is presented within Chapter 11: Biodiversity.

Scoping Comments	How addressed in the ES chapter

12.2.4. Assessment Scope

Technical Scope

The technical scope of this assessment is based upon the information obtained as part of the PRA for the application site. The completion of the PRA for the application site enabled the development of a Conceptual Site Model (CSM) which has then allowed consideration of the risks associated with the potential presence and mobilisation of possible historical contamination to human health and controlled waters associated with the proposed redevelopment of the application site.

The technical scope has also considered the risks associated with the introduction of potential new contamination as a result of leakage and/or accidental spills on-site from possible contaminative materials and fuels present on-site during both the demolition and construction and completed development stages.

The following potential pollutant linkages, which have the potential to present an unacceptable risk to human health and controlled waters, have been considered:

- Impacts on human health and buildings and infrastructure from direct contact/ingestion and inhalation of dust, asbestos fibres and other potential localised contaminants that may exist on-site, as well as potential new contaminants resulting from accidental spills or leakage during the demolition and construction works;
- Impacts on groundwater from leaching of potential contamination (existing and new) into groundwater and vertical/lateral migration through permeable strata;
- Impacts on surface water from leaching of potential contamination (existing and new) into groundwater and subsequent migration to surface water, as well as direct surface water run-off with suspended soils into surface water; and
- Impacts on human health and buildings and infrastructure from migration of ground gases and/or potential vapours.

The PRA (refer to Appendix 12.1) has identified that the application site is reported to lie within a Low Risk area for potential Unexploded Ordnance (UXO). Accordingly, risks from UXO have not been considered further as part of this assessment. However, as recommended in the PRA, an UXO Desk Study will be prepared prior to the commencement of demolition and construction works. This is expected to be conditioned to any future planning consent.

Spatial Scope

The study area for this assessment comprises the application site and surrounding area, as discussed in Section 12.2.6.

12.2.5. Assessment Scenario

The following scenarios have been assessed and are reported within this Chapter of the ES:

- Scenario 1: Existing Baseline;
- Scenario 2: Existing Baseline + Proposed Development; and
- Scenario 3: Existing Baseline + Proposed Development + Cumulative Schemes.

12.2.6. Baseline Characterisation Approach

Desk Study

This chapter has been prepared based on a combination of desk-based and field-based data. The desk-study exercise has included:

- A review of historical Ordnance Survey mapping to check for evidence of contaminative use; and



12. Ground Conditions & Contamination

- An overview of available published information, including third party environmental and geological databases in order to determine physical ground conditions (ground and groundwater), potential sources of contamination and contamination risks, and current and future potential receptors.

Site Walkover

A site walkover visit was undertaken by Tier on 27 October 2021 to provide further information to augment the baseline conditions information established in the desk-study, including checking for any visual or olfactory evidence of ground contamination associated with current and/or past uses.

12.2.7. Assessment Method

The assessment has been based on the scheme information and planning application drawings presented in ES Chapter 4: *Proposed Development* and the construction methodology presented in ES Chapter 6 *Construction Strategy & CEMP*.

Under current guidance and UK best practice, evaluation of the effects of contamination is based on a process of risk assessment, utilizing a source-pathway-receptor framework; for significant contamination to be present there must exist a source of contamination, a pathway to connect that source to a receptor, and a potentially sensitive receptor. Without all three elements, a significant contamination risk cannot occur.

A Conceptual Site Model (CSM) has been developed for the application site and has been used to enable a qualitative risk assessment of plausible ‘contaminant linkages’ associated with the proposed development. In line with the nature of the proposed development, the CSM has been based upon the development of the application site for a proposed commercial/industrial end use.

The assessment method follows a tiered assessment approach, which can be summarised as follows:

- Tier 1 PRA: a qualitative assessment informed by a Phase 1 land contamination study comprising a desk-based assessment and site-walkover. The PRA considers both the application site and the surrounding land within a 1km radius;
- Tier 2 Site Investigation and Generic Risk Assessment: an assessment of site-specific data by comparison to generic assessment criteria informed by a Phase 2 study comprising intrusive investigations and laboratory testing; and, if required,
- Tier 3 Detailed Quantitative Risk Assessment and Remediation Strategy: a quantitative risk assessment by comparison to site-specific assessment criteria. This would form the basis for the decision as to whether remediation is required.

This contamination assessment has used the findings of the existing PRA and site walkover (Tier 1) to assess the potential impacts on the proposed development and potentially sensitive receptors from ground contamination using the source-pathway-receptor approach outlined above.

The identification of likely significant effects during the demolition and construction and completed development stages has been based on a review of the presence of potential receptors, a qualitative assessment of the sensitivity of the receptors, the identification of potential impact pathways and an assessment of the magnitude of the potential impacts based on the information reviewed as part of the PRA.

The assessment of potential impacts and likely effects has, therefore, comprised the following approach:

- Identification and establishment of the sensitivity of receptors on the basis of their use, proximity to the application site, existing quality or resource value;
- Consideration of potential source-pathway-receptor linkages;
- Evaluation of the magnitude of potential impacts from potential contamination as a result of the introduction of the proposed development;
- Consideration of embedded mitigation measures integral to the proposed development proposals;
- Classification of the significance of likely effects;
- Identification of additional mitigation measures to eliminate or reduce residual effects, where considered necessary; and

- Re-assessment to conclude the significance of residual effects.

The Tier 1 risk assessment stage is considered to be sufficient for this assessment, based on the history of the application site and as the Tier 1 assessment considers all plausible contamination sources and pollutant linkages.

An Intrusive Ground Investigation will be undertaken in due course to inform a Tier 2 risk assessment. Please refer to the additional mitigation set out in Section 12.8 of the chapter for further information.

Cumulative Development Stage

As agreed through the EIA scoping exercise, the following cumulative schemes have been considered as part of this assessment:

- Land South of Ridley Wood (Ref: P/2020/0167);
- Unit 6 Pacific Park (Ref: P/2020/0603); and,
- Land Off, Ash Road South (Ref: P/2015/0843).

12.2.8. Assessment Criteria

Receptor Sensitivity Criteria

Table 12.2.2 sets out the scale of sensitivity that has been applied to receptors identified and considered within this assessment.

Table 12.2.2
Receptor Sensitivity Criteria

Sensitivity	Description			
	Human Health	Surface Water Features	Ground Water Features	Other
High	Construction & maintenance workers, existing and future site users, adjacent site users	Watercourse having a Water Framework Directive (WFD) classification and feeding into a site protected/ designated under EC or UK legislation (SAC, SPA, SSSI, Ramsar site, salmonid water) / Species protected by EC legislation	Principal aquifer providing a locally or regionally important resource, supporting a site protected under EC or UK legislation and/or supporting a river ecosystem.	Assets of high heritage or ecological value, such as scheduled monuments or ancient woodland
Medium	N/A	Watercourses possessing a WFD classification but not feeding into a protected site, as above.	Secondary aquifer, particularly an aquifer providing water for agricultural or industrial use with limited connection to surface water. Groundwater resource in Zone 3 of a SPZ.	Assets of moderate ecological value, such as mature woodland. Buildings and structures with no statutory heritage designation



12. Ground Conditions & Contamination

Sensitivity	Description			
	Human Health	Surface Water Features	Ground Water Features	Other
Low	N/A	Watercourses not possessing a WFD classification.	Unproductive strata	Areas of new planting/proposed soft landscaping within the final development.

Magnitude of Impact Criteria

The assessment has been undertaken based on the description of development contained in Chapter 4 of this volume of the ES. **Table 12.2.3** indicates the scale of impact magnitude that has been used in undertaking the assessment.

Table 12.2.3
Scale of Impact Magnitude

Magnitude	Description
Large	Complete loss of an attribute (e.g., total species loss or short term acute human health impact). Likely to result in failure to meet statutory objectives and result in breaches of legislation.
Medium	Large scale loss of an attribute (e.g., long term chronic human health impact or substantial pollution of ecologically important groundwater). Possible failures of statutory obligation and breaches of legislation and remediation may be required.
Small	Moderate impact on attribute or less sensitive receptor (e.g., soil contamination exists but the concentrations would not be in high enough concentrations to cause harm or that there is a low likelihood of serious pollution). Mitigation measures may need be implemented to reduce the potential impact.
Very Small	No discernible change or impact (e.g., soil contamination present but risk assessment suggests negligible/low risk to human health or controlled waters).

Scale of Effect Criteria

The assessment of significance within this chapter has been based on the scale of effect matrix presented in **Table 12.2.4**.

Table 12.2.4
Significance Matrix

Magnitude of Impact	Sensitivity of Receptor		
	High	Medium	Low
Large	Major	Moderate	Minor/ Moderate
Medium	Moderate	Minor/ Moderate	Minor
Small	Minor/ Moderate	Minor	Negligible
Very Small	Negligible/Minor	Negligible	Negligible
Where the effect is Minor/Moderate, professional judgement will be applied to determine the appropriate scale of effect.			

There is no published EIA guidance for transposing a risk-based contaminated land assessment into Environmental Impact Assessment (EIA).

Based on professional judgement, effects of a moderate or major scale are considered significant in EIA terms.

In determining the scale of effect and its significance, consideration has also been given to the duration of the effect, i.e. short term (0-7 years) and medium term (8-12 years) and temporary, or long term (>12 years) and permanent.

The nature of an effect can be described as either adverse or beneficial as follows:

- Beneficial – An advantageous effect to a receptor;
- Adverse – A detrimental effect to a receptor; and,
- Neutral – An effect that is on balance both beneficial and adverse.

12.2.9. Human Health

Under current guidance and UK best practice, evaluation of the effects of contamination is based on a process of risk assessment, utilizing a source-pathway-receptor framework.

As set out in Section 12.3, human health receptors, including demolition and construction workers, future site users and adjacent land users, have been considered in this chapter. Human health has therefore been considered inherently in the assessment.

12.2.10. Climate Change

The UKCP18 climate projections for the UK set out in Chapter 2 *EIA Methodology* of this Volume of the ES have been reviewed and considered in the context of ground conditions. The climate change projections / trends include milder and wetter winters and more frequent storms, heavy and extreme rainfall and extreme wind events. While there is substantial uncertainty in the long term trends, it is considered reasonable to assume that storms and extreme rainfall events will be more likely and become more extreme in the future. There is a potential for increased flooding in the future, which could increase the risks associated with leachable or dissolved phase contaminants that could pose a risk to groundwater receptors. However, none of the projected climate change trends are expected to affect the ground condition effects reported in this ES chapter.

12.2.11. Major Accidents and Disasters

The only risks of major accidents and disasters of relevance to ground conditions are associated with the operation of the proposed development for industrial uses and the petrol filling station, and the potential associated risks of accidental oil/fuel spills and leaks.

In line with the EIA Scoping Opinion, the potential impacts from accidental oil/fuel spills during the completed development stage have been considered within the Assessment of Effects section (Section 12.7 of this Chapter).

12.2.12. Relevant Associated Development

Given the hybrid nature of the planning application, the full extent of any associated development, such as utilities or junction works outside the application site boundary, are not confirmed at this stage. However, any such works are not expected to be substantial in the context of the proposed development as a whole and are not considered likely to affect the outcome of this assessment. As such, associated development has not been considered further in this chapter.

12.2.13. Assumptions / limitations

In undertaking the Ground Conditions and Contamination assessment, there are a number of limitations and constraints affecting the outputs from this work. These include:

- Due to the flexibility in potential uses being sought by the Applicant in respect of the outline component, consideration has been given to all potential uses to ensure that a conservative assessment has been undertaken. In this regard, the potential for a Petrol Filling Station (PFS) has been assumed to capture potential risks from accidental spills, for example. In respect of the assessment of potential impacts from phosphate emissions, a conservative assessment has been undertaken using a mix of the proposed land uses that would result in the highest-phosphate emissions. To this end, the potential hotel would comprise the highest phosphate-emitting land use and, for the purpose of the EIA, a total of up to 130 rooms has been considered a reasonable worst-case, as informed by the Applicant. The full set of assumptions used to inform the phosphate assessment are presented in Appendix 12.2.



12. Ground Conditions & Contamination

- It is assumed that the preliminary site clearance and preparatory works will be undertaken as a single phase of works and that all site won materials generated as part of the proposed development are to remain on-site for later reuse within the application site.
- At this stage, the assessment has been based on a desk-based assessment (PRA) supported by a site-walkover. An Intrusive Ground Investigation will be undertaken in due course, as set out in Section 12.8: Additional Mitigation.

12.3. Sensitive Receptors

The existing and introduced sensitive receptors that have been considered in the assessment are as follows:

- Human Health (Demolition & Construction Workers, Future Site Users and Adjacent Site Users);
- Surface Water Feature: River Dee and its tributaries;
- Surface Water Feature: River Dee and Bala Lake SAC;
- Ground Water Feature: Kinnerton Sandstone Formation Principal Aquifer;
- Ground Water Feature: Salop Formation Secondary A Aquifer;
- New buildings and infrastructure; and
- Retained and Proposed Vegetation.

12. Ground Conditions & Contamination

12.4. Baseline Conditions

Based upon the findings of the PRA (refer to Appendix 12.1), information salient to the general baseline conditions at the application site are set out in **Table 12.4.1**. **Table 12.4.2** sets out the baseline conditions relevant to each of the sensitive receptors.

Table 12.4.1
Baseline Conditions at the application site

Aspect of the Baseline	Description of Baseline Condition
The Application Site	The application site covers an area of circa 37.21 hectares (ha) and predominantly comprises arable land separated by hedgerows, with a small cluster of buildings and hardstanding.
Historical Development	Reference to available historical maps, as discussed in the PRA, indicate the application site to have remained largely undeveloped historically. Maps from 1872 indicate the presence of 20 ponds, many of which are no longer shown on later maps and may have been infilled. It is understood that Royal Ordnance Factory, Wrexham was developed on land to the southwest of the application site during the outbreak of World War II in 1939. The factory is believed to have made cordite, an explosive propellant for shells. Based upon the information obtained as part of the PRA, there is no evidence to suggest that any activities associated with the Royal Ordnance Factory took place within the current application site.
Published Geology	The PRA indicates the application site to be underlain by superficial deposits of Devensian Till – Diamicton. The British Geological Society (BGS) lexicon of named rock units describe these strata as ‘unsorted and unstratified drift, generally overconsolidated, deposited directly by and underneath a glacier without subsequent reworking by water from the glacier. It consists of a heterogenous mixture of clay, sand, gravel, and boulders varying widely in size and shape (diamicton)’. Although no specific ground investigation information is available for the application area at the time of writing, the PRA highlights available logs held by the BGS which suggest that the underlying Till is present to approximately 38m below ground level (bgl) to the south-east and 26m bgl to the northwest. The north-western area of the application site is shown by the BGS to be underlain by the Kinnerton Sandstone Formation, whilst the south-eastern parts of the application site are shown to by underlain by mudstone of the Salop Formation. An inferred fault is located beneath the application site orientated from south-west to north-east. The application site is located within a low to medium risk area from radon where protection measures should not be required, although fitting radon prevention in new buildings might still be considered, particularly if there is a high risk location such as a routinely occupied basement (which does not form part of the proposed development).
Mining and Quarrying	Part of the application site is located within a coal mining reporting area. However, a CON29M report for the application site states that the application site does not lie within the potential zone of influence of any recorded underground coal workings and no coal mine shafts and adits are recorded to lie within 20 metres.
Hydrology/Hydrogeology	The application site is situated on relatively flat and low-lying ground that slopes very gently from roughly 40m Above Ordnance Datum (m AOD) in the west to between 27m AOD and 31m AOD in the east/north-east and is covered with grass for grazing and crops. Topographic and historic published geological information indicates that groundwater will occur at depth, towards the Till/ Bedrock boundary and flow towards the east/northeast to the River Dee. Surface water drainage will predominantly percolate into shallow soils before draining as through flow down topographic gradient on the clay rich Till surface. As confirmed in the Flood Consequent Assessment which accompanies the planning application, the majority of the application site is not at risk from flooding, although small areas of the site are located within Flood Zones 2 and 3 for flooding from surface water and small watercourses. The PRA identifies a small number of ponds within the current application site. With the exception of these ponds, the nearest recorded surface water course is reported as being an underground watercourse (a culverted tributary of Redwither Brook), approximately 110m to the west, which discharges to the River Clywedog, a major tributary of the River Dee. As discussed in Chapter 11 Biodiversity, the River Dee has been designated as a Special Area of Conservation (the River Dee and Bala Lake SAC), which is located approximately 3.1 km from the application site at its closest point and has been designated for its riverine habitat and species. The PRA does not identify any reported potable or non-potable abstractions within 1km of the application site. Underlying glacial soils (Devensian Till – Diamicton), anticipated to be >20m thick, are classified as a Secondary (Undifferentiated) Aquifer. The bedrock strata beneath the application area are classified as a Principal Aquifer (Kinnerton Sandstone Formation – Sandstone) beneath the north-western area and Secondary A Aquifer (Salop Formation – Mudstone, Sandstone & Conglomerate) beneath the south-eastern area. Parts of the application site are shown to lie within a Source Protection Zone 3 (SPZ3) Total Catchment Area. A BGS borehole log (SJ35SE227), approximately 110m north-west of the application site, indicates that potential artesian groundwater is present (“artesian: not after 1979”). It is considered likely that this relates to groundwater within the bedrock. Previous ground investigations by Tier immediately south of the application site (south of Ridleywood Road) encountered cohesive Till to greater than 10m bgl.
Contamination Status	Based upon the findings of the PRA (refer to Appendix 12.1) and in the absence of site specific ground investigation information, the following assessment has assumed the potential for a range of potential contaminants (inorganic metals, metalloids, Polycyclic Aromatic Hydrocarbons and Petroleum Hydrocarbons) to be present locally within the application site and predominantly relating to areas of made ground and/or infilled ponds. In line with the presence of existing buildings, the potential for asbestos, both in the existing buildings and made ground within the application site has also been considered.
Unexploded Ordnance	The PRA indicates that the application site is located within a Low Risk from UXO; however, given the proximity of the application site to the former Royal Ordnance Factory (as close as 20m south), the PRA recommends that a UXO Desk Study is completed for the application site prior to the commencement of any demolition and construction works.



12. Ground Conditions & Contamination

Table 12.4.2
Baseline Conditions Relevant to the Identified Receptors

Sensitive receptors	Description of Baseline Condition	Sensitivity	Further information
Human Health (Demolition & Construction Workers, Future Site Users and Adjacent Site Users)	Demolition and construction workers, future site users and adjacent site users could potentially be impacted by any ground contamination present at the application site. The PRA suggests a potential for localised made ground within the application site. Made ground is a potential source of a range of potential contaminants (for example heavy metals, TPH and PAHs and asbestos – refer to Section 12.4). Human health receptors could potentially be affected by the inhalation of airborne asbestos fibres, or the inhalation of contaminated dusts and/or ingestion of other contaminants within possible made ground in the application site. The PRA also indicates a potential for migration and accumulation of hazardous ground gases, attributable to the possible presence of made ground and/or organic materials associated with historical ponds within the application site. In line with Table 12.2.2, human health is considered to be of High sensitivity.	High	Appendix 12.1
Surface Water Feature: River Dee and its tributaries	The River Dee and its tributaries could potentially be impacted by any ground contamination present at the application site, through leaching of contamination through ground and surface waters as well as direct surface water runoff. As outlined in Table 12.2.1, this includes the potential impact from phosphates entering the SAC river catchments as a result of the waste water emissions arising during the completed development stage. As discussed earlier in this section, in line with its classification as an SAC and the need to consider potential phosphate impact on the SAC, this receptor has been considered to be of high sensitivity for the purpose of this assessment.	High	Appendix 12.1
Surface Water Feature: River Dee and Bala Lake SAC	The River Dee and Bala Lake SAC could potentially be impacted by any ground contamination present at the application site through leaching of contamination through ground and surface waters as well as direct surface water runoff. As above, this includes the potential impact from phosphates entering the SAC as a result of the waste water emissions arising during the completed development stage. As the River Dee and Bala Lake SAC is an international statutory designated site and taking into consideration its sensitivity in relation to phosphates, this receptor has been considered to be of high sensitivity for the purpose of this assessment.	High	Chapter 11 <i>Biodiversity</i>
Ground Water Feature: Kinnerton Sandstone Formation Principal Aquifer	The Kinnerton Sandstone Formation underlies part of the application site. This could potentially be impacted by any mobile contamination present at the application site through the vertical/lateral migration of contamination. Part of the application site is also classified as a Source Protection Zone 3. A significant depth of low permeability cohesive soils, associated with glacial soils, are believed to underlie the application site which should help afford protection to the underlying aquifer. In the absence of confirmation of the presence of the underlying glacial soils, however, and taking into account comments received from NRW (refer to Table 12.2.1) this receptor has been considered to be of High sensitivity for the purpose of this assessment.	High	Appendix 12.1
Ground Water Feature: Salop Formation Secondary A Aquifer	The Salop Formation could potentially be impacted by any mobile contamination present at the application site through the vertical/lateral migration of contamination. As discussed previously, however, a significant depth of low permeability cohesive soils are anticipated to underlie the application site which should help afford protection to the underlying aquifers. In the absence of confirmation of the presence of the underlying glacial soils, however, and taking into account the need to consider this receptor as a potential pathway with regards to the assessment of potential phosphate impact from the final development then this receptor has been considered to be of High sensitivity for the purpose of this assessment.	High	Appendix 12.1
New buildings and infrastructure	New buildings and infrastructure could potentially be impacted by potential ground contamination present at the application site, through direct contact with contaminated soils and groundwater. New buildings and infrastructure could also be impacted by migration and accumulation of potential hazardous ground gases from the existing soils. It is noted that the only identified source of ground gases within the application site, highlighted within the PRA, are localised areas of made ground and/or organic materials within potentially infilled ponds. In line with Table 12.2.2, this receptor is considered to be of medium sensitivity.	Medium	Appendix 12.1
Retained and Proposed Vegetation	Retained and proposed vegetation could potentially be impacted by uptake of any potential ground contamination present within existing soils and groundwater at the application site. As discussed in Chapter 11: Biodiversity, a number of trees and hedgerows are proposed to be retained on-site. In line with the current usage of the site as arable land, this receptor is considered to be of low sensitivity (refer to Table 12.2.2).	Low	Appendix 12.1

12.5. Potential Impacts

The impacts considered to have the potential to result in significant effects (prior to inclusion of any embedded mitigation) are reported in **Table 12.5.1**.



12. Ground Conditions & Contamination

Table 12.5.1
Potential significant Impacts

Stage	Description of Potential Impacts	Adverse/beneficial
Human Health		
Demolition & Construction Stage	Impacts on human health (demolition and construction workers and adjacent site users) from inhalation of contaminated dust and ACMs that may exist on-site either within made ground and/or existing buildings.	Adverse
Demolition & Construction Stage	Impacts on human health (demolition and construction workers and adjacent site users) from direct contact/ingestion of potential existing contaminants that may exist on-site.	Adverse
Demolition & Construction Stage	Impacts on human health (demolition and construction workers and adjacent site users) from inhalation of potential ground gases and vapours.	Adverse
Demolition & Construction Stage	Impacts on human health (demolition and construction workers and adjacent site users) from direct contact/ingestion and inhalation of potential new contaminants resulting from accidental fuel spillages from heavy plant and machinery during the demolition and construction works.	Adverse
Surface Water Features		
Demolition & Construction Stage	Impacts on surface water (River Dee and its tributaries and the River Dee and Bala Lake SAC) from leaching of potential existing contamination into groundwater and subsequent migration to surface water, as well as direct surface water run-off with suspended soils into surface water	Adverse
Demolition & Construction Stage	Impacts on surface water (River Dee and its tributaries and the River Dee and Bala Lake SAC) from leaching/migration of potential new contaminants through groundwater and/or direct surface water runoff from accidental fuel spillages from heavy plant and machinery during the demolition and construction works.	Adverse
Ground Water Features		
Demolition & Construction Stage	Impacts on groundwater (Kinnerton Sandstone Formation Principal Aquifer and Secondary A Aquifer – Salop Formation) from leaching of potential existing mobile contamination into groundwater and vertical/lateral migration through permeable strata	Adverse
Demolition & Construction Stage	Impacts on groundwater (Kinnerton Sandstone Formation Principal Aquifer and Secondary A Aquifer – Salop Formation) from leaching of potential new contaminants through groundwater and vertical/lateral migration through permeable strata from accidental fuel spillages from heavy plant and machinery during the demolition and construction works.	Adverse
Vegetation		
Demolition & Construction Stage	Impacts on retained vegetation from uptake of potential existing contaminants within soils and groundwater.	Adverse
Human Health		
Completed Development Stage	Impacts on human health (future site users and adjacent site users) from direct contact/ingestion and inhalation of contaminated dust and ACMs from exposed areas of soft landscaping	Adverse
Completed Development Stage	Impacts on human health (future site users and adjacent site users) from direct contact/ingestion of potential existing contaminants exposed within areas of soft landscaping	Adverse
Completed Development Stage	Impacts on human health (future site users and adjacent site users) from inhalation of potential ground gases and vapours	Adverse
Completed Development Stage	Impacts on human health (future site users and adjacent site users) from direct contact/ingestion and inhalation of potential new contaminants resulting from accidental fuel spillages associated with the operation of the site and the potential petrol filling station	Adverse
Surface Water Features		
Completed Development Stage	Impacts on surface water (River Dee and its tributaries and the River Dee and Bala Lake SAC) from leaching of potential existing mobile contamination into groundwater and subsequent migration to surface water, as well as direct surface water run-off with suspended soils into surface water	Adverse
Completed Development Stage	Impacts on surface water (River Dee and its tributaries and the River Dee and Bala Lake SAC) of increased phosphate concentrations through wastewater from site occupants and future site operations	Adverse
Completed Development Stage	Impacts on surface water (River Dee and its tributaries and the River Dee and Bala Lake SAC) from leaching/migration of potential new contaminants resulting from accidental fuel spillages associated with the operation of the site and the potential petrol filling station	Adverse



12. Ground Conditions & Contamination

Stage	Description of Potential Impacts	Adverse/beneficial
Ground Water Features		
Completed Development Stage	Impacts on groundwater (Kinnerton Sandstone Formation Principal Aquifer and Secondary A Aquifer – Salop Formation) from leaching of potential existing mobile contamination into groundwater and vertical/lateral migration through permeable strata	Adverse
Completed Development Stage	Impacts on groundwater (Kinnerton Sandstone Formation Principal Aquifer and Secondary A Aquifer – Salop Formation) from leaching of potential new contaminants resulting from accidental fuel spillages associated with the operation of the site and the potential petrol filling station	Adverse
Buildings and Infrastructure		
Completed Development Stage	Impacts on new buildings and infrastructure (i.e. potable water supply pipes) from direct contact between buried concrete within the buildings and structures with soils which may contain contaminants that are aggressive to buried concrete and/or other construction materials.	Adverse
Vegetation		
Completed Development Stage	Impacts on retained and proposed vegetation from uptake of potential existing contaminants within soils and groundwater.	Adverse

12.6. Embedded Mitigation

Table 12.6.1 identifies those design interventions that have been incorporated into the design of the proposed development, as well as any control methods that have been incorporated into the proposed development to mitigate the potential impacts identified during the course of the design evolution process. These measures are collectively referred to as embedded mitigation.

Table 12.6.1
Embedded Mitigation

Embedded Mitigation	Description	Reason for Intervention	Further information
Presence of hardstanding across much of the proposed development	The proposed development will comprise a commercial/industrial end use. Much of the application site will comprise buildings and/or hardstanding (roads, parking and storage areas).	The presence of hardstanding and buildings will break/minimise the pollutant linkages between potential existing contamination in soils and groundwater beneath the application site and future site users. Hardstanding will also decrease infiltration of potential contaminants downwards towards the Principal and Secondary A Aquifers.	Refer to Proposed Masterplan (Detailed Component) in ES Chapter 4 <i>Proposed Development</i> and the Design and Access Statement.
Drainage Strategy	A drainage strategy has been developed by Tier Consult for the application site (detailed for the detailed component and outline strategy for the outline component), that will include mitigation measures to protect the environment and future site users against potential impacts arising from accidental spills, leakages, etc. Measures to be implemented will include oil interceptors for service yard and access areas, permeable paving in car parks and swales. In addition, any tank storage and the proposed petrol filling station will be designed in accordance with the Groundwater Protection Codes for Wales: Underground Storage Tanks, 2017 and the Association for Petroleum and Explosives Administration (APEA) Design, Construction, Modification, Maintenance and Decommissioning of Filling Stations, 2018.	To ensure that any spillages or leakages will not adversely affect water quality (surface water and ground water resources) or human health.	Storm Water / SuDS Maintenance Plan, Tier Consult

12.7. Assessment of Effects (including Embedded Mitigation)

12.7.1. Demolition and Construction Stage

The assessment of the likely ground conditions and contaminated land effects of the proposed development during the demolition and construction stage (including embedded mitigation) is set out in **Table 12.7.1**.



12. Ground Conditions & Contamination

Table 12.7.1
Demolition and Construction Stage Assessment

Receptor(s) affected	Receptor Sensitivity	Description of Impact	Magnitude of Impact	Scale of Effect and Significance	Additional Mitigation proposed?	Further information
Human Health (demolition & construction workers & adjacent site users)	High	Where present, demolition & construction workers and adjacent site users may be exposed to contaminated dusts and Asbestos Containing Materials. The magnitude of impact is considered to be medium, as this could potentially result in long term chronic human health impacts (lung disease).	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Human Health (demolition & construction workers and adjacent site users)	High	Where present, demolition and construction workers may be exposed to contamination via direct contact/ingestion of potentially contaminated soils/waters that may exist on-site. Where present, organic contamination could impact on existing or proposed potable water supply pipes which could pose a risk to human health both on and off site. The magnitude of impact is considered to be medium, as this could result in long term chronic human health impacts.	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Human Health (demolition & construction workers and adjacent site users)	High	Where present, demolition and construction workers and adjacent site users may be at risk from inhalation of potential ground gases and vapours originating from contamination and/or localised made ground on-site. The magnitude of this impact is large as this could result in a short term acute human health impact, for example, asphyxiation or an explosion potentially causing a substantial injury or loss of life. However, given the absence of significant historical development within the application site and the anticipated nature of the contamination if present this is considered unlikely based on the findings of the PRA. This is therefore considered a particularly conservative judgment.	Large	Major Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Human Health (demolition & construction workers and adjacent site users)	High	Impacts on human health (demolition and construction workers and adjacent site users) from direct contact/ingestion and inhalation of potential new contaminants resulting from accidental fuel spillages and leaks from heavy plant and machinery during the demolition and construction works. The magnitude of impact is considered to be medium, as this could result in long term chronic human health impacts.	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Surface Water Features (River Dee and its tributaries and the River Dee and Bala Lake SAC)	High	Where present, contamination within the application site could impact on surface water (River Dee and its tributaries and the River Dee and Bala Lake SAC) from leaching of potential existing mobile contamination into groundwater and subsequent migration to surface water, as well as direct surface water run-off with suspended soils and/or contamination into surface water. The magnitude of the potential impact is considered to be medium as such an impact could result in possible harm to species supported by the SAC and possible failure of statutory obligation and breaches of legislation.	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Surface Water Features (River Dee and its tributaries and the River Dee and Bala Lake SAC)	High	The River Dee and its tributaries and the River Dee and Bala Lake SAC could be at risk from impact from leaching/migration of potential new contaminants through groundwater and/or direct surface water runoff from accidental fuel spillages and/or leaks from heavy plant and machinery during the demolition and construction works at the application site. The magnitude of impact is considered to be medium as such releases could result in possible harm to species supported by the SAC and possible failure of statutory obligation and breaches of legislation.	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Ground Water Features (Kinnerton Sandstone Formation Principal Aquifer)	High	Where contamination exists then this could lead to impact on groundwater (Kinnerton Sandstone Formation Principal Aquifer) from leaching of potential existing mobile contamination into groundwater and vertical/lateral migration through permeable strata. It is noted that the presence of a significant depth of low permeability cohesive soils are anticipated to underlie the site and will afford some protection to the underlying aquifers. The magnitude of impact is considered to be medium as such releases could result in possible failure of statutory obligation and breaches of legislation.	Medium	Moderate Adverse (significant)	Yes	Appendix 12.1 and Table 12.8.1
Ground Water Features (Kinnerton Sandstone Formation Principal Aquifer)	High	The Kinnerton Sandstone Formation Principal Aquifer could be at risk from leaching of potential new contaminants through groundwater and vertical/lateral migration through permeable strata from accidental fuel spillages from heavy plant and machinery during the demolition and construction works. It is noted that the presence of a significant depth of low permeability cohesive soils are anticipated to underlie the site and will afford some protection to the underlying aquifers. The magnitude of impact is considered to be medium as such releases could result in possible failure of statutory obligation and breaches of legislation	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1



12. Ground Conditions & Contamination

Receptor(s) affected	Receptor Sensitivity	Description of Impact	Magnitude of Impact	Scale of Effect and Significance	Additional Mitigation proposed?	Further information
Ground Water Features (Secondary A Aquifer – Salop Formation)	Medium	Where contamination exists then this could lead to impact on groundwater (Secondary A Aquifer) from leaching of potential existing mobile contamination into groundwater and vertical/lateral migration through permeable strata. It is noted that the presence of a significant depth of low permeability cohesive soils are anticipated to underlie the site and will afford some protection to the underlying aquifers. The magnitude of impact is considered to be medium as such releases could result in possible failure of statutory obligation and breaches of legislation.	Medium	Minor Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Ground Water Features (Secondary A Aquifer – Salop Formation)	Medium	The Salop Formation Secondary A Aquifer could be at risk from leaching of potential new contaminants through groundwater and vertical/lateral migration through permeable strata from accidental fuel spillages from heavy plant and machinery during the demolition and construction works. It is noted that the presence of a significant depth of low permeability cohesive soils are anticipated to underlie the site and will afford some protection to the underlying aquifers. The magnitude of impact is considered to be medium as such releases could result in possible failure of statutory obligation and breaches of legislation	Medium	Minor Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Retained Vegetation	Low	Where phytotoxic contamination exists within existing soils and groundwater then this could impact on retained vegetation within the application site. It is noted that, given the current arable use of the site, then the risk of significant widespread phytotoxic contamination is considered to be low and the magnitude of the impact is considered to be small.	Small	Negligible Adverse	Yes	Appendix 12.1 and Table 12.8.1

12.7.2. Completed Development Stage

The assessment of the likely ground conditions and contamination effects of the proposed development during the completed development stage (including embedded mitigation) is set out in **Table 12.7.2**.

Table 12.7.2
Completed Development Stage Assessment

Receptor(s) affected	Receptor Sensitivity	Description of Impact	Magnitude of Impact	Scale of Effect and Significance	Additional Mitigation proposed?	Further information
Human Health (future site users and adjacent site users)	High	Where present, future site users and adjacent site users may be exposed to contamination through direct contact/ingestion and inhalation of contaminated dust and ACMs where such soils are exposed such as areas of soft landscaping. The magnitude of impact is considered to be medium, as this could potentially result in long term chronic human health impacts (lung disease).	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Human Health (future site users and adjacent site users)	High	Where present future site users may be exposed to contamination via direct contact/ingestion of contaminated soils/waters where these are exposed in the final development in areas such as soft landscaping. Where present, organic contamination could impact on existing or proposed potable water supply pipes which could pose a risk to human health both on and off site. The magnitude of impact is considered to be medium, as this could result in long term chronic human health impacts.	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Human Health (future site users and adjacent site users)	High	Impacts on human health (future site users and adjacent site users) include from inhalation of potential ground gases and vapours originating from contamination and/or localised made ground on-site. The magnitude of this impact is large as this could result in a short term acute human health impact, for example, asphyxiation or an explosion potentially causing a substantial injury or loss of life. However, given the absence of significant historical development within the application site and the anticipated nature of the contamination if present this is considered unlikely based on the findings of the PRA. This judgement is therefore considered particularly conservative.	Large	Major Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Human Health (future site users and adjacent site users)	High	Impacts on future site users from direct contact/ingestion and inhalation of potential new contaminants resulting from accidental fuel spillages and leaks associated with the operation of the site and the potential petrol filling station. The magnitude of impact is considered to be medium, as this could result in long term chronic human health impacts.	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1



12. Ground Conditions & Contamination

Receptor(s) affected	Receptor Sensitivity	Description of Impact	Magnitude of Impact	Scale of Effect and Significance	Additional Mitigation proposed?	Further information
Surface Water Features (River Dee and its tributaries and the River Dee and Bala Lake SAC)	High	Where present, contamination within the application site could impact on surface water (River Dee and its tributaries and the River Dee and Bala Lake SAC) from leaching of potential existing mobile contamination into groundwater and subsequent migration to surface water, as well as direct surface water run-off with suspended soils and/or contamination into surface water. The magnitude of potential impact is considered to be medium as such impact of contamination could result in possible harm to species supported by the SAC and possible failure of statutory obligation and breaches of legislation.	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Surface Water Features (River Dee and its tributaries and the River Dee and Bala Lake SAC)	High	The River Dee and its tributaries and the River Dee and Bala Lake SAC could be at risk from impact from increased phosphate concentrations, mainly through wastewater from site occupants and site usage. The magnitude of impact is considered to be medium as such releases could result in possible harm to species supported by the SAC and possible failure of statutory obligation and breaches of legislation.	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.2 and Table 12.8.1
Surface Water Features (River Dee and its tributaries and the River Dee and Bala Lake SAC)	High	The River Dee and its tributaries and the River Dee and Bala Lake SAC could be at risk from impact through surface water and accidental spills and leaks of potential new contaminants associated with the operation of the final site and the potential petrol filling station. The magnitude of impact is considered to be medium as such releases could result in possible harm to species supported by the SAC and possible failure of statutory obligation and breaches of legislation.	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Ground Water Features (Kinnerton Sandstone Formation Principal Aquifer)	High	Where contamination remains within the final development then this could lead to impact on groundwater (Kinnerton Sandstone Formation Principal Aquifer) from leaching of potential existing mobile contamination into groundwater and vertical/lateral migration through permeable strata. It is noted that the presence of a significant depth of low permeability cohesive soils are anticipated to underlie the site and will afford some protection to the underlying aquifers. The magnitude of impact is considered to be medium as such releases could result in possible failure of statutory obligation and breaches of legislation.	Medium	Moderate Adverse (significant)	Yes	Appendix 12.1 and Table 12.8.1
Ground Water Features (Kinnerton Sandstone Formation Principal Aquifer)	High	The Kinnerton Sandstone Formation Principal Aquifer could be at risk from leaching of potential new contaminants through groundwater and vertical/lateral migration through permeable strata from accidental spills and leaks of potential new contaminants associated with the operation of the final development and the potential petrol filling station. It is noted that the presence of a significant depth of low permeability cohesive soils are anticipated to underlie the site and will afford some protection to the underlying aquifers. The magnitude of impact is considered to be medium as such releases could result in possible failure of statutory obligation and breaches of legislation.	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Ground Water Features (Secondary A Aquifer – Salop Formation)	Medium	Where contamination remains within the final development then this could lead to impact on groundwater (Secondary A Aquifer) from leaching of potential existing mobile contamination into groundwater and vertical/lateral migration through permeable strata. It is noted that the presence of a significant depth of low permeability cohesive soils are anticipated to underlie the site and will afford some protection to the underlying aquifers. The magnitude of impact is considered to be medium as such releases could result in possible failure of statutory obligation and breaches of legislation.	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
Ground Water Features (Secondary A Aquifer – Salop Formation)	Medium	The Salop Formation Secondary A Aquifer could be at risk from leaching of potential new contaminants through groundwater and vertical/lateral migration through permeable strata from accidental spills and leaks of potential new contaminants associated with the operation of the final development and the potential petrol filling station. It is noted that the presence of a significant depth of low permeability cohesive soils are anticipated to underlie the site and will afford some protection to the underlying aquifers The magnitude of impact is considered to be medium as such releases could result in possible failure of statutory obligation and breaches of legislation.	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1



12. Ground Conditions & Contamination

Receptor(s) affected	Receptor Sensitivity	Description of Impact	Magnitude of Impact	Scale of Effect and Significance	Additional Mitigation proposed?	Further information
Retained Vegetation and New Planting	Low	Where phytotoxic contamination exists within existing soils and groundwater in the final development then this could impact on retained vegetation and any new planting within the application site. It is noted that, given the current arable use of the site, then the risk of significant widespread phytotoxic contamination is considered to be low and the magnitude of the impact is considered to be small.	Small	Negligible Adverse	Yes	Appendix 12.1 and Table 12.8.1
New Buildings and Infrastructure	Medium	A potential risk exists where buried concrete and plastic pipework comes into direct contact with existing Made Ground and natural soils which contain compounds (for example sulphates) that are aggressive to buried concrete and plastic. The magnitude of impact is considered to be medium because the presence of certain contaminants could result in possible failure of statutory obligation and breaches of legislation (quality of potable water or integrity of structures).	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1
New Buildings and Infrastructure	Medium	Lateral and vertical migration of hazardous ground gas and volatile vapours originating from localised Made Ground or organic natural soils on site (for example within former infilled ponds), potentially resulting in an explosion that could cause damage to a building or related infrastructure. The magnitude of impact is considered to be medium because such an event could result in possible failure of statutory obligation and breaches of legislation (integrity of structures).	Medium	Moderate Adverse (Significant)	Yes	Appendix 12.1 and Table 12.8.1

12.8. Additional Mitigation & Enhancement Measures

Table 12.8.1 identifies the additional mitigation measures that have been proposed in order to address the effects identified in Section 12.7, as well as the effectiveness of those measures, and how they would be secured. Possible enhancement measures have also been identified where relevant.

Table 12.8.1
Proposed Mitigation & Enhancement Measures

Stage	Receptor(s) affected	Possible effect being mitigated	Mitigation measure	How secured / trigger	Further information
Demolition and Construction Stage	Human Health (Demolition and construction workers and adjacent site users)	Risks associated with the potential exposure of workers and/or accidental spread of ACMs within existing buildings.	ACM surveys will be completed on existing buildings, prior to the commencement of demolition works, to identify if asbestos is present. Where present, demolition would be preceded by the removal of asbestos by licensed contractors as required by the Control of Asbestos Regulations (2012)	Planning Condition	ES Chapter 6 <i>Construction Strategy & CEMP</i>
Demolition and Construction Stage	Human Health (demolition and construction workers, adjacent site users); Surface Waters including the River Dee and its tributaries and the River Dee and Bala Lake SAC); Ground Waters (Kinnerton Sandstone Formation Principal Aquifer and Salop Formation Secondary A Aquifer); Retained Vegetation	All potential impacts on these receptors set out in Table 12.7.1 relating to the mobilisation of potential new contamination	A detailed Construction Environmental Management Plan (CEMP) will be developed to place environmental controls on the demolition and construction activities to ensure any construction related impacts are mitigated. This will include the preparation of a pollution incident control plan, which will be put in place during the demolition and construction works and will include the consideration of any required dewatering activities. Other mitigation measures that will be included in the CEMP include: – Correct storage of chemicals, fuels and oils (e.g. use of secondary containment such as bunds and drip trays as appropriate); – Designated refueling areas for vehicles and equipment to minimise the risk of spills entering the environment; – Appropriately managed concrete washout; – Dust suppression and monitoring; and – An emergency response spill kit and detailed procedures for the response to a pollution incident.	Planning Condition	ES Chapter 6 <i>Construction Strategy & CEMP</i>
Demolition and Construction Stage	Human Health (demolition and construction workers, adjacent site users); Surface Waters (the River Dee and its tributaries and the River Dee and Bala Lake SAC); Ground Waters (Kinnerton Sandstone Formation Principal Aquifer and Salop Formation Secondary A Aquifer); Retained Vegetation	Exposure to and mobilisation of potential existing contamination, where present, within existing soils.	Prior to the start of any works on-site, ground Investigation will be carried out to confirm the anticipated ground and groundwater conditions indicated by the PRA. The proposed ground investigation will include testing of existing soils in order to confirm the presence/absence of any contamination present. If required, a remediation strategy would be prepared to record how the remediation works would be undertaken to ensure the site is ‘Suitable for Use’ and will not present a risk to human health, groundwater, or the built environment. Mitigation measures that would be included within the remediation strategy would include: – Removal of any contamination hot spots; – In-situ or off site remediation of contaminated soils or groundwater;	Planning Condition	ES Chapter 6 <i>Construction Strategy & CEMP</i>



12. Ground Conditions & Contamination

Stage	Receptor(s) affected	Possible effect being mitigated	Mitigation measure	How secured / trigger	Further information
			Requirements for clean cover systems within areas of soft landscaping; and The relevant compliance criteria suitable for the proposed end use (including for imported material) as well as any monitoring required for verification.		
Demolition and Construction Stage	Human Health (demolition and construction workers and adjacent site users)	Potential impacts from migration of hazardous ground gas and vapours from made ground	The CEMP will include necessary mitigation measures to be adopted. Due to the potential for ground gas and depleted oxygen, construction and maintenance workers undertaking sub surface works will be required in the CEMP to refer to relevant Occupational Health guidance of working in hypoxic environments and employ appropriate protection and control measures.	Planning Condition	ES Chapter 6: Construction Strategy & CEMP
Demolition and Construction Stage	New Buildings and Infrastructure	Direct contact of newly installed structures and services with aggressive ground and potential hazardous ground gases/vapours.	Prior to the start of any works on site, Ground Investigation will be carried out to confirm the anticipated ground and groundwater conditions indicated by the PRA. The ground investigation will include testing in order to determine appropriate concrete design and service materials to be implemented.	Planning Condition	ES Chapter 6: Construction Strategy & CEMP
Completed Development Stage	Controlled Waters (Kinnerton Sandstone Formation Principal Aquifer and Salop Formation Secondary A Aquifer; and Surface Waters, including the River Dee and Bala Lake SAC)	Risks associated with contamination from the storage and use of fuels and other materials on site, including risks associated with the storage of fuels within the proposed Petrol Filling Station.	Safe and appropriate storage and use of materials on site, to be implemented in accordance with appropriate Environmental Management Plan (EMP) and in line with relevant legislation and Environmental Permits where necessary.	Various i.e. Planning Condition, Contract documentation/Legislation/Environmental Permits	N/A
Completed Development Stage	Controlled Waters (Kinnerton Sandstone Formation Principal Aquifer and Salop Formation Secondary A Aquifer; and Surface Waters, including the River Dee and Bala Lake SAC)	Risks associated with increased phosphates	Consultation is currently being undertaken with NRW and DCWW to identify if there is sufficient capacity in the existing Five Fords WwTW for phosphate treatment. Should this not be the case, the wastewater from the proposed development will be treated on-site, including 'polishing' to reduce phosphate concentrations to appropriate levels, prior to discharge into the application site's surface water drainage system.	Planning Condition	N/A
Completed Development Stage	Human Health (Future Site Users)	Exposure to contamination, where present, within existing soils.	Prior to the start of any works on-site, ground Investigation will be carried out to confirm the anticipated ground and groundwater conditions indicated by the PRA. Following completion of the ground investigation, where contamination has been shown to exist within the application site, then a remedial strategy will be prepared. The remedial strategy will define any remedial works required in order to render the site 'suitable for use' as proposed and will be submitted for agreement with the Local Planning Authority. Where required, potential remedial works may include: Details of any hotspots to be removed and details of validation testing required. Details of any clean cover systems required within areas of soft landscaping. Details of any gas protection requirements to be installed within proposed buildings. These remedial works will be completed and implemented as part of the demolition and construction phase.	Planning Condition	N/A
Completed Development Stage	New Buildings and Infrastructure	Direct contact of newly installed structures and infrastructure with aggressive ground.	Concrete design and infrastructure specification to be informed by the findings of ground investigation to ensure the use of suitable materials.	Planning Condition	N/A
Completed Development Stage	New Buildings and Infrastructure	Risks associated with migration of potential hazardous ground gases/vapours	Ground Investigation will be carried out to confirm the existing ground conditions. Subject to the identified ground conditions, gas monitoring to be carried out to inform the need for gas protection measures within the proposed buildings. Where required, gas protection measures will be implemented into proposed buildings.	Planning Condition	N/A



12. Ground Conditions & Contamination

Stage	Receptor(s) affected	Possible effect being mitigated	Mitigation measure	How secured / trigger	Further information
Completed Development Stage	Retained vegetation and New Planting	Direct contact of retained vegetation and/or new planting within contaminated (phytotoxic) soils.	Ground investigation will be carried out to confirm the existing ground conditions and understand the potential risks to new planting within the final development. Where potential risks are identified then recommendations for remedial works, such as the provision of clean cover within proposed landscaped areas will be implemented in accordance with an agreed remedial strategy.	Planning Condition	N/A

12.9. Residual Effects

Table 12.9.1 provides a tabulated summary of the outcomes of the ground conditions and contamination assessment of the proposed development.

Table 12.9.1
Residual Effects

Stage	Receptor (sensitivity)	Description of Residual Effect and Any Additional Mitigation	Residual Effect						
			Magnitude post-mitigation	Scale of Effect and Significance	ADV / BEN	ST / MT/ LT	D/IND	P/T	R/IRR
Key: ADV/BEN= Adverse/Beneficial; ST/MT/LT = Short-term/Medium-term/Long-term; D/IND = Direct/Indirect; P/T = Permanent/Temporary; R/IRR = Reversible/Irreversible									
Demolition and Construction Stage	Human Health (Demolition & Construction Workers and adjacent site users (High)	Where present, demolition & construction workers and potential users of the adjacent land may be exposed to Asbestos Containing Materials through dusts generated during the demolition of existing buildings and during the general site clearance works on site. ACM surveys will be completed on existing buildings, prior to the commencement of demolition works, to identify if asbestos is present. Where present, demolition would be preceded by the removal of asbestos by licensed contractors as required by the Control of Asbestos Regulations (2012).	Very Small	Negligible (not significant)	ADV	ST	D	P	IRR
Demolition and Construction Stage	Controlled Waters (Kinnerton Sandstone Formation Principal Aquifer and Salop Formation Secondary A Aquifer; and Surface Waters, including the River Dee and Bala Lake SAC) (High/Medium)	The removal of existing surface vegetation and topsoil from across the application site as part of the site clearance works may result in an increased risk of surface water run off which could impact on both the local surface water network and ultimately the SAC. Demolition and construction works will be carried out in accordance with a CEMP which will define environmental controls to be implemented throughout the works, including the need for surface water management and possible environmental monitoring and testing during the works, where required.	Very Small	Negligible (not significant)	ADV	ST	D	T	R
Demolition and Construction Stage	Human Health (Demolition & Construction Workers, Adjacent site users) (High)	The removal of existing surface vegetation and topsoil from across the site will expose any areas of vapours/hazardous ground gases and contamination present within existing soils and water across the application site. This poses a risk to both the workers on site involved in these works, and occupants and users of adjacent land through the increased risks of dust. Prior to the start of any works on-site, ground Investigation will be carried out to confirm the anticipated ground and groundwater conditions indicated by the PRA. The proposed ground investigation will include testing of existing soils in order to confirm the presence/absence of any contamination present. The findings will inform the mitigation measures to be included in, and implemented via, the CEMP and within individual contractors' Risk Assessments and Method Statements for precautionary or mitigation measures required during the works, such as Personal Protective Equipment (PPE) and dust monitoring or environmental sampling.	Very Small	Negligible (not significant)	ADV	ST	D	T	R
Demolition and Construction Stage	Controlled Waters (Kinnerton Sandstone Formation Principal Aquifer and Salop Formation Secondary A Aquifer; and Surface Waters, including the River Dee and Bala Lake SAC), Human Health (Demolition & Construction Workers, Adjacent site users) (High/Medium)	In addition to imported materials required by the construction, it is anticipated that site won topsoil and other site-won soils, cleared as part of the preliminary site clearance works, will be stockpiled and retained on site for later re-use. An increased risk of surface water run off exists associated with the storage of such materials on site. Demolition and construction works will be carried out in accordance with a CEMP which will define environmental controls to be implemented throughout the works, including the need for surface water management and possible dust and environmental monitoring and testing during the works, where required.	Very Small	Negligible (not significant)	ADV	ST	D	T	R



12. Ground Conditions & Contamination

Stage	Receptor (sensitivity)	Description of Residual Effect and Any Additional Mitigation	Residual Effect						
			Magnitude post-mitigation	Scale of Effect and Significance	ADV / BEN	ST / MT/ LT	D/IND	P/T	R/IRR
Key: ADV/BEN= Adverse/Beneficial; ST/MT/LT = Short-term/Medium-term/Long-term; D/IND = Direct/Indirect; P/T = Permanent/Temporary; R/IRR = Reversible/Irreversible									
Demolition & Construction Stage	Controlled Waters (Kinnerton Sandstone Formation Principal Aquifer and Salop Formation Secondary A Aquifer); and Surface Waters, including the River Dee and Bala Lake SAC), Human Health (Demolition & Construction Workers, Adjacent land Users (High/Medium)	As part of the demolition and construction phase, new sources of potential contamination will be introduced to the site, including fuels which will be stored on site for use by the construction plant and machinery. The storage and use of such materials represent a risk to both Controlled Waters and Human Health Receptors through the potential for leakage and accidental spills. Demolition and construction works will be carried out in accordance with a CEMP, which will define environmental controls to be implemented throughout the works, including; - Recommendations for the correct storage of chemicals, fuels and oils on site, including the need for secondary containment such as bunds and drip trays, as appropriate. - The need for suitable areas for the storage of materials and hazardous materials on site, including designated refuelling areas and areas of concrete washing. - Details of emergency spill response and procedures for pollution incident reporting.	Very small	Negligible (not significant)	ADV	ST	D	T	R
Demolition and Construction Stage	Retained vegetation (Low)	Where phytotoxic contamination exists at shallow depth within the application site then a potential risk exists to retained planting in soft landscaping within the completed development. Ground investigation will be carried out to confirm the existing ground conditions and understand the potential risks to retained planting within the final development. Where potential risks are identified then recommendations for remedial works will be made, such as the provision of clean cover within proposed landscaped areas which will be implemented in accordance with an agreed remedial strategy.	Very small	Negligible (not significant)	BEN	LT	D	P	IRR
Completed Development Stage	Controlled Waters (Kinnerton Sandstone Formation Principal Aquifer and Salop Formation Secondary A Aquifer; and Surface Waters, including the River Dee and Bala Lake SAC) (High/Medium)	Where contamination is present within the application site then Controlled Waters may be at risk where these soils are retained within the final development. In line with the nature of the proposed development then it is noted that the majority of the surface of the final development will comprise hardstanding (reduced infiltration) thus this risk applies predominantly to areas of open space and/or landscaping within the final development. Prior to the start of any works on-site, ground investigation will be carried out to confirm the anticipated ground and groundwater conditions indicated by the PRA. Following completion of the ground investigation, where contamination has been shown to exist within the application site, then a remedial strategy will be prepared. The remedial strategy will define any remedial works required in order to render the site ‘suitable for use’ as proposed and will be submitted for agreement with the Local Planning Authority. Where required, potential remedial works may include: – Details of any hotspots to be removed and details of validation testing required. – Details of any treatment proposal prior to reuse/retention within the proposed development. – Details of any clean cover systems required within areas of soft landscaping. These remedial works will be completed and implemented as part of the demolition and construction phase.	Very small	Negligible (not significant)	BEN	LT	D	P	IRR
Completed Development Stage	Controlled Waters (Kinnerton Sandstone Formation Principal Aquifer and Salop Formation Secondary A Aquifer; and Surface Waters, including the River Dee and Bala Lake SAC) (High/Medium)	Controlled Waters could be at risk from impact from increased phosphate concentrations, mainly through wastewater from site occupants and site usage. The wastewater from the final development is likely to be treated on-site, including ‘polishing’ to reduce phosphate concentrations to appropriate levels, prior to discharge into the application site’s surface water drainage system. Alternatively, the wastewater may be discharged into the existing DCWW combined sewer prior to treatment at the Five Fords WwTW and subsequent discharge into the River Dee (subject to confirmation from DCWW regarding sufficient loading capacity and headroom for phosphate treatment). The wastewater treatment strategy for the proposed development will be agreed with Wrexham CBC and secured by an appropriately worded planning condition.	Very small	Negligible (not significant)	BEN	LT	D	P	R



12. Ground Conditions & Contamination

Stage	Receptor (sensitivity)	Description of Residual Effect and Any Additional Mitigation	Residual Effect						
			Magnitude post-mitigation	Scale of Effect and Significance	ADV / BEN	ST / MT/ LT	D/IND	P/T	R/IRR
Key: ADV/BEN= Adverse/Beneficial; ST/MT/LT = Short-term/Medium-term/Long-term; D/IND = Direct/Indirect; P/T = Permanent/Temporary; R/IRR = Reversible/Irreversible									
Completed Development Stage	Controlled Waters (Kinnerton Sandstone Formation Principal Aquifer and Salop Formation Secondary A Aquifer; and Surface Waters, including the River Dee and Bala Lake SAC), Human Health Future Site Users, Adjacent land Users (High/Medium)	Given the proposed development would comprise industrial floorspace, as well as a PFS, there is the potential for impacts to both Controlled Waters (ground and surface waters), including the SAC, as well as future site users, as a result of leaks and spillage of contaminative materials stored. Mitigation is proposed in the form of safe and appropriate storage and use of materials on site, to be implemented in accordance with appropriate Environmental Management Systems (EMS) and in line with relevant legislation and Environmental Permits where necessary. For all hazardous materials, there should be sufficient infrastructure in place to mitigate and contain any spills and a review of the site drainage and oil interceptors should be undertaken and submitted as part of the planning process.	Very small	Negligible (not significant)	BEN	LT	D	T	R
Completed Development Stage	Controlled Waters (Kinnerton Sandstone Formation Principal Aquifer and Salop Formation Secondary A Aquifer; and Surface Waters, including the River Dee and Bala Lake SAC) (High/Medium)	The wastewater from the final development is likely to be treated on-site, including ‘polishing’ to reduce phosphate concentrations to appropriate levels, prior to discharge into the application site’s surface water drainage system. Alternatively, the wastewater may be discharged into the existing DCWW combined sewer prior to treatment at the Five Fords WwTW and subsequent discharge into the River Dee (subject to confirmation from DCWW regarding sufficient loading capacity and headroom for phosphate treatment).	Very small	Negligible (not significant)	BEN	LT	D	P	R
Completed Development Stage	Human Health (Future Site Users and Adjacent land users) (High)	Where contamination is present within the application site then Future Site Users may be at risk where these soils are exposed within the final development. In line with the nature of the proposed development then it is noted that the majority of the surface of the final development will comprise hardstanding thus this risk applies predominantly to areas of open space and/or landscaping within the final development. Prior to the start of any works on-site, ground Investigation will be carried out to confirm the anticipated ground and groundwater conditions indicated by the PRA. Following completion of the ground investigation, where contamination has been shown to exist within the application site, then a remedial strategy will be prepared. The remedial strategy will define any remedial works required in order to render the site ‘suitable for use’ as proposed and will be submitted for agreement with the Local Planning Authority. Where required, potential remedial works may include: – Details of any hotspots to be removed and details of validation testing required. – Details of any clean cover systems required within areas of soft landscaping. – Details of any gas protection requirements to be installed within proposed buildings. These remedial works will be completed and implemented as part of the demolition and construction phase.	Very small	Negligible (not significant)	BEN	LT	D	P	IRR
Completed Development Stage	New Buildings and Infrastructure (Medium)	A potential risk exists where buried concrete and plastic pipework comes into direct contact with existing made ground and natural soils which contain compounds (for example sulphates) that are aggressive to buried concrete. Concrete design and infrastructure specification will be informed by the findings of ground investigation to ensure the use of suitable materials are implemented as part of the demolition and construction stage.	Very small	Negligible (not significant)	BEN	LT	D	P	IRR
Completed Development Stage	New Buildings and Infrastructure (Medium)	Lateral and vertical migration of hazardous ground gas and volatile vapours originating from made ground or organic natural soils on site (for example within former infilled ponds), potentially resulting in an explosion that could cause damage to a building or related infrastructure. Ground Investigation will be carried out to confirm the existing ground conditions. Subject to the identified ground conditions, gas monitoring will be carried out to inform the need for gas protection measures within the proposed buildings. Where required, gas protection measures will be implemented into proposed buildings as part of the demolition and construction stage.	Very small	Negligible (not significant)	BEN	LT	D	P	IRR



12. Ground Conditions & Contamination

Stage	Receptor (sensitivity)	Description of Residual Effect and Any Additional Mitigation	Residual Effect						
			Magnitude post-mitigation	Scale of Effect and Significance	ADV / BEN	ST / MT/ LT	D/IND	P/T	R/IRR
Key: ADV/BEN= Adverse/Beneficial; ST/MT/LT = Short-term/Medium-term/Long-term; D/IND = Direct/Indirect; P/T = Permanent/Temporary; R/IRR = Reversible/Irreversible									
Completed Development Stage	Retained vegetation and new planting (Low)	Where phytotoxic contamination exists at shallow depth within the application site then a potential risk exists to new planting in soft landscaping within the final development.	Very small	Negligible (not significant)	BEN	LT	D	P	IRR
		Ground investigation will be carried out to confirm the existing ground conditions and understand the potential risks to new planting within the final development. Where potential risks are identified then recommendations for remedial works will be made, such as the provision of clean cover within proposed landscaped areas which will be implemented in accordance with an agreed remedial strategy as part of the demolition and construction stage.							

12.10. Ground Conditions & Contamination: Inter-Development Cumulative Effects

The assessment of inter-development cumulative effects broadly takes place over two stages, the first of which is screening. The screening exercise undertaken for the cumulative schemes identified in Chapter 2: EIA Methodology of this volume of the ES is included in Section 12.10.1. Those identified to have the potential to result in cumulative effects with the proposed development have been assessed in Section 12.10.2.

12.10.1. Screening of Cumulative Schemes

Table 12.10.1
Ground Conditions Inter-development Cumulative Effects Assessment

Cumulative scheme	Scheme Description	Potential for cumulative effects?	Considered within assessment?
Land South of Ridley Wood (Ref: P/2020/0167)	Erection of a storage and distribution warehouse. The site is also owned by the Applicant and the development is intended to increase Net World Sports space from 11,148 sqm (120,000 sq. ft.) to 38,183 sqm (411,000 sq. ft.), having a net uplift of 27,035 sqm, comprising primarily B8 floorspace.	This scheme was completed and occupied in early 2023. It has therefore been considered in the existing baseline, rather than as a cumulative scheme. During the ground investigation works undertaken by Tier Environmental (Report Ref. TE1456GIR1.3 dated 10th July 2021) on this site, no contamination was identified and low permeability Till Deposits were encountered to greater than 10m.	Yes – already considered in Sections 12.7 and 12.9.
Unit 6 Pacific Park (Ref: P/2020/0603)	Erection of 2 new storage and warehousing industrial units	Given the scheme is currently under construction, it is not expected that the demolition and construction works will overlap with those of the proposed development. Furthermore, cumulative impacts are not expected to occur as current contaminated land and waste legislation dictates that following development, a site must be suitable for use (i.e. not represent a plausible source of contamination to both human health and the wider environment). Therefore, all cumulative schemes are expected to come forward in such a way that they are suitable for their intended use (i.e. they do not represent a plausible source of contamination to both human health and the wider environment), and this is true for both the demolition and construction stages, as well as the completed development stage. On this basis, and given that negligible effects are anticipated from the proposed development in isolation (as set out in Table 12.9.1 above), no significant inter-development cumulative effects are anticipated as a result of the cumulative schemes in combination with the proposed development.	No
Land Off, Ash Road South (Ref: P/2015/0843)	Erection of industrial unit comprising two storey office and warehouse accommodation and single storey dust extraction building and associated car parking and storage area.	Given the scheme is currently under construction, it is not expected that the demolition and construction works will overlap with those of the proposed development. Furthermore, cumulative impacts are not expected to occur as current contaminated land and waste legislation dictates that following development a site must be suitable for use (i.e. not represent a plausible source of contamination to both human health and the wider environment). Therefore, all cumulative schemes are expected to come forward in such a way that they are suitable for their intended use (i.e. they do not represent a plausible source of contamination to both human health and the wider environment), and this is true for both the demolition and construction stages, as well as the completed development stage. On this basis, and given that negligible effects are anticipated from the proposed development in isolation (as set out in Table 12.9.1 above), no significant inter-development cumulative effects are anticipated as a result of the cumulative schemes in combination with the proposed development.	No



12. Ground Conditions & Contamination

Cumulative scheme	Scheme Description	Potential for cumulative effects?	Considered within assessment?

12.10.2. Cumulative Effects

Based on the information presented in **Table 12.10.1** above, it is considered that there is no potential for inter-development cumulative effects to arise in combination with the proposed development.

12.11. Bibliography

1. UK Government. Section 78A of Part 2A of the Environmental Protection Act. 1990.
2. Agency, Environment. Land Contamination Risk Management (LCRM) guidance. [Online] 2020, as updated 2021. [Cited:] <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>.
3. British Standards Institute. BS 10175:2011 + A2:2017 Investigation of potentially contaminated sites - Code of practice. 2017.
4. Institute, British Standards. BS 5930:2015 + A1:2020 Code of practice for ground investigations.
5. CL:AIRE. Definition of Waste: Development Industry Code of Practice, Version 2. 2011.
6. CIRIA. CIRIA C552 'Contaminated Land Risk Assessment – A guide to good practice. 2001.
7. WLGA & NRW. Development of Land Affected by Contamination, Version 3. May 2017 .
8. Agency, Environment. Managing and reducing land contamination: guiding principles. April 2016.
9. Welsh Government. Groundwater Protection Codes for Wales: Underground Storage Tanks. 2017.
10. Association for Petroleum and Explosives Administration (APEA). Design, Construction, Modification, Maintenance and Decommissioning of Filling Stations (also known as the Blue Book) (Fourth Edition). 2018.
11. Wrexham County Borough Council. Wrexham Local Planning Policy Guidance Note 23. <https://www.wrexham.gov.uk/sites/default/files/2023-04/lpg-23e.pdf>. [Online] 2013.
12. UK Government. The Water Resources Act 1991. 1991.
13. —. The Water Resources Act 1991 (Amendment) (England and Wales) Regulations. 2009.
14. —. Water Act. 2014.
15. —. The Control of Asbestos Regulations. <https://www.legislation.gov.uk/ukxi/2012/632/contents/made>. [Online] 2012.
16. Welsh Government. National Development Framework. <https://www.gov.wales/future-wales-national-plan-2040>. [Online]
17. UK Government. The Water Environment (Water Framework Directive) (England and Wales) Regulations. <https://www.legislation.gov.uk/ukxi/2017/407>. [Online] 2017.
18. Welsh Government. Future Wales: The National Plan 2040. s.l. : GOV.WALES, 2021.
19. Ministry of Housing, Communities & Local Government. National Planning Policy Framework. s.l. : MGCLG, 2021.
20. Wrexham County Borough Council. Unitary Development Plan. 2005.
21. Wrexham Council. Wrexham Local Development Plan 2013-2018. s.l. : [Unpublished].
22. British Standards Institute. BS 5930:2015 + A1:2020 Code of practice for ground investigations.
23. UK Government. Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance. 1990.
24. Affairs, Department for Environment Food and Rural. Environmental Protection Act 1990: Part 2A Conaminated Land Statutory Guidance. s.l. : HM Government, April.

