

## REPORT

# **Boston Alternative Energy Facility – Preliminary Environmental Information Report**

Appendix 11.1 Land Quality Phase 1 Preliminary Risk  
Assessment

Client: Alternative Use Boston Projects Ltd

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## Executive Summary

Royal HaskoningDHV has been commissioned by Alternative Use Boston Projects Ltd (AUP) to carry out a Phase 1 Land Quality Preliminary Risk Assessment (PRA) to support a DCO application for the Boston Gasification Project.

The key objectives of the desk study were to identify potential sources of contamination within or around the site that may represent an unacceptable risk to construction workers, site users and/or the environment. This will determine whether further investigation or assessment is needed to understand and mitigate the identified risks. A preliminary conceptual site model (CSM) has been therefore been developed to describe potential pollutant linkages and is summarised below.

Identified potential sources of contamination include the historic landfill site, recycling centre and other historic activities including a plastic factory. Identified potential sources of contamination associated with the off-site sources include former brick works. Potential contaminants of concern (PCOC) associated with these land uses could represent an unacceptable risk to sensitive receptors.

Potential contaminants of concern include:

- Metals and metal compounds;
- Petroleum hydrocarbons;
- Polycyclic aromatic hydrocarbons (PAHs);
- Volatile and semi-volatile organic compounds (VOCs / SVOCs)
- Phenols
- Polychlorinated biphenyls (PCBs)
- Pulverised fuel ash (PFA)
- Inorganic contaminants (e.g. ammonia, arsenic, cyanides, sulphides, phosphates); and
- Asbestos

Potentially viable pathways are:

- direct exposure of site workers to on-site contaminated soils or groundwater (through dermal contact, ingestion or inhalation) during construction;

- exposure of future site users to on-site contaminated soils in landscaped areas of the proposed development (through dermal contact, ingestion or inhalation);
- gas generation and transport;
- leaching of any on-site contamination causing deterioration of shallow groundwater quality; and
- groundwater migration.

Further investigation and assessment is considered necessary to clarify the potentially unacceptable risks to human health and controlled waters. To clarify the risks associated with the potential pollutant linkages identified above, it is recommended that an intrusive ground investigation is undertaken at the site. This should include soil and soil leachate groundwater and gas.

## **A11 Appendix 11.1: Land Quality Phase 1 Preliminary Risk Assessment**

### **A11.1 Introduction**

A11.1.1 Royal HaskoningDHV has been commissioned by Alternative Use Boston Projects Ltd (the Applicant) to carry out a Phase 1 Land Quality Preliminary Risk Assessment (PRA) to support a DCO application for the Boston Gasification Project.

A11.1.2 This report has been prepared by RHDHV for the sole benefit of the Applicant.

### **Proposed Development**

A11.1.3 The Applicant is proposing the development of a gasification facility (the Facility), which will include a 96 MWe Power Station (80 MWe exportable) using solid waste as a fuel source; and associated development. At this scale, the Facility would constitute a Nationally Significant Infrastructure Project (NSIP). Therefore, AUP are pursuing a Development Consent Order (DCO) for the gasification facility and associated development which includes a lightweight aggregate (LWA) manufacturing plant, a new wharf, and a waste checking and storage facility to support in the operational phase of the gasification process.

### **Key Objectives**

A11.1.4 The objectives of the PRA are to:

- identify (as far as reasonably possible) any potential sources of contamination within or around the site that may represent an unacceptable risk to construction workers, site users and/or the environment; and,
- conclude whether further investigation or assessment is needed to understand and mitigate the identified risks.

### **Methodology**

A11.1.5 The PRA has been completed in general accordance with the recommended approach in Contaminated Land Report 11, (DEFRA and Environment Agency, 2004. Model Procedures for the Management of Contaminated Land, R & D Publication CLR11).

A11.1.6 The PRA is a desk-based study and forms the initial step in the assessment of potentially contaminated land. It proceeds, if required, intrusive investigation,

risk assessment, options appraisal, remedial design, implementation planning and completion reporting.

A11.1.7 The main purpose of the PRA is to identify whether there are potentially unacceptable risks to human health or the environment posed by the site and the immediate surroundings, which warrant further investigation.

A11.1.8 The following desk-based information sources have been reviewed:

- Envirocheck Report comprising historical maps, environmental sensitivity data and permitting records for a search area of 1 km around the site boundary (Order No.: 136439979\_1\_1);
- British Geological Survey (BGS) Onshore GeoIndex web portal; and
- Google Earth.

A11.1.9 A site walkover survey was also undertaken on the 16 August 2017 to verify current conditions at the site.

## **Report Format**

A11.1.10 The remainder of this report comprises the following principal sections:

- Section 2 – Site Setting and Land Use.
- Section 3 – Environmental Setting.
- Section 4 – Preliminary Conceptual Site Model and Qualitative Risk Assessment.
- Section 5 – Conclusions.
- Section 6 – References.

## **A11.2 Site Setting and Land Use**

### **Site Location and Description**

A11.2.1 The site is located in Boston, Lincolnshire to the west of the Haven and east of Nursery Road. The site is generally flat, low level land between 2 to 5 mAOD, except for the raised flood embankments on the banks of the Haven and small embankment (shown as old Roman embankment). The site was used as arable land in the past (evidence of ploughing still visible on the ground) but is currently not cultivated with crops. The site currently comprises mostly semi-improved grassland. The surrounding area is dominated by an industrial estate including car parks and storage buildings. The site can be accessed from Nursery Road

to the north and Bittern Way to the south (further details regarding site access are provided in **Section 2.2**).

A11.2.2 The site location is shown in **Annex 11.1.2**.

### **Site Walkover Survey**

A11.2.3 A site inspection survey was carried out by Royal HaskoningDHV on 16 August 2017; the key findings are summarised below. The site is sub-divided into areas according to the proposed components of the DCO application. The land immediately surrounding the site is occupied by various industrial estate related operations including mixed use warehouses, as well as a recycling centre and depot. The site is undeveloped and appears to be semi-improved grassland. The boundary is generally not secure.

#### Boston 2 and 3 – Gasification and LWA facility

A11.2.4 The site is not fenced off and can be accessed from Bittern Way to the south and Nursery Road to the north. There is an internal track which crosses the site and connects Bittern Way and Nursery Road. The site topography is flat. Both areas appear to comprise semi-improved grassland.

A11.2.5 There are no buildings or other structures on the site. There are open drainage channels crossing the site. The drains are densely vegetated (mostly by common reed). A new culvert is currently being installed along an existing track within Boston 2 by the local Council. An overhead electricity transmission line runs above the eastern boundary of the Boston 2 site.

A11.2.6 No evidence of contamination (including fly tipping) or invasive species was noted on site.

#### Boston 4 – new wharf area

A11.2.7 The perimeter of the area is fenced with landside access via a gate on Nursery Road; or on the riverside via a gate on Lealand Way. The site is generally flat with a high embankment with steep slopes to the eastern edge, which runs along the Haven. A barbed wire fence runs along the embankment's toe. There is a track which runs along the dry side of the embankment and connects to the track coming from the Nursery Road.

A11.2.8 A wide deep drain runs parallel to the embankment on its western side. The water levels were very low at the time of the survey. A partially collapsed culvert outfall was noted on-site. It is anticipated that there is culvert which runs along the



access track from Nursery Road and joins with the channel along the embankment. Several manholes were noted along the track.

A11.2.9 A public footpath runs along the top of the embankment. A sign marking the position of an underground water main was noted during the survey on the waters-edge of the embankment.

A11.2.10 No evidence of fly tipping or other contamination were noted on this area; and no invasive species were noted on site. However, the site is adjacent to an active recycling centre and a fenced off area where old agricultural plant and different types of wastes (timber, concrete slabs and soil) are stored.

#### Boston 5 – proposed waste reception area

A11.2.11 The site is separated from the proposed Boston 4 area by a dense hedge and can be accessed by track from Boston 4 only. The area is surrounded by an embankment from the west, south and east. The site comprises mostly bare ground with ruderal vegetation along the site edges.

A11.2.12 The site is currently used for storing sands and gravels and some construction type waste (mostly reinforced concrete). A metal container was noted on site. No invasive species were noted on site.

A11.2.13 Site photographs are provided in the site inspection record (**Annex 11.1.3**).

#### **Historical Land Use**

A11.2.14 Potentially contaminative historical land use information is summarised for the site in **Table A11.1.1** and for the surrounding area (within 1 km), in **Table A11.1.2**. The information was determined from historical Ordnance Survey maps contained within the Envirocheck Report (Ref. 0) presented in **Annex 11.1.4**.

**Table A11.1.1 Historical Land Use: On-site.**

| Map Dates | On-site Features  |
|-----------|---|
| 1888      | Throughout this period the site remains undeveloped, possibly forming part of an agricultural holding associated with Battery Farm. A drainage channel appears to pass through the site. There are saltings shown on the map along the river bank and in Boston 5 area. An embankment marked as Roman Bank runs through the site. |
| 1906      | No significant change   |
| 1938      | No significant change   |
| 1951      | No significant change   |
| 1956      | No significant change   |

| Map Dates   | On-site Features   |
|-------------|--|
| 1967 - 1984 | No significant change                                      |
| 1967 - 1984 | No significant change                                      |
| 1973-1974   | No significant change                                      |
| 1985        | No significant change                                      |
| 2000        | Electricity overhead cable running along the site boundary |

**Table A11.1.2 Historical Land Use: Off-site**

| Map Dates   | Off-site Features   | Distance | Direction  |
|-------------|---|----------|------------|
| 1888        | Pump  | 250m     | South-west |
|             | Boston docks and dock railway   | 500m     | North-west |
|             | Iron works  | 250m     | North      |
|             | Boston Union Works  | 500m     | North      |
| 1906        | Riffle Range  | 250m     | South-east |
|             | Iron works shown as disused   | 250m     | North      |
|             | Saw Mill  | 500m     | North      |
| 1938        | Wood Mills  | 500m     | North-east |
|             | Hydraulic Engine House  | 750m     | North-west |
|             | Timber slip   | 500m     | East       |
| 1950 - 1951 | No significant change   |          |            |
| 1956        | No significant change   |          |            |
| 1967 - 1984 | Warehouses (no further detail presented)  | 100m     | West       |
| 1968 - 1971 | Plastic factory   | 200m     | West       |
|             | Concrete works and box factory  | 500m     | West       |
| 1973-1974   | Poultry houses  | 250m     | West       |
|             | Timber Yard   | 250m     | West       |
|             | Timber Yard   | 250m     | East       |
|             | Works and Depot   | 500m     | East       |
|             | Hydraulic Engine House and timber slip no longer shown on the map replaced by a large timber yard | 750m     | North-west |

| Map Dates | Off-site Features   | Distance  | Direction  |
|-----------|---|-----------|------------|
|           | Wood Mill no longer shown on the map                                    | 500m      | North-east |
| 1985      | Factory (no further detail presented)                                   | 0m        | West       |
|           | Depot   | 100m      | West       |
|           | Warehouses, works (no further detail presented), abattoir and factories | 250-1000m | West       |
|           | Works (no further detail presented)                                     | 250m      | North      |
| 1993      | Tanks   | 150m      | West       |
| 2000      | Riverside industrial estate   | 50-1000m  | West       |
|           | Factory (no further detail presented)                                   | 500m      | East       |
|           | Substation  | 500m      | North      |
|           | Depot   | 250m      | South      |
|           | Abattoir  | 50m       | West       |
|           | Timber yard no longer shown on the map                                  | 750m      | North-west |

## Regulatory Information

A11.2.15 Regulatory information relating to potentially contaminative activities near the site has been summarised in **Table A11.1.3**. Further details are provided in the Envirocheck Report (Ref. 0) enclosed in **Annex 11.1.4**.

**Table A11.1.3 Regulatory Information**

| Environmental Records                    | On-site | 0-250m | Description  |
|--|---------|--------|--|
| Discharge Consents                       | 0       | 9      | <p>No discharge consents on site. Nine licensed discharge consents are recorded within 250 m including: sewage discharges (final/treated effluent, storm overflow/storm tank), storm sewage overflow, trade discharges, discharge of other matter- and freshwater stream/river discharges.</p> <p>Between 250 m and 1 km licensed discharge consents are recorded at 22 separate locations including: sewage discharges (final/treated effluent, storm overflow/storm tank), storm sewage overflow, trade discharges, discharges of other matter, miscellaneous discharges and freshwater stream/river discharges.</p> |
| Pollution Incidents to controlled waters | 0       | 7      | <p>One significant incident and six minor incidents within 250 m of the site, involving vegetable washings, oils – diesel, crude sewage and chemicals – solvents, all into surface waters (drains or directly into The Haven).</p>   |

| Environmental Records  | On-site | 0-250m | Description  |
|--|---------|--------|--|
|  |         |        | Four significant incidents and 23 minor incidents were recorded between 250 m and 1 km of the site. The incidents involved oils, organic wastes and crude sewage, all into surface water (drains or directly into the Haven or its tributaries).   |
| Substantiated Pollution Incidents                                    | 0       | 1      | <p>One significant incident to land and water 65 m to the north. Pollutants included contaminated water: firefighting run-off. This incident is likely to be up hydraulic gradient of the site.</p> <p>Four significant incidents occurred between 250 m and 1 km of the site, involving asbestos waste, gas and fuel oils and vegetable washings.</p>   |
| Registered landfill, historic landfill or other waste disposal sites | 0       | 5      | <p>Two historic landfills located immediately adjacent to the Boston 5 area. Both registered as Boston Landfill Site operated by Lincwaste Limited. The landfill sites overlap. Deposited waste included:</p> <p>Site 1 inert industrial, commercial, household and special waste, and liquid sludge.</p> <p>Site 2 special waste.</p> <p>One historic landfill site within 250 m of the site (located to the east). Deposited waste included: commercial and household waste, and liquid sludge.</p> <p>Two historic landfill site:</p> <p>At 343 m of the site.</p> <p>Deposited waste included inert waste.</p> <p>At 852 m west of the site. Deposited waste included inert waste.</p> <p>These sites are likely to be up hydraulic gradient of the site.</p> <p>Two registered landfill sites within 250 m of the site (located to the east). Authorised Waste include:</p> <p>animal processing wastes, bentonite drilling mud, bonded asbestos, empty used containers, fibrous asbestos, food processing wastes/starch, industrial effluent treatment sludge, interceptor pit wastes.</p> <p>Category A inert waste - solid, or granular material which either does not decompose or decomposes only very slowly and is virtually insoluble in water.</p> <p>Category B semi inert waste - solid, or granular or broken materials which either may decompose slowly, or are only slightly soluble in water.</p> |

| Environmental Records   | On-site | 0-250m | Description   |
|---|---------|--------|---|
|   |         |        | <p>Category C putrescible waste - materials which may decompose and may consist in part of soluble matter which could cause pollution if allowed to enter ground or surface water systems.</p> <p>Two registered landfill sites between 250 m and 1 km of the site:<br/>           At 387 m to the east. Authorised Waste include Category A inert waste.<br/>           At 933 m to the west. Authorised Waste include Category A inert waste.</p>   |
| Licensed waste management facilities (transfer, treatment and disposal sites) | 0       | 3      | <p>Three Licensed Waste Management Facilities within 250 m of the site:<br/>           at 68 m to the north of the site (Vehicle Depollution Facility).<br/>           at 96 m to the north-west of the site. Authorised waste include Household, Commercial and Industrial (HCI) waste and asbestos.<br/>           at 234 m (household, commercial and industrial transfer stations).</p> <p>Nine Licensed Waste Management Facilities between 250 m and 1km located to the west, south and southeast of the site, including HCI waste transfer stations, metal recycling site, physical treatment facility and co-disposal landfills sites.</p>  |
| Integrated Pollution Prevention and Control authorisations                    | 0       | 2      | <p>Two within 250 m associated with:<br/>           incineration of non-hazardous waste (likely to be downgradient of Boston 2 and 3).<br/>           waste landfilling (likely to be located up gradient of Boston 2 and 3).</p> <p>Within 1 km there are six authorisations located to the south and south east of the site, all associated with waste landfilling.</p>   |
| Local Authority Pollution Prevention and Control authorisations               | 0       | 7      | <p>Within 250 m there are 7 authorisations including:</p> <ul style="list-style-type: none"> <li>- blending, packing, loading and use of bulk cement at 166 m southwest (in operation).</li> <li>- processes for the manufacture of particleboard and fibreboard at 229 m northeast, 232 m northeast and 235 m northeast, Three different operators but located under the same address (two authorisations revoked, one in operation)</li> <li>- manufacture of timber and wood-based products at 232 m northeast and 235 m northeast, two different operators under the same address (one authorisation in operation)</li> <li>- combustion of fuel manufactured from/or comprised of solid waste in appliances between 0.4-3 MW thermal input at 235 m NE (authorisation in operation)</li> </ul> |

| Environmental Records                                    | On-site | 0-250m | Description   |
|--|---------|--------|---|
|  |         |        | There are 12 authorisations between 250 m and 1 km north, northeast and northwest of the site, including authorisations for blending, packing, loading and use of bulk cement, wood combustion processes, treatment and processing of animal or vegetable matter, paper coating and textile, and fabric coating of finishing processes.   |
| Hazardous substances consents and handling notifications | 0       | 0      | Two consents for explosive site at 810 m northwest and 745 m southwest for ammonium nitrate and ammonium nitrate compounds (where nitrogen content is more than 28% by weight) or aqueous ammonium nitrate solutions (where concentration of ammonium nitrate is more than 90% by weight).  |
| Prosecutions relating to Authorised Processes            | 0       | 1      | One associated with failure to comply with packaging waste regulations at 149 m west.<br><br>Three between 250 m and 1 km northwest of the site, associated with knowingly keeping transferring and disposing of controlled waste on land not in accordance with a waste management licence and failure to comply with packaging waste regulations.   |
| Prosecutions Incidents to Controlled Waters              | 0       | 0      | None present within 1 km.   |
| Licensed radioactive substances                          | 0       | 0      | None present within 1 km.   |
| Fuel sites   | 0       | 0      | One closed petrol station is present at 943 m east.   |
| Contemporary Trade Directory records (active and former) | 0       | 75     | Within 250 m of the site there are 75 entries including (mostly located north and north west of the site): <ul style="list-style-type: none"> <li>- Bus &amp; Coach Operators &amp; Stations</li> <li>- Meat – Wholesale</li> <li>- Electric Motor Sales &amp; Service</li> <li>- Domestic Appliances - Servicing, Repairs &amp; Parts</li> <li>- Distribution Services</li> <li>- Abrasive Products - Manufacturers &amp; Distributors</li> <li>- Printing Equipment Manufacturers</li> <li>- Pallets, Crates &amp; Packing Cases</li> <li>- Garage Services</li> <li>- Printers</li> <li>- Wood Recycling</li> <li>- Scrap Metal Merchants</li> <li>- Waste Disposal Services</li> <li>- Car Dealers</li> </ul> |

| Environmental Records | On-site | 0-250m | Description   |
|-----------------------|---------|--------|---|
|                       |         |        | Between 250 m and 500 m there are 23 records.<br>Between 500 m and 1 km there are 44 records.<br><br>See <b>Annex 11.1.4</b> for further details. |

## A11.3 Environmental Setting

### Geological Conditions

A11.3.1 Information on geological conditions at the site has been collated from the British Geological Survey (BGS) datasets including 1:50,000 scale geological mapping, historical borehole records and Envirocheck data provided in **Annex 11.1.4**. The anticipated geological sequence is outlined in **Table A11.1.4** below.

**Table A11.1.4 Geology**

| Stratum                     | Unit                   | Description  |
|-----------------------------|------------------------|--|
| <b>Superficial Deposits</b> | Tidal Flat Deposits    | Normally a consolidated soft silty clay, with layers of sand, gravel and peat.   |
| <b>Bedrock</b>              | Amphill Clay Formation | Mudstone, mainly smooth or slightly silty, pale to medium grey with argillaceous limestone (cementstone) nodules; some rhythmic alternations of dark grey mudstone in the lower part; topmost beds are typically pale grey marls with cementstone. |

A11.3.2 A ground investigation was undertaken at the Biomass UK No. 3 Ltd site in 2012 to the east of the Boston 2 site (Geotechnical Engineers & Report, 2012). At each of the borehole locations, the underlying natural strata was represented by a sequence of Tidal Flat or Alluvial deposits (clay, silt and sand) underlain by Glacial Till. The Glacial Till comprised firm to stiff, greenish brown, mottled lightly grey, silty, slightly sandy clay containing chalk and flint. This rested on a band of wet medium dense greenish brown and yellowish silty sand with coarse gravels. The band was underlain by boulder clay. Occasionally, lenses of sand were encountered and also hard stony layers (**Table A11.1.5**).

**Table A11.1.5 Boston 1 Ground Investigation borehole logs (Geotechnical Engineers & Report, 2012).**

| Borehole | Depth [m bgl] | Description                    |
|----------|---------------|--------------------------------|
| BH 1     | 0-0.35        | Topsoil / disturb ground       |
|          | 0.35-5.6-     | Tidal Flat Deposits / Alluvium |
|          | 5.6-14.95     | Glacial Till / Boulder Clay    |

| Borehole | Depth [m bgl] | Description                    |
|----------|---------------|--------------------------------|
| BH2      | 0-0.3         | Topsoil                        |
|          | 0.3-5.8       | Tidal Flat Deposits / Alluvium |
|          | 5.8-15        | Glacial Till / Boulder Clay    |
| BH 3     | 0-0.23        | Topsoil                        |
|          | 0.23-7        | Tidal Flat Deposits / Alluvium |
|          | 7-14.95       | Glacial Till / Boulder Clay    |
| BH 4     | 0-0.3         | Topsoil                        |
|          | 0.3-6         | Tidal Flat Deposits / Alluvium |
|          | 6-14.95       | Glacial Till / Boulder Clay    |

### Mining and Mineral Extraction

A11.3.3 The site is in an area that is considered not to be affected by coal mining activity.

A11.3.4 There are no BGS recorded mineral sites within 1 km of the site.

### Radon Gas

A11.3.5 The presence of radon gas is assessed in the UK according to the number of homes likely to be above the Action Level (200 Bq m<sup>-3</sup>). Under building regulations the requirement for protection measures (described in BRE, 2015) in



the construction of new buildings, conversions or extensions is dependent on Radon Potential<sup>1</sup>.

A11.3.6 BGS data indicate that the site is located within a lower probability radon area (less than 1% of homes above the Action Level) therefore no protective measures are required.

## **Groundwater**

### Hydrogeology

A11.3.7 The superficial and bedrock deposits underneath the site have been classified as Unproductive Strata (by the Environment Agency (Tidal Flat Deposits, Amphill Clay Formation).

A11.3.8 Unproductive Strata are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

A11.3.9 Environment Agency groundwater vulnerability maps indicate the site is located within an area of low groundwater vulnerability. This indicates that surface soils may provide the some protection to groundwater from pollution and are likely to be characterised by low leaching soils and/or the presence of low permeability drift deposits.

A11.3.10 Perched groundwater was encountered at Boston 1 within the alluvial deposits at depths around 3.5 m bgl (Geotechnical Engineers & Report, 2012). Groundwater was also encountered at the base of alluvial sequence and within the upper weathered layers of the glacial deposits at the depths around 7 m bgl. It is anticipated that the groundwater flow is likely to be from the west to the east

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<sup>1</sup> Public Health England, 2016 <http://www.ukradon.org/>

(towards The Haven). The groundwater and surface watercourses on the site is likely in hydraulic continuity.

A11.3.11 BGS flood risk information indicates that the site is not located within an area with potential for groundwater flooding.

#### Groundwater Abstractions

A11.3.12 There are no licensed groundwater abstractions on or within 1 km of the site.

A11.3.13 Note that the data search has not included identification of unlicensed water supplies abstracting less than 20 m<sup>3</sup> of water per day.

#### Groundwater Source Protection Zones

A11.3.14 Groundwater Source Protection Zones (SPZs) are defined around abstraction boreholes used for potable water supply, to delineate the area where release of a contaminant into the aquifer could impact on the abstraction<sup>2</sup>. The site does not lie within a published SPZ and none are present within 1 km.

### **Surface Water**

#### Hydrology and Drainage

A11.3.15 There are drainage channels located along the site boundary and crossing the site. Most of the drains are culverted. The Haven is located to the east of the site and is a tidal river. The watercourse flows in a south easterly direction into The Wash approximately 7 km to the southeast. The Haven is part of the River Witham transitional water body (GB530503000100). The water body was classified by the Environment Agency as being of 'bad' overall potential in 2015.

#### Surface Water Abstractions

A11.3.16 There are no on-site licensed surface water abstractions. There are seven licensed surface water abstractions within 1 km of the site:

- Four at 313 m to the south-west (water may be abstracted from a river or stream reach, or a single point used for amenity purposes).
- One at 323 m to the east (water may be abstracted from a stream).
- One at 507 m to the south-west (water may be abstracted from a stream).

<sup>2</sup> The Inner Zone (Zone 1) is the most sensitive and certain potentially hazardous activities are restricted in this area. Outside this are the Outer Zone (Zone 2) and the Total Catchment (Zone 3), which indicates the recharge area that contributes to that water supply. The Environment Agency has published SPZs for public water supplies and other significant sources. For potable abstractions without published SPZs there is a default Inner Zone of 50 m radius and, (for sources providing more than 2,000m<sup>3</sup>) an Outer Zone of 250 m radius.

- One at 655 m to the north-west (water may be abstracted from the river and used for general washing/process washing).

A11.3.17 Note that the data search has not included identification of unlicensed water supplies abstracting less than 20 m<sup>3</sup> of water per day.

### Sensitive Land Use

A11.3.18 Havenside Local Nature Reserve is located 99 m north-east of the site.

## A11.4 Preliminary Conceptual Site Model and Qualitative Risk Assessment

A11.4.1 Current guidance recommends that a preliminary Conceptual Site Model (PCSM) is formulated based on the information available and updated as more data is acquired. The PCSM is limited to the identification and assessment of potential sources, potential receptors, and the anticipated pathways to those receptors identified from documentary research.

A11.4.2 For contamination within soil or water to pose a risk, a viable pollutant linkage must be established. A pollutant linkage consists of three parts:

- A source of contamination in or on the land;
- A pathway by which the contaminant can cause harm (or which presents a significant possibility of such harm being caused); and
- A receptor which is sensitive to impact from the contamination.

A11.4.3 Where all three of these are present, a pollutant linkage exists.

### Potential Sources

A11.4.4 Potential on-site sources of contamination are identified in **Table A11.1.6**.

**Table A11.1.6 Potential On-site Sources of Ground Contamination**

| Potential Source   | Potential Associated Contaminants   |
|--|---|
| Sand and gravels as well as construction wastes are being stored in the Boston 5 area. | Unknown potential contaminants of concern (PCOC) might be associated with the waste materials stored at the site.   |
| Embankments  | Unknown infill material might have been used to construct the embankments. PCOCs might contaminants such as asbestos, metals, their compounds, oils, and fuels and many others. |

A11.4.5 Several current and historical activities undertaken within 1 km of the site may have released contaminants into the ground, which have subsequently migrated to the site in groundwater. These are identified in **Table A11.1.7**.

**Table A11.1.7 Potential Off-site Sources of Ground Contamination**

| Potential Source  | Potential Associated Contaminants  |
|---|--|
| Boston Recycling Centre   | One significant substantiated pollution incident occurred at the site in 2010. The pollutants include contaminated water (firefighting run-off). PCOC associated with this site could include heavy metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), volatile and semi-volatile organic compounds (VOCs and SVOCs), phenols, cyanides, ammonium, chlorides and sulphates, as well as Per- and poly-fluorinated alkyl substances (PFAS) associated firefighting foams.  |
| Landfill sites and transfer stations  | Landfill sites have potential to be associated with various contaminants including asbestos, heavy metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), volatile and semi-volatile organic compounds (VOCs and SVOCs), phenols, cyanides, ammonium, chlorides and sulphates.   |
| Former Timber yard sites  | Timber yard activities may be associated with contaminants such heavy metals, inorganic elements and compounds like chlorates and sulphates and PAHs.  |
| Former Slaughterhouse   | The activities at sites might be associated with very wide range of contaminants including solvents (kerosene are the usual solvents (isopropanol, ethyl acetate, xylene, toluene and chlorinated solvents), acids, particularly hydrochloric or sulphuric, and alkalis as well as hydrocarbons and heavy metals.  |
| Former Concrete works   | The activities at sites might be associated with very wide range of contaminants including inorganic compounds, pulverised fuel ash (PFA), bitumen, kerosene and other organic compounds.  |
| Former Plastic Factory  | The activities at sites might be associated with very wide range of contaminants including metals, metalloids and their compounds, inorganic ions (phosphates and borates), organic solvents and compounds.  |
| Industrial Estate and Industrial Premises including Boston Union Works and Hydraulic engine house | The Trade Directory entries and authorisation records indicate the presence of a range of activities including:<br>Engineering- potentially associated with contaminants such as fuel and lubricating oils, degreasing solvents and metals.<br>Bus depot - Depot may be associated with very wide range of contaminants including hydrocarbons and other organic compounds.<br>Garages - PCOC associated with these industries include hydrocarbons, VOCs (MTBE chlorinated hydrocarbons), SVOCs, heavy metals (zinc, copper and lead) and PAHs into the ground.<br>Tanks – PCOC include hydrocarbons.<br>Paper and Printing services - potentially associated with contaminants such as oils, solvents, metals and other inorganic compounds. |
| Boston docks and rail   | Ship construction, maintenance and repair activities may have been source of contaminants such as heavy metals, hydrocarbons, phenols and pesticides.  |

| Potential Source       | Potential Associated Contaminants  |
|------------------------|--|
|                        | The railway activities may be potentially associated with contaminants such as asbestos, metals, metalloids and their compounds, acids, inorganic and organic chemicals. |
| Electricity substation | An electricity substation is shown on the maps south of the proposed works which may be associated with contaminants including Polychlorinated Biphenyls (PCBs).         |
| Iron works             | The PCOCs include heavy metals (arsenic, chromium, lead and tin), volatile hydrocarbons, PAHs, ammonia, cyanide and sulphates.   |

#### A11.4.6 Potential contaminants of concern include:

- Metals and metal compounds;
- Petroleum hydrocarbons;
- Polycyclic aromatic hydrocarbons (PAHs);
- Volatile and semi-volatile organic compounds (VOCs / SVOCs)
- Phenols
- Polychlorinated biphenyls (PCBs)
- pulverised fuel ash (PFA)
- Inorganic contaminants (e.g. ammonia, arsenic, cyanides, sulphides, phosphates); and
- Asbestos.

#### Preliminary Conceptual Site Model and Qualitative Risk Assessment

A11.4.7 The PCSM and Qualitative Risk Assessment are presented below in **Table A11.1.8**.

**Table A11.1.8 Preliminary Conceptual Site Model and Qualitative Risk Assessment**

| Source  | Pathway                               | Receptor  | Qualitative Assessment   |
|---|---------------------------------------|---|--|
| Potential on-site sources of soil and groundwater contamination | Dermal contact, ingestion, inhalation | Construction workers<br>Site users (staff and visitors / maintenance workers) | <p>The documentary research indicates that the site is undeveloped, however PCOC may be present at the site as result of the storage of construction wastes and material used to construct embankments. Such PCOC could represent an unacceptable risk to construction workers/ maintenance workers. Any construction/ maintenance undertaken on the site could result in the potential exposure of site operatives if contaminated soil is present. However, it is likely that short term risks associated with construction/ maintenance could be managed using personal protective equipment and appropriate working practices. Furthermore, it should be assumed that, asbestos might be encountered within the embankment infill material.</p> <p>The site end use will be commercial and it is anticipated that most of the site will be covered by hardstanding. However, there is a potentially unacceptable risk to future users of the site, who could be exposed to PCOC in landscaped areas or as result of the migration of volatile contaminants (if present) into buildings.</p> <p>Based on the information currently available we consider that feasible pollutant linkages may be present at the site and further targeted assessment is required to establish the presence and extent of PCOC. The results of any assessment would be used to update the qualitative assessment, feed into contractor's risk assessment for construction works, help to inform the potential for reusing excavated material and potential off-site disposal routes and provide information on baseline conditions for any site condition report which will be required as part of the permitting process.</p> |
|   | Leaching and groundwater transport    | Surface waters<br>Groundwater resources                                       | <p>The site is located adjacent to the Haven and drainage ditches and culverts are present in the site and along site boundaries. The documentary research indicates that the site is undeveloped, however PCOC may be present at the site as result of the storage of construction wastes and material used to construct embankments. Precipitation over time may have exacerbated the leaching of PCOC potentially resulting in impacts to surface water and groundwater. However, impacts to surface waters or groundwater are unlikely to be significant based on the following rationale:</p> <ul style="list-style-type: none"> <li>the embankments are likely to have been in place for many years and any ongoing leaching of PCOC is likely to be minimal</li> <li>the on-site storage of construction wastes appears to be of small scale</li> </ul>   |

| Source  | Pathway  | Receptor   | Qualitative Assessment   |
|---|--|--|--|
|   |  |  | <p>the soil deposits are likely to be of low permeability thereby minimising the potential for horizontal and vertical migration</p> <p>should contaminants impact the surface water the dilution potential is likely to be sufficient to minimise detrimental impacts on water quality</p> <p>The Environment Agency data suggests that the site is underlain by unproductive strata</p> <p>There are no groundwater abstractions for potable supply within 1km of the site</p> <p>The site is not located within a groundwater source protection zone</p> <p>It would be prudent to undertake some targeted ground investigation and sampling to confirm this qualitative assessment. The results of any assessment would be used to update the qualitative assessment, feed into contractor's risk assessment for construction works, help to inform the potential for reusing excavated material and potential off-site disposal routes and provide information on baseline conditions for any site condition report which will be required as part of the permitting process.</p> |
|   | Physical transport by surface runoff or due to erosion | Surface waters   | During construction, there is a risk that runoff from exposed made ground or spoil heaps during construction could transport contaminated sediments or dissolved contaminants to surface waters via the on-site or highway drainage system, resulting in potentially unacceptable risks to controlled waters. However, it is likely that short term risks associated with construction would be managed using appropriate working practices in line with current best practice.  |
| Potential off-site sources of groundwater contamination | Groundwater migration                                  | Surface waters<br>Groundwater resources<br>Groundwater on-site | <p>Several current and historical potentially contaminative land uses have been identified on land surrounding the site. It is anticipated that the local groundwater flow is likely to be from the west to the east and that there is the potential for contaminated groundwater to migrate from adjacent sites located to the west and northwest of the proposed works including recycling centre and activities associated with the Riverside Industrial Estate. Migration in groundwater of potential contaminants from these sites could have impacted the quality of groundwater beneath the site, and could represent an unacceptable risk to construction/ maintenance workers and future site users.</p> <p>The superficial and bedrock deposits underneath the site have been classified as Unproductive Strata (by the Environment Agency (Tidal Flat Deposits, Ampthill Clay Formation) and groundwater vulnerability maps indicate the site is located within an area of low groundwater vulnerability. However, a ground investigation</p>                               |

| Source                   | Pathway                      | Receptor                                | Qualitative Assessment  |
|--------------------------|------------------------------|---|---|
|                          |                              |   | <p>undertaken on the adjacent site encountered perched groundwater within the alluvial deposits. Groundwater was also encountered at the base of alluvial sequence and within the upper weathered layers of the glacial deposits. At this stage it is not known whether the perched groundwater encountered represent a continuous water body or localised discontinuous water bodies.</p> <p>It is likely that potential risks to construction/ maintenance workers can be managed via the use of personal protective equipment and appropriate working practices. Site users are unlikely to come into contact with surface/ groundwater, however volatile contaminants may represent a risk if present and are able to migrate and accumulate in confined spaces.</p> <p>It would be prudent to undertake some targeted ground investigation and sampling to confirm this qualitative assessment. The results of any assessment would be used to update the qualitative assessment, feed into contractors risk assessment for construction works, and provide information on baseline conditions for any site condition report which will be required as part of the permitting process.</p> |
| Ground gases and vapours | Gas generation and transport | Construction workers, Future site users | <p>There are two historic landfill sites immediately adjacent to the site. Landfill gas generated during decomposition of waste deposits have the potential to migrate via permeable deposits and accumulate in confined space and may represent a risk to human health. Whilst such risks can be mitigated against during construction and operation, given the close proximity of the sites it would be prudent to undertake some on site monitoring to establish if this potential pollutant linkage is active.</p> <p>It would, therefore be prudent to undertake some targeted ground investigation and monitoring to confirm this qualitative assessment. The results of any assessment would be used to update the qualitative assessment, feed into contractors risk assessment for construction works, and provide information on baseline conditions for any site condition report which will be required as part of the permitting process.</p>  |



## Uncertainties in the Conceptual Site Model

A11.4.8 Uncertainties in the conceptual model are associated with defining the source term and the respective pathways as summarised below:

- The presence, magnitude and extent of the PCOC needs to be established to determine risks to human health, controlled waters and property;
- The mobility of contaminants needs to be established to determine risks to controlled waters; and
- Characterisation of geological and hydrogeological regime at the site needs to be established to determine the potential for contaminant migration, including ground gas.

## A11.5 Conclusions / Recommendations

A11.5.1 The key objectives of the desk study were to identify potential sources of contamination within or around the site that may represent an unacceptable risk to construction/ maintenance workers, site users and/ or the environment and conclude whether the site is suitable for the proposed end use. A preliminary conceptual site model (PCSM) has, therefore been developed based on documentary research to aid in the identification of any potential pollutant linkages associated with the proposed redevelopment that may represent unacceptable risks.

A11.5.2 The PRA has identified several plausible pollutant linkages that could represent an unacceptable risk to sensitive receptors. However, several uncertainties in the understanding of the PCSM have also been identified which warrant further assessment. Key receptors are likely to be construction/ maintenance workers, site operatives and controlled waters.

A11.5.3 We consider it would therefore be prudent to undertake a targeted preliminary intrusive ground investigation and subsequent data assessment in line with current guidance to develop an initial understanding of the ground and groundwater conditions at the site and inform the potential risk to human health and controlled waters.

A11.5.4 The intrusive investigation should comprise *inter alia* the drilling of boreholes across the site to facilitate the recovery of soil samples. Boreholes should be installed with combined groundwater and gas monitoring wells to facilitate the collection of groundwater samples and the monitoring of ground gases. Soil samples should be recovered from the key source areas and any other Made Ground/ reworked material encountered during the ground investigation. Soil

and groundwater samples should be analysed for a range of potential contaminants of concern based on the documentary research presented in this PRA report. It would also be cost effective to combine the scope of the ground investigation with any geotechnical investigation that may be required to inform the proposed development.

- A11.5.5 On completion of the investigation and receipt of laboratory results, a generic quantitative risk assessment should be undertaken utilising the findings of the intrusive works and laboratory analysis, and the PCSM updated. The assessment should be undertaken in line with current guidance.
- A11.5.6 It would also be prudent, where possible, to engage with the Regulators at an early stage (pre-site investigation) to agree the scope of works and gain agreement to the proposed approach.

## A11.6 References

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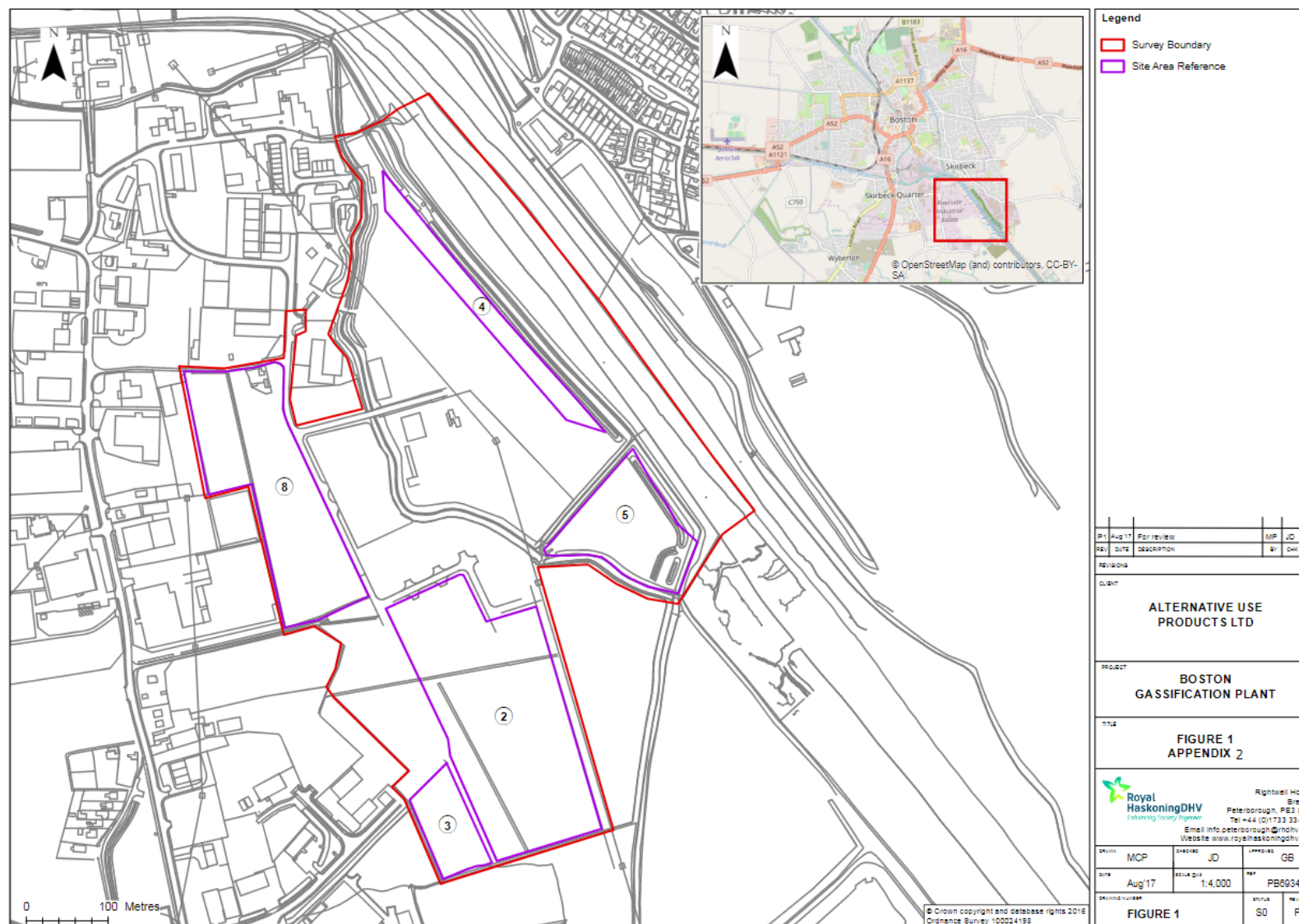
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### **Annex 11.1.1: Limitations**

- A11.6.1 The direct assessments and judgements given in this report are limited by both the finite data on which they are based and the proposed works to which they are addressed. The acquisition of data is constrained by both physical and economic factors and, by definition, is subject to limitations. Conditions at the site will change over time due to natural variations and may be affected by human activities.
- A11.6.2 This document has been prepared for the titled project and should not be relied upon or used for any other project. Royal HaskoningDHV accepts no responsibility or liability for the consequences of this document being used for a purpose other than that purpose for which it was commissioned. The assessments and judgements contained herein should not be relied upon as legal opinion.
- A11.6.3 The findings and opinions are relevant to the dates of the information reviewed and should not be relied upon to represent conditions at later dates. The opinions included herein are based on the information obtained from the assessments undertaken in the study area and from the experience of the reviewers.
- A11.6.4 This Phase I Land Quality Assessment has utilised a variety of publicly available data sources such as the Environment Agency, Landmark Group, historical maps and the British Geological Survey. Therefore, the study is limited by the age and limitations inherent in the data described.

## Annex 11.1.2: Site Location Plan



### Annex 11.1.3: Site Photos





**Plate A11.1.1.1 Boston 2 and 3 comprises mostly grassland**



**Plate A11.1.1.2 A Culvert is Currently being Installed along the Track in Boston 2**





**Plate A11.1.1.3 A Partially Collapsed Culver Outfall in Boston 4**



**Plate A11.1.1.4 A Sign Marking Location of a Pipe Line**





**Plate A11.1.1.5 The Embankment along The Haven**



**Plate A11.1.1.6 Sand and Gravels stored in Boston 5**

## Annex 11.1.4: Envirocheck Report