

Bradford Road, Manchester (Site Code 0049)

Bespoke Demolition and Infilling Report

National Grid Property Holdings Limited

March 2023

Final



Notice

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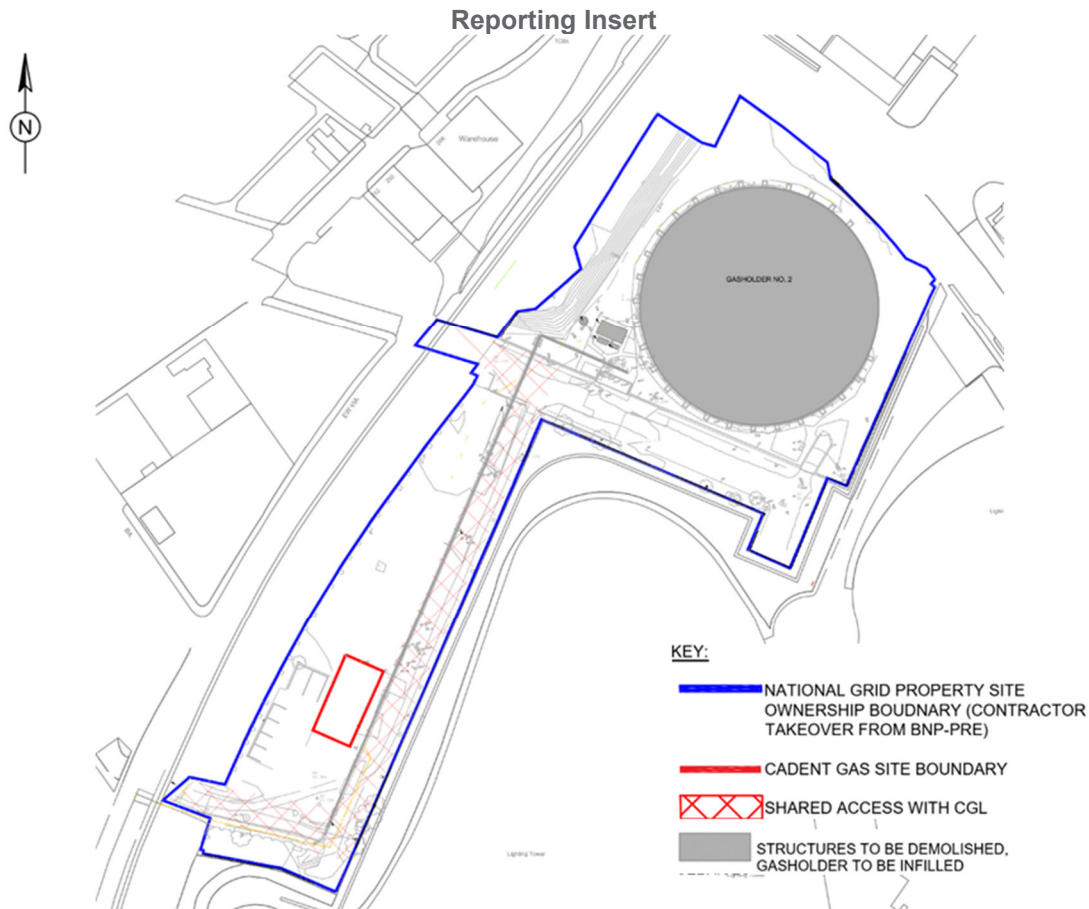
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1. Introduction

1.1. General

Atkins Limited (Atkins) was commissioned by National Grid Property Holdings Limited (NGPH) to complete a bespoke report summarising the demolition and infilling works strategy to dewater, de-sludge, demolish and backfill (herein referred to as “the works”) the former Gasholder No. 2 at Bradford Road, Manchester, M40 7BN (herein referred to as “the site”). A site location plan is presented as Figure 1 and the structure to be demolished and infilled (Gasholder No. 2) is presented in Figure 2. This report pertains only to the demolition and infilling of Gasholder No. 2 (including associated above ground structures) and excludes the land outside of this structure. This report aims to respond to the local authority Decision Notice presented in Appendix A.

1.2. Scope and Objectives

A General Permitted Development Order (134295/DEM/2022) was submitted and responded by Manchester City Council on 30 August 2022 to gain prior approval for the demolition of Gasholder No. 2 and associated buildings and infrastructure and the associated restoration of the site.

The objective of this bespoke report is to provide information to support the approach to demolition and infilling of Gasholder No. 2 and the conditions that the City Council have set out in the General Permitted Development Order (134295/DEM/2022) as below:

- Condition 1 - previous site investigation information which subsequently informed detailed risk assessments to evidence the conceptual understanding of the site and the local environment through a conceptual site model (CSM), illustrating potential linkages by which both on-site and off-site human health and controlled waters receptors could be at risk from the proposed demolition and infilling works;
- Condition 2 - appropriate infilling methodology, materials management plan and strategy, based on the results of the investigation and risk assessments of the site; and
- Condition 3 - a verification plan providing details of the data that will be collected in order to demonstrate that the works set out in this demolition and infilling approach are complete and whether longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action is required.

This report considers the demolition and infilling of Gasholder No. 2 only and is in general adherence to the Environment Agency’s Land Contamination Risk Management (LCRM) [1] where applicable. However, remediation works are not being undertaken.

1.3. Proposed Works

The proposed works includes the demolition, dewatering, desludging and infilling of Gasholder No. 2:

- implementation of all enabling works including site establishment; service verification, isolation and protection; CCTV drainage survey; ecological mitigation; noise, dust and odour mitigation; and protection of surface drainage systems and monitoring wells;
- removal and disposal of filming oil;
- dewater and desludge the gasholder, complying with the relevant conditions associated with the discharge consent;
- dismantle the gasholder and remove all metal work including the superstructure and guide rails / stairs / rollers;
- removal of the overhead redundant pipework and associated stanchions;
- removal of asbestos from structures to be demolished and disposal off-site;
- removal of the above-ground antifreeze pipe;
- disconnect / isolate from electrical supply and dismantle the boiler house;
- dismantle the chimney stack;
- removal of various barriers, handrails, signage and redundant lighting columns;
- infill the below ground gasholder tank by identifying and importing an suitable source of bulk infill import / capping layer material, placement and compaction of bulk material within Gasholder No. 2 to match existing surrounding ground levels in accordance with the Infilling Acceptance Criteria in Section 4;
- disposal/recycling of materials arising from the works;

- ensure there will be no risk of significant pollution or contamination of waters as a result of demolition and infilling (most notably to the Ashton canal); and
- ensure the works shall be designed, planned and carried out in such a way as to minimise disruption to traffic and pedestrians using Broxton Street and Bradford Road when accessing site and to maintain unrestricted access to Cadent Gas Limited (CGL) compound.

1.4. Key Parties

A summary of key parties involved in these works is presented in Table 1-1 below.

Table 1-1 - Summary of Key Parties

Responsibility	Organisation
Client and Landowner	National Grid Property Holdings
Project Manager	National Grid Property Holdings
Key Stakeholders	Environment Agency
Planning Authority	Manchester City Council
Environmental Consultant	Atkins Limited
Principal Contractor	Erith

1.5. Limitations and Assumptions

The assumptions and limitations of this report are as follows:

- assessment of risks of the source-pathway-receptor pollutant linkages are limited to the demolition and infilling of Gasholder No. 2 only;
- the criteria used for imported material within this report are specific to the site setting and environmental conditions at this site and the criteria may vary at other sites;
- understanding of the ground conditions has been developed based on the findings of published geology, third-party ground investigations and investigations undertaken as summarised in Section 3 of this report. The sources and the accuracy of the data provided by third parties are assumed to be correct and have not been verified by Atkins as a part of this report;
- due to the environmental risk of drilling through the base of structures on site, no exploratory locations have been undertaken within / beneath the gasholder. Atkins has therefore developed the CSM based on reasonable inferences from historical data points located outside of the gasholder;
- the infilling of the tank, including the selection of appropriate infill material, will be carried out in accordance with the Atkins scope of works incorporating details within this report; and
- it has been assumed that the tank is cylindrical for the purposes of the risk assessment to derive the infill criteria.

2. Summary of Previous Works

2.1. Previous Reports

The following previous site investigations, monitoring and collection of data have taken place at the site between 1997 to 2022:

- WSP, 2003, Surplus Land and Holder Site Bradford Road Factual Site Investigation Report [2];
- WYG, 2012, Data Review Report Bradford Road Gasholder Station and Surplus Land, Manchester [3];
- WYG, 2014, Ground Investigation Factual Report, Bradford Road NGG Land, A074754-142-0049-NGG-FAC-V1 FINAL [4];
- WYG, 2017, Factual Preliminary Dismantling Assessment Report for Gasholder No. 2, A074754-430-0049-Final [5];
- Environmental Essentials Limited, 2021, Asbestos Re-inspection Survey, Bradford Road, Manchester [6]
- Atkins Limited, 2022, Controlled Waters Gasholder Infill Acceptance Criteria [7];
- Atkins Limited, 2022, Bradford Road, Manchester, Preliminary Infilling Assessment [8];
- Atkins Limited, 2022, Bradford Road, Gasholder, Preliminary Ecological Appraisal Report [9]; and
- Englobe UK, 2022, Bradford Road No. 2 Gasholder – Factual Technical Summary of Holder Overflow Water Methane Management [10]

2.2. Site Setting

A summary of relevant background information including observations made during the previous site investigations are presented in Table 2-1.

Table 2-1 - Site Setting

Site Address	Gasholder Compound, Bradford Road, Manchester, M40 7BN.
Site Code	0049
Ordnance Survey Grid Reference	386580E 399170N
Site Ownership	National Grid Property Holdings (NGPH). There is a high-pressure gas compound (confined within a palisade fence) located within the confines of the site boundary which is owned by Cadent Gas Ltd (CGL), which can only be accessed by NGPH land. The CGL land comprises an area of 0.05 ha.
Site Area	NGPH land holding: 2 hectares (ha) Gasholder No. 2: 0.6 ha
Site Location	The site is located along Broxton Street approximately 2.5 km to the east of Manchester city centre. The site is located within a mixed residential and commercial estate. A site location plan is presented in Figure 1.
Site Topography and Elevation	The site is generally flat with the south of the site having an approximate elevation of 52 m Above Ordnance Datum (AOD) whilst the north of the site surrounding Gasholder No. 2 has an approximate elevation of 54 m Above Ordnance Datum (AOD). There are steps and raised ground around the gasholder.
Site Description	The site is part of the vacant NGPH land which split into two distinct areas; the north and the south. The north comprises the gasholder compound and ancillary buildings (the subject of this report) whilst the south is vacant and disused vegetated scrubland housing a Cadent Gas Limited (CGL) high pressure gas compound.

	The gasholder compound in the northern area comprises one below ground column guided gasholder (Gasholder No. 2), a former boiler house and a chimney stack. The CGL compound in the southern area is located within palisade fencing and is considered 'off-site', however access to this area is via the main site entrance located off Broxton Street. During the works access to this area is to be maintained. A redundant above ground gas main runs from the gasholder compound in the north, past the site entrance and through the southern part of the site where it exits the site at the southern boundary and crosses the railways line adjacent to Miles Platting Gasholder compound. A site layout plan is presented in Figure 2.
Adjacent Land Uses	• North: Alan Turing Way (A6010), fire station, light industrial/commercial property and Philips Park Cemetery. • East: Alan Turing Way (A6010), Sports City car park and Philips Park Cemetery. • South: CGL compound, disused NGPH land, public sports venues, Ashton Canal. • West: NGPH land (Miles Platting Gasholder compound), railway and New Viaduct Street, residential and commercial properties.
Live Plant	CGL own and operate a high-pressure gas compound (confined within a palisade fence) in the south of the site.
Known Live Services and Utilities	There is a low voltage (LV) below ground electricity main that enters the site from the north and traces the north-west perimeter of the gasholder until it terminates at the former boiler house. There is a live 16 inch steel high pressure below ground gas main entering site from the north-east corner to the north-west around the gasholder and south-west around the western side of the gasholder, before exiting the site at the far east site corner. A 12 inch steel intermediate pressure below ground gas main enters the site from Broxton Street and exists in a roughly south-east orientation and then north-east along the eastern side of the gasholder before exiting the site at the far east site corner, A 15 inch cast iron medium pressure below ground gas main enters the site from the north-east site corner and exists south-east adjacent to the east side of the gasholder, where it then exists north-west parallel to the southern side of the gasholder before trending south past the CGL compound and exiting the site west along the subway. A combined sewer enters the site from Broxton Street and terminates prior to reaching the gasholder. There are two unknown metallic traces both trending roughly south-west in the central area of the site. Redundant gas mains serving the Gasholder are present on site. Unrecorded live services may be present on site. Service information is based on third party information. Atkins accepts no liability for its accuracy or the accuracy of indicative service locations presented on any of the drawings or plans contained within this report. Service plans are presented on Figure 4.
Site Drainage	The gasholder overflow points are located on the north-eastern sides of the gasholder. There are three separate foul drain drainage routes. Two of which flow south of the gasholder, join and flow west to join the combined system on Broxton Street. The third flows north from the interceptor, located on the

north/north-east of the gasholder, to join the combined system in Alan Turing Way.

There are two storm drains that flow east towards the culverted River Medlock and combined sewer.

2.3. Environmental Setting

A summary of the environmental setting is presented in Table 2-2 below.

Table 2-2 - Summary of Environmental Setting

Site History Summary	Information regarding the history of the site has been summarised from the WYG Data Review in 2012 [3]. The site was formally part of the larger coal gas manufacturing and storage facility of Bradford Road Gasworks. Development of the gasworks began in the late 19th century. The first gasworks structures on the site were built by 1922. The main manufacture and processing plant were located to the east and south of the site. The gasworks extended to the west of these sites. The River Medlock was culverted around the turn of the 20th century according to the historical Ordnance Survey maps. The gasworks continued to expand until production ceased in the 1970s. The majority of structures were demolished in the late 1970s and 1980s although gasholder No2 remained on site.
Geology	The BGS GeoIndex [11] indicates there is Made Ground on site. Previous site investigations identified Made Ground across the site with an average thickness of 1.5 m comprising gravelly fine to coarse sand with brick, ash and clinker [3]. Superficial Deposits are recorded by the BGS GeoIndex [11] as Devensian Till, described by the BGS lexicon [12] as a diamicton. Previous site investigations identified Glacial Till in the form of a firm, very stiff slightly sandy gravelly clay. The thickness of Glacial Till ranged from 7.90 – 9.22 m across the site [3]. The BGS GeoIndex [11] records the bedrock geology as the Pennine Upper Coal Measures Formation (Sandstones, Mudstones and Coal) which is defined as interbedded grey mudstone, siltstone and pale grey sandstone, commonly with coal seams [12]. BH3 in the south of the Gasholder Station was the only exploratory hole to encounter Coal Measures; a weak dark grey, sandy very, clayey shale from 8.5 m bgl to 9 m bgl (42.66-41.36 m AOD), at which point the borehole terminated [3]. A Coal Authority report issued in 2004 found 14 mine entries within 20 m of the site, none of which are located on-site.
Hydrogeology	The Devensian Till deposits is classified as a secondary undifferentiated aquifer and the underlying Pennine Upper Coal Measures Formation is classified as a secondary A aquifer [13]. The Environment Agency (EA) [14] defines a secondary undifferentiated aquifer as where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type and secondary A aquifers as permeable layers that can support local water supplies and may form an important source of base flow to rivers. There are no Source Protection Zones within 1 km of the site [13]. Groundwater was not encountered in Made Ground or Glacial Till during previous site investigation works. Following groundwater monitoring of boreholes screened within the Glacial Till, recorded groundwater elevations were recorded between 47.97 m AOD (6.4 m bgl) and 48.41 m AOD (3.84 m bgl) [5]. On one occasion BH1 was recorded as dry. BH3 screened across the Made Ground and underlying sand and gravel on the southern site boundary recorded a mean groundwater elevation of 46.47 m AOD (4.69 m bgl) [3]. According to WYG Data Review [3], it is anticipated that hydraulic conductivity between the Made Ground and the underlying Secondary Aquifer (Coal Measures) is likely to be limited due to the low permeability Glacial Till present between the two strata (> 9 m thickness in places). In the south of the site, the stratum thins to 1.1 m thickness in BH3

	and it is likely that the Glacial Till is breached by structures or services. A groundwater strike was not recorded in BH3 where the Coal Measures were encountered.
Hydrology	The River Medlock is located 200 m to the south of the site and Ashton Canal is located 220 m south of the site. The nearest surface water abstraction is from the Ashton Canal approximately 370 m east of the site and is operated by British Waterways [5].
Flooding	DEFRA online flood risk mapping [15] indicates the site is located in a Flood Zone 1 area, with a low probability of flooding.
Unexploded Ordnance	According to the WYG 2017 report [5], the regional Unexploded Bomb (UXB) map, obtained from Zetica, indicated the site is located in an area of moderate risk from UXB.
Ecology	According to the Atkins Preliminary Ecological Appraisal Report [9], habitats within the site comprise broadleaved woodland, hardstanding, dense scrub, semi-improved neutral grassland and gravel with ephemeral vegetation. Habitats within the site are suitable for bats, badgers and nesting birds. Several invasive non-native invasive species (INNPS) such as Himalayan balsam, Cotoneaster species, Japanese rose and Japanese knotweed have been identified within and adjacent to the site.

2.4. Gasholder No. 2 Dimensions

A summary of the Gasholder No. 2 dimensions recorded in the WYG factual preliminary dismantling assessment in 2017 [5] is presented in Table 2-3 below.

Table 2-3 - Gasholder No.2 Information / Description

Year of Construction	1910
Tank Diameter	86.87 m
Tank Depth	14.0 m
Tank Construction	Brick and puddle clay
Tank Volume	83,007 m ³
Dumpling Size	45.02% of the tank volume (37,367m ³)
Dumpling Shape	Truncated cone (flat topped)
Dumpling Construction	The dumpling is of solid construction (brick stone and concrete). A copy of the dumpling survey is included in Appendix B.

3. Summary of Previous Investigations

3.1. Previous Investigations and Reports

Information from several historical sources have been considered when developing the bespoke demolition and infilling report including previous phases of intrusive site investigation, groundwater monitoring, preliminary dismantling assessment, preliminary infill design report and detailed quantitative risk assessment (DQRA) for infill criteria. A figure presenting exploratory hole locations progressed during previous investigations that still exist at present is presented on Figure 4.

3.1.1. WSP, 2003, Factual Site Investigation Report [2]

WSP undertook a ground investigation across the Bradford Road Gasworks which included:

- three boreholes drilled to depths between 8.5 m bgl and 10.22 m bgl, all completed with groundwater monitoring installations in either the Glacial Till or Made Ground;
- eight trial pits were excavated to depths between 1.5 m bgl and 3.2 m bgl;
- two hand pits located adjacent to the operational gasholder;
- 21 soil samples scheduled for analytical suites including phenols, Polycyclic Aromatic Hydrocarbons (PAHs), inorganics and metals with five samples for Total Petroleum Hydrocarbons (TPH), one for Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) and four asbestos analyses;
- eight soil leachate samples were scheduled for phenols, PAHs, inorganics and metals; and
- eight groundwater samples were scheduled for phenols, PAHs, inorganics and metals.

Made Ground was generally recorded at thicknesses of less than 1 m in across the majority of the gasworks. The Made Ground encountered was generally concrete and brick footings. BH3 located in the south of the site found Made Ground to 5.75 m bgl comprising 4.7 m of ash fill with fragments of pottery, ceramic and fabric over clay fill.

Coal Measures were encountered beneath the site to a depth of 9.8 m bgl.

3.1.2. WYG, 2014, Ground Investigation Factual Report [4]

WYG undertook a ground investigation between 9 and 23 January 2013 and two rounds of groundwater monitoring between 11 and 12 February and 6 and 7 March 2013. The gasworks was split into the north Gasholder compound and the area to the south.

A total of 13 trial pits were excavated across the site to a maximum depth of 2.5 m bgl. Three dynamic sampling boreholes were drilled to a maximum depth of 18.5 m bgl where two locations with rotary follow on were extended up to a maximum depth of 30 m bgl.

Made Ground was found at surface comprising predominantly of granular materials to maximum proven depths of 0.8 m bgl in the north of the site and deepening from 0.7 m bgl to 5.75 m bgl from north to south-east in the south of the site.

Glacial Till was encountered across the site (minimum depth 0.4 m bgl). The maximum encountered thickness of the Till diminished from north to south; being 18.3 m thick in the north and 12.9 m in the south of the site. A pocket / band of sand was noted within the Till in the southwest of NGP2, having a maximum thickness of 0.5 m.

Variably weathered mudstone and siltstone of the Upper Coal Measures were encountered from 14.5 m bgl in NGP2 and 18.8 m bgl in the north of the site. Coal beds (<0.32 m thickness) were encountered in north and south of the site at 21.26 m bgl and 17.27 m bgl respectively.

- Soil samples were recovered during the ground investigation which were scheduled for variety of contaminants including metals, PAHs, inorganics, TPH, fraction of organic carbon and asbestos;
- Soil samples were scheduled for soil leachate analysis which included contaminants such as metals, PAHs, inorganics and TPH; and
- Groundwater samples were recovered from two rounds of groundwater monitoring and were scheduled for contaminants such as metals, PAHs, inorganics, hardness, TPH, multi natural attenuation (MNA) suite, semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs).

3.1.3. WYG, 2017, Factual Preliminary Dismantling Assessment Report for Gasholder No. 2 [5]

WYG was commissioned by NGPH to undertake a preliminary dismantling assessment of one below ground gasholder (Gasholder No.2) located at Bradford Road, Manchester. The aim of the assessment was to identify and collate factual information relevant to the future dismantling of the gasholder. This included factual information on:

- ecology;
- asbestos;
- hazardous substances;
- hydrogeological regime (below ground gasholder tanks);
- soil/groundwater contamination;
- unexploded ordnance;
- sampling and testing;
- operational plant and equipment;
- gasholder information;
- building information;
- gasholder status and isolations;
- gasholder history; and
- gasholder dewatering.

Samples of water and paint were collected from Gasholder No.2 on 16 June 2017. Water samples were collected from four equidistant points north, east, south and west. At each sampling location, two samples were collected, one shallow sample at 600 mm below the water level and one deep sample from 3 m above the base of the holder tank.

Paint samples were collected from four equidistant points around each gasholder, roughly north, east, south and west. The paint was scraped through all layers until the metal exposed at each location and a composite sample of the paint flakes prepared.

3.1.4. Environmental Essentials Ltd, 2021, Asbestos Re-Inspection Survey [16]

NGPH commissioned Environmental Essentials Ltd to undertake a pre-inspection survey of the site at Bradford Road, Manchester, Greater Manchester, M40 7BW. The purpose of the survey was to establish the current condition of asbestos materials identified during previous surveys of the site in order to enable an update of the asbestos register and to assist in the ongoing asbestos management plan.

Asbestos within the gaskets to the front of the boiler house and cold storage tanks were identified.

3.1.5. Atkins, 2022 Controlled Waters Gasholder Infill Acceptance Criteria [7]

Atkins was commissioned by NGPH to establish Infill Assessment Criteria (IAC) for the infilling of Gasholder No.2 at Bradford Road following planned dismantling works, to facilitate the selection of appropriate infill material.

It was noted, that given the structure of the former gasholder, the geology beneath the site and the recorded groundwater levels, infill materials at the base of the holder are likely overlying the cohesive Glacial Till. IAC were derived to be protective of controlled waters on this basis.

The development of the IACs considered current guidance including the Water Framework Directive (WFD), which acts to prevent hazardous substances from entering groundwater and limit the entry of non-hazardous pollutants into groundwater to avoid pollution, deterioration in the status of groundwater body and to prevent sustained and upward trends in pollutant concentrations in groundwater. The IACs are intended to be applied to material imported under the CL:AIRE Definition of Waste Code of Practice (DoWCoP) e.g. clean naturally occurring material. The IAC are intended to support such that material imported is unimpacted by anthropogenic contamination. Naturally occurring soils may include concentrations of metals that may exceed adopted regulatory criteria (i.e. Drinking Water Standards) but are unlikely to pose an actual risk to controlled waters. Therefore, a distinct approach was taken for potential contaminants that are likely to be naturally occurring and potential contaminants that are from anthropogenic sources. The IAC may also be applied to primary/secondary aggregate produced under the WRAP protocol as additional information for a quality assurance and quality check.

Three specific approaches to define assessment criteria were developed based on potential contaminants of concern.

3.1.5.1. Naturally occurring substances

The IAC values for naturally occurring non-hazardous compounds have been aligned to background levels. By aligning these IACs to background levels it is expected that any inputs into the surrounding water environment would not result in a significant and sustained upward trend in concentration of these determinants in line with the WFD.

The IAC values have been obtained by calculating the mean concentration and two standard deviations of each determinant using the available site data from previous site investigations discussed in Section 3.

3.1.5.2. Potentially anthropogenic non-hazardous substances

The derivation of IAC for potentially anthropogenic non-hazardous gas works contaminants was undertaken using Golder Associates ConSim v2.5, which is a precautionary approach to develop IAC values taking a risk-based approach in line with EA guidance. ConSim utilises a range of contaminant transport and hydrogeological equations to model contaminant transport from a defined source (in soil, soil-leachate or groundwater) to a defined compliance point and to predict contaminant concentrations. Site specific assessment criteria (SSAC) are then calculated based on the attenuation factors derived by the model and compared to measured concentrations recorded at the site. In this case, the assessment modelled the base of Gasholder No. 2 recorded at the site.

The Level 3 modelling results for the potentially anthropogenic non-hazardous substances (cyanide (total) and phenol) indicated modelled concentrations at the receptor that calculated soil-leachate SSAC greater than 1E+10 mg/kg for both compounds and as such there was considered to be a negligible risk to groundwater.

No anthropogenic Made Ground soils will be imported and used as infill within Gasholder No. 2, other than the inert recycled product recovered under the WRAP protocol.

3.1.5.3. Potentially anthropogenic hazardous substances

In line with the WFD, IAC soil values for hazardous compounds, which are not commonly naturally occurring, were derived utilising the Environment Agency P20 worksheet to back calculate corresponding soil criteria from compound laboratory detection limits (LOD) or MRVs (where available). TPH compounds were also assessed in this manner, although not classified as hazardous (according to Groundwater Directive 2006/118/EC [17]).

Soil-leachate Limit of Detection (LOD) or Minimum Reporting Values (MRV) (benzene and tetrachloroethylene) values were multiplied by the dilution factor upon entry to the aquifer calculated within the Level 2 assessment completed above a value of 3.36 mg/kg.

3.1.6. Atkins, 2022, Preliminary Infilling Assessment [8]

Atkins were commissioned by NGPH to undertake a preliminary infilling assessment to establish criteria protective of human health receptors and to present the criteria calculated by Atkins [8] protective of controlled waters receptors and geotechnical criteria for imported material associated with the infilling of a below ground gasholder (Gasholder No. 2) at Bradford Road.

The source of the material to be used to infill the gasholder was unknown and the assessment aimed to develop infill acceptance criteria (IAC) mitigating the risk to human health and controlled waters (derived from the Atkins Controlled Waters Gasholder Infill Acceptance Criteria [7]) to facilitate the selection of appropriate infill material for the site. It was proposed that there was a risk that the infill material may come into contact with human health receptors within the upper 500 mm capping layer and therefore a set of IAC protective of human health receptors for the upper 500 mm capping layer were also derived. This was achieved using Generic Assessment Criteria (GAC) protective of human health receptors for a residential without plant uptake land use scenario as a conservative assessment. Geotechnical IAC were presented to ensure the imported material is able to achieve the compaction requirements throughout the infilling works in Gasholder No. 2.

3.1.7. Englobe, 2022, Factual Technical Summary of Holder Overflow Water Methane Management [10]

This letter report contained a factual technical summary of gasholder overflow water methane management works by Englobe Regeneration UK. At the request of NGPH, Englobe managed methane concentrations in gasholder overflow water at the Bradford Road No. 2 Gasholder in Manchester between 2016 and 2020. Englobe were asked to assist in early 2016 when United Utilities discharge compliance team had identified that the discharge

water from the gasholder had methane concentrations that were failing the 0.14 ppm methane discharge consent limit.

Englobe plugged the holder discharge overflow system to prevent discharge of water on 16 February 2016. Englobe then mobilised and set up a water treatment system on the site. Englobe commenced discharging treated water to foul sewer on 12 May 2016 after commissioning the water system and testing the treated water. Englobe treated and managed the overflow water from the gasholder tank until 13 July 2020 at which point a total of 24,377 m³ had been treated and discharged to the foul sewer.

Treated water was sampled and analysed monthly during the works to ensure methane concentrations met the 0.14 ppm discharge consent criteria. Approximately every six months the treated water was analysed for a wider gasworks suite.

4. Infill Criteria for Imported Material

4.1. Human Health Infill Acceptance Criteria

The Generic Assessment Criteria (GAC) protective of human health receptors for a residential without plant uptake land use scenario for soils to be used as infill within the upper 500 mm (capping layer) of Gasholder No. 2 are presented in Table 4-1.

Table 4-1 - Human Health Infill Acceptance Criteria – Capping Layer (upper 500mm)

Determinant	Infill Acceptance Criteria (mg/kg)
	Residential without Plant Uptake 1% Soil Organic Matter (SOM)
Asbestos	No Asbestos Detected
Acenaphthene	2680
Anthracene	34300
Antimony	473
Arsenic	39.9
Barium	1340
Benzene	0.31
Benzo(a)pyrene	5.33
Cadmium	149
Carbon disulphide	0.105
Chromium III	16700
Chromium VI	20.5
Copper	9060
Ethylbenzene	85
Fluoranthene	4880
Fluorene	3260
Free Cyanide	34
Lead	313
Naphthalene	0.851
Nickel	188
Phenol	570
Pyrene	3650
Selenium	595
Toluene	312
Total Cresols	4740
TPH aliphatic C10-C12	81.8
TPH aliphatic C12-C16	385
TPH aliphatic C16-C35	212000
TPH aliphatic C5-C6	42.9
TPH aliphatic C6-C8	99.6
TPH aliphatic C8-C10	13.9
TPH aromatic C10-C12	139
TPH aromatic C12-C16	703
TPH aromatic C16-C21	1930
TPH aromatic C21-C35	1930

Determinant	Infill Acceptance Criteria (mg/kg)
	Residential without Plant Uptake 1% Soil Organic Matter (SOM)
TPH aromatic C5-C7 (Benzene)	0.31
TPH aromatic C7-C8 (Toluene)	312
TPH aromatic C8-C10	22.7
Xylene, m-	28
Xylene, o-	30
Xylene, p-	26.8
Zinc	47000

4.2. Controlled Waters Infill Acceptance Criteria

A controlled waters detailed quantitative risk assessment (DQRA) for the site has been undertaken in order to derive an Infill Acceptance Criteria (IAC) for soil and soil leachate protective of controlled waters receptors [7]. A summary of the controlled water IAC is presented in Table 4-2.

Table 4-2 - Controlled Waters Infill Acceptance Criteria

Determinands	Soil IAC (mg/kg)	Soil-leachate (IAC (mg/l))	Haz/non-haz
Arsenic	35.17	-	Naturally occurring
Cadmium	0.60	-	Naturally occurring
Chromium (total)	306.76	-	Naturally occurring
Lead	380.50	-	Naturally occurring
Nickel	64.12	-	Naturally occurring
Benzene	0.0041	-	Hazardous
Anthracene	0.0031	-	Hazardous
Benzo(a)pyrene	0.011	0.00003	Hazardous
Fluoranthene	0.05	0.00003	Hazardous
Tetrachloroethylene	0.001	-	Hazardous
Trichloroethene	0.00004	0.00003	Hazardous
Aliphatic >C5-C6	0.05	-	Hazardous
Aliphatic >C6-C8	0.21	-	Hazardous
Aromatic >C5-C7	0.004	-	Hazardous
Aromatic >C7-C8	0.011	-	Hazardous
Aromatic >C8-C10	0.07	0.0033	Hazardous
Aromatic >C10-C12	1.14	0.033	Hazardous
Aromatic >C12-C16	2.28	0.033	Hazardous
Asbestos	Detection	-	Hazardous (>0.1%)

4.3. WRAP Material Infill Acceptance Criteria

For WRAP sourced material, the material is considered to have reached end of waste status and no additional testing is required from a regulatory perspective, as it is classed as an inert material prior to being imported to site.. However, for quality assurance and quality check purposes, additional chemical samples will be obtained from WRAP sources and scheduled in accordance with Table 4-3 below.

Table 4-3 - WRAP Material Infill Chemical Testing Suite

Determinands for Infill Material

pH
Loss on Ignition
Moisture Content
Asbestos (identification and quantification)
Cyanide (easily liberated)
Cyanide (Free)
Total Ammonium
Ammonium as NH ₄
Phenols (total and speciated)
PAHs (total and speciated)
Aliphatics >C5-C6
Aliphatics >C6-C8
Aliphatics >C8-C10
Aliphatics >C10-C12
Aliphatics >C12-C16
Aliphatics>C16-C35
Aromatics >C5-C7
Aromatics >C7-C8
Aromatics >C8-C10
Aromatics >C10-C12
Aromatics >C12-C16
Aromatics >C16-C21
Aromatics >C21-C35
Total TPH
BTEX (benzene, toluene, ethyl benzene and xylenes (0-xylene, m-xylene, p-xylene and total xylene,
Total Cresols
Arsenic
Cadmium
Barium
Boron
Chromium III
Chromium VI
Copper
Lead
Mercury (total)
Nickel

Determinands for Infill Material

Iron

Pyrene

Selenium

Zinc

All import material will be visually and olfactory checked before placement for evidence of potential contamination and / or deleterious material. Non-compliant material shall not be used for infilling. Infill material shall be obtained and scheduled for the chemical analyses prior to the materials being imported to site to ensure that the material is compliant with the infill criteria.

4.4. Geotechnical Infill Criteria

Geotechnical testing detailed in Table 4-4 shall be undertaken to classify the import material in accordance with the geotechnical specification recorded in Appendix C.

Table 4-4 - Summary of Geotechnical Testing Suite

Test Description	Standard
Sample Description	BS5930:2015/ BS EN 1997-2:2007 Eurocode 7: Geotechnical Design
Particle size distribution by wet sieve	BS1377: 2016 Part 2 Clause 9.2 BS EN 933: Part 2
Determination of optimum moisture content using 2.5 kg rammer or vibrating hammer	BS1377: 2016 Part 4, Clause 3.4 or 2.7
Los Angeles coefficient	BS EN 1097-2
Undrained shear strength	BS1377: 2016 Part 7, Clause 8
Moisture content and Atterberg Limits	BS1377: 2016 Part 2
Plate bearing test	BS1377: 2016 Part 9

5. Conceptual Site Model

A detailed conceptual site model (CSM) for the proposed development (demolition and infilling of the Gasholder No. 2) has been developed. This section aims to provide information relevant to land contamination from material which will be used to infill the Gasholder No. 2 at Bradford Road. In accordance with guidance provided in the LCRM [1], and based on the information presented above, potential sources of contamination, receptors and plausible exposure pathways have been summarised within this section.

Land contamination is assessed through the identification and assessment of Potential Contaminant Linkages (PCLs), denoting where plausible source-pathway-receptor relationships and potential risks to the receptor. The approach involves the development of a CSM to describe sources of contamination, potential migration / exposure pathways and potential receptors that may exist at the site, and subsequently identified PCLs.

5.1. Potential Sources of Contamination

The following potential sources of contamination are summarised below.

Table 5-1 - Potential Sources of Contamination

Location	Potential Source	Potential Contaminants
On-site	Perched groundwater within the Gasholder	A range of inorganic and organic contaminants associated with the historical gasworks use including free product. [10]
	Sludge at the base of the Gasholder	A range of inorganic and organic contaminants associated with the historical gasworks use including free product.
	Asbestos identified from previous surveys in the Boiler House and potential for asbestos within the redundant pipework and Gasholder [5] [6]	Asbestos fibres or asbestos containing material (ACM).
	Paint flakes	High concentrations of lead and heavy metals have been identified in paint used on Gasholder No.2. [5]
	Imported fill material	A range of inorganic and organic contaminants including metals, hydrocarbons, PAHs and asbestos.

5.2. Potential Receptors and Pathways

The Superficial Deposits of the Devensian Till are classified by the Environment Agency as a secondary undifferentiated aquifer, however, groundwater within the unit is not considered to be the primary receptor itself as it is considered to have limited resource potential. This is based on the limited overall thickness and limited sandy/gravelly bands recorded in previous ground investigations (summarised in Section 3) resulting in limited specific storage. Moreover, it is considered likely that any abstraction would be associated with the Pennines Upper Coal Measures and local properties in the wider area are likely to be supplied by mains water supply.

The surface of the River Medlock where it is culverted below the Sports City Car Park 130 m east of the site is at a level of approximately 50 m Above Ordnance Datum (m AOD). Regional groundwater flow in the Pennines Upper Coal Measures is mapped in a westerly direction within groundwater recorded at a level of between 38.95 and 38.85 m AOD in recent monitoring. As such, hydraulic continuity between groundwater in the Pennines Upper Coal Measures and the River Medlock is considered to be unlikely.

For the purpose of this assessment, the Pennines Upper Coal Measures aquifer is considered to be the primary controlled waters receptor.

The internal base of the below ground gasholder has been recorded as approximately 15.80 m bgl. The geology on site indicates that the base of the gasholder is unlikely to extend into the Pennines Upper Coal Measures.

Therefore, this assessment and associated modelling have assumed that the source material, and any water that subsequently accumulated within the filled gasholder, is only in direct connection with the Devensian Till beneath

the site. The Devensian Till is considered the primary pathway for migration from the gasholder to the Pennines Upper Coal Measures aquifer.

The gasholder overflow drainage system will be disconnected during the decommissioning works and therefore has not been considered as a potential pathway.

The potential receptors which are relevant to the current and future site use, and the potential contaminant exposure and migration pathways, are summarised in Table 5-2.

Table 5-2 - Summary of Potential Receptors and Pathways

Receptor Group	Receptor	Potential Contaminant Migration Pathways
Human Health (on-site)	Future site maintenance works and transient members of the general public.	Dermal contact / ingestion / inhalation of contaminants in soil and soil-derived dust; Dermal contact / ingestion of contaminants in groundwater within excavations for future maintenance workers; Inhalation of airborne asbestos fibres; and Inhalation of ground gas / vapours.
Human Health (off-site)	Off-site workers (50 m north and north-west), residents (70 m west), and transient members of the general public.	Dermal contact with and ingestion of contaminants in soil-derived dusts and water that may have migrated off-site; and Inhalation of soil-derived dust, fibres, gas and vapours which may have migrated off-site.
Controlled Waters: Groundwater	Groundwater within the bedrock secondary A Aquifer (Upper Pennines Coal Measures).	Leaching or dissolution of contaminants in soils and subsequent migration of contaminants in groundwater; and Vertical migration of dissolved phase contaminants to the underlying groundwater.

5.3. Potential Contaminant Linkages

Following multiple previous ground investigations, asbestos surveys, assessments of the perched groundwater within the gasholder, contaminants within the paint and potential infill material discussed in Section 4, a summary of the CSM and remaining PCLs to be addressed by this strategy are summarised in Table 5-3 below. PCLs were classified in accordance with CIRIA 552 guidance [19]. A schematic of the CSM is presented in Figure 3.

Table 5-3 - Conceptual Site Model

Sources	Pathway	Receptor	Classification of Risk (Consequence/Probability)	Proposed Mitigation
Perched groundwater within the gasholder	Vertical migration of dissolved phase contaminants to the underlying groundwater (Devensian Till)	Groundwater within secondary A aquifer (Pennines Upper Coal Measures)	Low Risk (Medium/Unlikely)	The risks of leaching of contaminants and migration of the perched groundwater and sludge within Gasholder No. 2 will be mitigated through source removal. The dewatering and desludging works will be undertaken by the contractor prior to the demolition and infilling works of Gasholder No. 2.
Sludge at the base of the gasholder	Vertical migration of dissolved phase contaminants to the underlying groundwater (Devensian Till)	Groundwater within secondary A aquifer (Pennines Upper Coal Measures)	Low Risk (Medium/Unlikely)	
Asbestos identified from previous surveys in the Boiler House and potential for asbestos within the redundant above ground pipework and gasholder	Inhalation of airborne asbestos fibres	Human Health On-site future site maintenance works and transient members of the general public. Off-site workers (50 m north and north-west), residents (70 m west), and members of the general public	Moderate / Low Risk (Severe/Unlikely)	Most direct contact pathways for an open storage end use will be addressed by source removal during the demolition of the boiler house, gasholder and associated above ground pipework. There will be potential for exposure during the demolition however, specific health and safety requirements will be required during any management or asbestos removal works in line with CAR (2012) [20] which will minimise short-term exposure risk.
Paint flakes associated with the gasholder	Inhalation, ingestion and dermal contact with lead and other heavy metals in paint flakes	Human Health On-site future site maintenance works and	Low Risk (Medium/Unlikely)	Most direct contact pathways for an open storage end use will be addressed by Source

Sources	Pathway	Receptor	Classification of Risk (Consequence/Probability)	Proposed Mitigation
		transient members of the general public Off-site workers (50 m north and east), residents (70 m west), and transient members of the general public		Removal during the demolition of the Gasholder. The contractor shall design and implement the works to minimise the spread of paint flakes and debris during the demolition including ground protection.
Imported fill material	Vertical migration of dissolved phase contaminants through groundwater (Devensian Till)	Groundwater within secondary A aquifer (Pennines Upper Coal Measures)	Low Risk (Medium/Unlikely)	The contractor shall source and test potential infilling material in accordance with Section 4 prior to import to ensure it is suitable for placement within Gasholder No. 2. The human health IAC is presented in Table 4-1 and the controlled waters IAC is presented in Table 4-2.
	Dermal contact / ingestion / inhalation of contaminants in soil and soil-derived dust; Dermal contact / ingestion of contaminants in groundwater within excavations for future maintenance workers; Inhalation of airborne asbestos fibres; Inhalation of ground gas / vapours	Human Health On-site future site maintenance works and transient members of the general public Off-site workers (50 m north and east), residents (70 m west), and transient members of the general public.	Low Risk (Medium/Unlikely)	

6. Strategy for Demolition and Infilling Works

The objective of this strategy and verification plan is to set out appropriate mitigation for the demolition and infill requirements. The main scope of works is summarised in Section 1.2, however more detail is discussed in the following sections in regard to pre-mobilisation works, dewatering and desludging, demolition and infilling of Gasholder No. 2.

6.1. Pre-mobilisation Works

The contractor must satisfy the requirements for pre-mobilisation works which comprise:

- submission of the discharge consent application;
- submission of the Section 80;
- deployment of the Environmental Permit;
- liaison with Network Rail due to the close proximity of the works to the railway;
- Ground Penetrating Radar (GPR) survey in all areas that are planned to be subject to ground disturbance with mechanical plant or surcharging with a significant load;
- pre-works CCTV drainage survey and associated repair works;
- bat emergence survey of the boiler house;
- nesting bird survey of the superstructure;
- liaison with CGL to;
 - establish plant protection measures required for below-ground pipework, and the CGL compound;
 - establish protection measures required for the valve pits (presented on Figure 4 and Figure 6); and
 - establish the status of gas and electrical supplies to the boiler room and undertake the necessary isolation and disconnection of the structure prior to dismantling.

A plan detailing the specific plant protection measures during the enabling works is presented in Figure 6.

6.2. Dewatering and Desludging

The following works will be undertaken to remove all filming oil, water, residual water and sludge from the gasholder prior to demolition:

- analyse, remove, treat and dispose of filming oil, if present;
- analyse, remove, treat and dispose to foul sewer the bulk water from the gasholder and all siphon pits;
- analyse, remove, treat and dispose to foul sewer the residual water;
- analyse, treat, remove and dispose of sludge from within the gasholder tank, including any sludge that may be present within the cups and grips or on the gasholder base and other features within the gasholder; and
- use proactive odour mitigation measures for the duration of the desludging phases of work.

Relevant permits and consents will be sought as required before the dewatering and desludging works are undertaken.

6.3. Demolition

The works to dismantle and remove the following from site includes;

- the complete dismantling and removal from site of Gasholder No. 2 of the crown rest structure and four lifts including all associated pipework, steelwork and small plant items, guides, stairs and rollers;
- the removal and disposal of the riveted steel crown rest structure (king pin). The columns will be removed to match the profile of the dumpling, leaving the column bases in situ to maintain the integrity of the dumpling;
- the below ground gas walls and dumpling base will remain in-situ with adequate drainage to minimise the potential for standing water (ponding);

- the removal of the overhead redundant pipework and six supporting stanchions.;
- a siphon pit and redundant above ground pipework attached to the Gasholder No. 2 will be removed to ground level, sealed, backfilled and capped and the siphon pits infilled;
- the removal and disposal of the above-ground antifreeze pipe and associated gantry structure and bases;
- disconnect/isolate from electrical supply and gas supply and dismantle to slab level the corrugated steel single story boiler house, associated tanks and chimney.
- removal and appropriate disposal of asbestos cement identified in the boiler house;
- remove various barriers, handrails, signage and redundant lighting columns;
- remove visible paint flakes originating from Gasholder No. 2 and dispose of appropriately; and,
- complete a topographic survey of the base of the tank and tank walls prior to infilling.

A plan detailing the demolition works is presented in Figure 5.

6.4. Paint Flakes

The demolition works will be carried out to minimise the spread of paint flakes and debris. Full details of the test results of the paint flakes are presented in the WYG 2017 preliminary dismantling assessment [5]. Ground protection in locations where the generation of paint flakes is particularly likely to be generated by the works will be implemented.

6.5. Infilling

Following demolition of the superstructure, the infill the tank of Gasholder No. 2 in accordance with Figure 7 Infilling Plan will commence.

Table 6-1 - Gasholder Parameters (Infilling)

Gasholder	Gasholder No.2
Tank Diameter (m)	86.87
Tank Depth (m) (Below Ground)	14
Dumpling Volume (m ³)	37,367
Infill Volume (m ³)	45,640

All imported fill material will be tested at a minimum rate of 1 sample per 1000 m³ and at least 3 samples per material source at a UKAS accredited laboratory. Where possible, the number of fill material sources utilised will be minimised.

Infill material will be analysed and compared against the two chemical infill acceptance criteria in Section 4, one for bulk infill presented in Table 4-2 and one for a 500 mm capping surface layer presented in Table 4-1. A geotextile marker layer of Terram 1000 or equivalent will be placed between the top 500 mm and bulk infill material.

The placement of suitably tested material in the Gasholder will be undertaken in a manner that will not cause settlement. Acceptable earthworks materials will be placed in accordance the geotechnical classification provided in Appendix C and Infill Acceptance Criteria presented in Section 4.

Compaction testing will be undertaken in accordance with Appendix C and at the following frequencies:

- plate bearing test at final formation level at a minimum rate of 1 test per 200 m²;
- sand replacement and nuclear density measurements at 1.0 m depth intervals (or nearest layer in accordance with method related compaction) from 1.0 m above the tank base to 1.0 m below the final formation level.

The general arrangement for infilling works in Gasholder No.2 is summarised in Table 6-2 below.

Table 6-2 - Summary of Holder Infilling Information

General Requirement	Acceptable Fill Material Classification	Fill Depth (m bgl)	Approximate Volume
Below Water Fill	Class 6A	Varies from base to cover, any residual water remaining after pumping has taken place. Assume 1.0 m thickness	5,928.3 m ³
General Fill (placed within Gasholder tank base)	Class 2 General Fill	From top of Below Water Fill to 0.50 m bgl	36,747.5 m ³
500 mm Capping Layer	Class 6f2	From 0.50 m bgl to ground level	2,964.2 m ³

A plan detailing the infilling works is presented in Figure 7.

6.6. Import of Material

There are two potential import material mechanisms for the infill of Gasholder No. 2:

1. Waste and Resources Action Programme (WRAP) / Environment Agency Quality Protocol [21]; or
2. CL:AIRE Definition of Waste: Development Industry Code of Practice (DoWCoP) [22] material under Direct Transfer, which is only clean, naturally occurring material.

The approach for these material sources is detailed below.

6.6.1. WRAP Import

For WRAP import the following process will occur:

- The WRAP source will be identified, and testing provided by the producer will be reviewed for its potential use as infill on-site;
- No chemical infill criteria will be applicable as the material has achieved end of waste status and WRAP only applies to inert waste. However, for quality assurance and quality check purposes, additional chemical samples will be obtained from WRAP sources and scheduled in accordance with Section 4 of this report;
- Geotechnical data will be required to adhere to the values detailed in Appendix C; and
- Upon arrival at site a visual assessment of the material upon entry at the site will be confirmed to ensure the absence of visual contaminants, olfactory contamination, and deleterious material.

Testing of the material in accordance with Table 4-3 prior to placement will be completed, as stipulated by NGPH, for information purposes. A rate of one sample per 1000 m³ and at least three samples per source will be undertaken with the results included in the verification report.

6.6.2. DoWCoP Import

For CL:AIRE DoWCoP sourced material the following process will occur:

- The material source, under a Direct Transfer scenario (that only applies to clean, naturally occurring material) will be identified and analytical data from the source location collected for review;
- The risk to human health and controlled waters has been evaluated by Atkins and IAC are detailed in Section 4. The source analytical data will be compared against the IAC;
 - If the analytical data is below the IAC a Material Management Plan (MMP) will be completed and a declaration submitted to CL:AIRE by a Qualified Person demonstrating that the principals for the use of the material as a non-waste apply. The declaration is to be submitted a minimum of 14 days prior to the commencement of import and included in the verification report;
 - If the analytical data is above the infill criteria it will not be suitable for use on site and an alternative source will be identified;

- At the time of import the material will be visually assessed upon its arrival at site for potential deleterious intrusions;
- The material will also be tested and the analytical results compared against the IAC in Section 4 and as detailed in the MMP. A rate of one sample per 1000 m³ and at least three samples per source will be undertaken; and
- At the end of the infill works a verification report will be submitted to CL:AIRE to ensure that the MMP has been completed in accordance with the declaration.

Geotechnical criteria for detail in the MMP are enclosed in Appendix C.

6.7. Management of shallow groundwater/perched groundwater

There is the potential for groundwater ingress through the base of the Gasholder as the surrounding groundwater elevation is higher than the gasholder base in areas, which extends to 14 m bgl.

Should groundwater ingress occur, an appropriate solution will be designed and implemented to enable completion of the works as far as practical. Any mitigation measures will be recorded and included in the verification plan.

6.8. Unexpected contamination

The scope of works comprised demolition and infilling only. Therefore, unexpected contamination is not likely to occur. Unexpected contamination will be identified using common indicators of contamination, including unusual colouration, hydrocarbon odours, suspected asbestos, and deleterious materials.

As a worst case scenario, if identified the following approach would be completed:

- suitably trained members of the *Contractor's* team will obtain samples (if required) of material suspected of containing contamination. Details of all visual and olfactory observations, samples collected and photo ionisation detector (PID) readings will be recorded throughout this phase of the works;
- the project team will be informed by the *Contractor*; and
- a methodology to address this unexpected contamination before proceeding upon agreement with the project team.

6.9. Stockpiling

Temporary stockpiles of imported materials may be required during the works and as such shall be constructed in such a way to reduce rainwater infiltration to minimise leachate generation, minimise the release of dust, and to minimise any potential nuisance to adjacent site users.

An appropriate location for stockpiling will be assessed which will be protective of excessive loading on surface / below ground constraints including utilities. Stockpiling of material is considered temporary and due to the limited site area all material will be relocated at the earliest opportunity.

7. Verification

The verification plan shall be included as part of their design and a verification report shall be produced following completion of the demolition and infilling works. A copy of the Plan will be provided to Manchester City Council at the earliest available opportunity.

However, the verification plan set out the requirements for gathering data/evidence to demonstrate that the demolition and infilling meets the objectives and criteria discussed in this report. It shall include monitoring, sampling and testing criteria, and identify all the records that should be retained to demonstrate compliance with this strategy.

A verification report will be produced that shall provide a complete record of all demolition and infilling activities on site and the data collected (as identified in the verification plan) to support compliance with agreed objectives and criteria discussed in this strategy. It shall also include a description of the work (as built drawings) and details of any unexpected conditions (e.g. contamination) found during the demolition and infilling and how it was dealt with.

7.1. Verification Plan

The verification plan shall include the following:

- introductory information (site details and stakeholders);
- the scope and objectives of the demolition and infilling with reference to the criteria in this strategy;
- planning conditions and the planned approach to enable discharge;
- infill acceptance criteria;
- how will the demolition and infilling performance will be verified;
- schedule of planned verification report; and
- contingency plans should the infill acceptance criteria or geotechnical compaction testing fail to be met.

7.2. Verification Reporting

The verification report should include the following:

- background information (site details, personnel and roles, reasons and objectives for the demolition and infilling);
- demolition and infilling;
 - methodology and programme;
 - verification;
 - monitoring; and
 - testing regime.
- final site condition;
- details of residual contamination (if present);
- third party agreements (records of regulator liaison);
- supporting information (plans, drawings, photographs, field and laboratory test results and progress reports); and
- a risk assessment for any residual contamination identified within the site and updated CSM following infilling works.

The verification report shall be produced to also satisfy the requirements of the CL:AIRE DoWCoP [22] and hence should contain all details and records pertaining to the MMP including (but may not be limited to):

- materials tracking;
- transfer notes;
- delivery notes;
- weighbridge tickets;
- the as-built records including any alterations made;

- site plans showing areas of material placement from imported material); and
- photographic record of the earthworks movements.

A plan detailing the final site conditions is presented in Figure 8.

8. Environmental Management

8.1.1. Environmental Protection Arrangements and Monitoring Schedule

Environmental protection is a key aspect of remediation and verification works. Noting that the demolition and infilling scope is not remediation, these works will be undertaken assuming the potential for environmental risks; therefore, we have outlined potential environmental protection arrangements below. All preparatory works concerning environmental protection and monitoring shall be completed prior to infill works commencing.

All the works will be undertaken in line with task-specific method statements, task-specific risk assessments and under the control of the *Contractors* health and safety protocols. These will be detailed elsewhere as part of the *Contractors* operational controls, contractual requirements and legal responsibilities, and are not detailed in this methodology..

Any environmental incidents will be dealt with in accordance with the *Contractors* incident reporting procedure and the NGPH incident reporting, investigation and review procedure. The same procedures are to be followed should any communications or complaints be received from local residents, businesses or elsewhere.

8.1.2. Licensing, Permissions, Consents, Permits and Notices

The Contractor undertaking the works shall, if necessary, obtain all applicable licences and consents as necessary including, but not limited to, the following:

- submission of the discharge consent application;
- submission of the Section 80;
- deployment of the Environmental Permit;
- liaison with Network Rail due to the close proximity of the works to the railway; and
- CL:AIRE Definition of Waste Code of Practice submissions [22] (depending on the source material utilised).

8.1.3. Noise and Vibration

. A baseline background noise monitoring survey shall be undertaken prior to the commencement of the works. If necessary, a Section 60 or Section 61 permit in accordance with the Control of Pollution Act (COPA) (1974) shall be obtained by the *Contractor* after liaison with the Local Authority. Noise monitoring shall be undertaken throughout the works to ensure levels remain acceptable and below agreed thresholds.

Vibration monitoring shall also be undertaken as required in relation to sensitive structures in the vicinity of the works, such as the high pressure live gas pipework and infrastructure, and where requested by CGL.

8.1.4. Odour, Gases and Vapours

An appropriate standard of odour control will be maintained when completing the demolition works, for example chemical sprays or physical barriers if required.

An outline of the proposed odour monitoring regime, including baseline monitoring requirements, proposed monitoring locations, the method and frequency that field and analytical data is to be collected, and the exposure limits should be detailed in the tender return. HSE Workplace Exposure Limits shall be used to assess the vapour levels and the *Contractor* shall ensure that these limits are appropriate for this site. Reference is made to the Institute of Air Quality Management guidance document [25].

8.1.5. Dusts and Particulates

Dust monitoring locations shall be located at the site boundaries to ensure levels remain acceptable. The results shall be reported on a regular basis in order to identify scenarios where mitigation may be required and allow for appropriate measures to be put in place. HSE Workplace Exposure Limits should be used as target levels, however this shall be agreed with the local authority prior to commencement of the works.

Should elevated dust levels be recorded, then dust mitigation measures shall be used where appropriate such as dampening down during periods of dry and / or windy weather. Other measures could include dust screens and semi-permeable fabric to catch / divert airborne particles from sensitive areas.

8.1.6. Asbestos

A refurbishment and demolition asbestos survey was completed in 2017 of the boiler house (presented in the WYG Factual Preliminary Dismantling Assessment [5]).

Specific health and safety requirements will be required during any management or asbestos removal works in line with CAR (2012). The details of the proposed controls for asbestos removal works will be included in the verification plan.

Mitigation measures should be implemented if asbestos is visually observed within imported material during these works. These mitigation measures are anticipated to include segregating and clearly marking any area of the site with suspected asbestos before the material is returned to the supplier.

8.1.7. Protection of Controlled Waters

General working arrangement with respect to the prevention of pollution to controlled waters include:

- Existing site drainage features will be appropriately sealed / protected or decommissioned prior to any material being transported and / or stockpiled;
- Placement of materials throughout the works will be carried out under supervision by a qualified banksman who will ensure safe systems of work are adhered to; and
- All fuels will be stored on-site above ground in designated re-fuelling areas in double- skinned and self-bunded tanks. Oils and lubricants for plant will be stored either in the bunded tanks or on drip tray(s) inside locked metal store(s). Spill response kits will be available at the designated refuelling points. MSDS shall be made available on site and COSHH assessments will be provided for the use and storage of the materials.

8.1.8. Environmental Management Plan

Identified environmental aspects requiring specific consideration within the Contractor's Construction Phase EMP are presented in Table 8-1. This table is not exhaustive, and the Contractor shall ensure that adequate provision is made for all foreseeable environmental aspects considered to require specific consideration during the works.

Table 8-1 - Environmental Management Plan

Item	Details
Air Emissions	The Contractor is required to design and undertake the works in an appropriate manner which employs the measures detailed in the EMP to minimise, as far as reasonably practicable air emissions associated with the works, inclusive of dust, odours and vapours and to implement an appropriate monitoring programme. The Contractor shall inform NGPH's appointed communications agency who will inform the relevant Cadent Integrity Engineers, Emergency Network Managers, Regional Press Officers and National Gas Emergency Service contacts at least two weeks prior to the commencement of desludging activities to reduce the strain on the "Smell Gas" emergency phone number. The Contractor shall use odour suppressants for the duration of the dewatering and desludging works and ensure emissions from desludging plant and/ or equipment is carefully controlled e.g. deodoriser, carbon filters. In addition, all equipment used on the site shall be checked prior to use for the level of emissions. If considered to be above an acceptable level, the equipment shall be repaired or removed from site.
Water Discharges	Water is present within the gasholder tank and will require removal from the holder and subsequent disposal. The Contractor shall make adequate provision for storage, testing and disposal in accordance with current legislative requirements. Should the Contractor intend to discharge wastewater to sewer, this shall only be undertaken under an appropriate licence/consent and may necessitate treatment of the water prior to disposal. Run-off from temporary material stockpiles shall require consideration and mitigation measures shall be implemented by the Contractor as required.

Item	Details
	The Contractor shall develop emergency management procedures and a response plan to prevent surface water run-off from entering the drainage system.
Land Contamination	The proposed works are not anticipated to include excavations works with the exception of trial trenches to prove below-ground services. Due to limited excavations, exposure to below-ground contaminants is not for long duration. The Contractor's CPP shall include provision for managing and mitigating encountered contaminations. Potential land contamination issues relating to waste management and the storage of materials and control of spillages are discussed below.
Waste Management	The demolition of the Gasholder, associated pipework and structures will result in a range of waste types likely to include steel and metal. The derelict water treatment plant located to the south of the Gasholder No. 2 also requires removing. The Contractor shall make adequate provision for storage, testing and disposal in accordance with current legislative requirements and based on risk assessment of the waste type. Where possible, waste shall be sent for re-use/recycling rather than disposal to landfill. The Contractor is responsible for applying for all required permits and consents and ensuring that all wastes are managed in full compliance with all legal requirements and the Duty of Care.
Energy Management	Maintenance records for mechanical equipment shall be checked and an assessment of the efficient running of the equipment made. Consideration shall be given to minimising the amount of energy used on-site.
Storage of Materials, Spillage Control	The storage of materials (location, type, bunding/sheeting, duration etc.) arising as a result of the works shall be informed by risk assessment. Oils/fuels and water shall be stored in bunded / double skinned tanks. Fuel storage on site shall be kept to a minimum and Environment Agency guidance relating to fuel storage shall be followed. Absorbent materials suitable for all liquid types stored on-site shall be provided at each liquid storage area. All plant and equipment shall be checked, serviced and maintained to reduce the potential for spillages and leaks to ground. Appropriate bunding and plant nappies/drip trays shall be used for plant and equipment. Incident response procedures and emergency contact details shall be contained within the construction phase EMP. An environmental emergency response drill shall be undertaken by the Contractor at an appropriate point in the programme. Site layout shall be designed and maintained to ensure minimal possibility of disturbance to neighbours.
Paint Flake Control	The paint on the Gasholder is flaking and in poor condition. The Contractor shall include within his design the methods for mitigating paint flake disturbance and migration to the surrounding area, including migration off-site.
Water Treatment Plant	Water Treatment systems shall be designed to include appropriate alarm and shut-off systems and fault/troubleshooting conditions.
Noise	The works on site will be limited to working hours (Monday to Friday, 08:00-18:00). The Contractor shall, as far as is reasonably practicable, limit noise levels causing a nuisance to other site users and adjacent site users. Methodologies to reduce noise emission are to be adopted. Regular noise monitoring shall

Item	Details
	be undertaken during the works and noise levels shall be regularly reviewed and considered as the progress.
Transport	The Contractor shall minimise as far as is reasonably practicable the impact of the works on the local road network and disruption to surrounding land users. Measures shall include: • limiting the frequency of lorry movements during peak traffic times. • prohibiting vehicle waiting outside of the site boundary near residential properties. • wheel wash/ road sweeper where required.
Service Suppliers / Sub-Contractors / Customers	The Contractor shall review all suppliers and sub-Contractors, as appropriate, to ensure compliance with the requirements of NGPH and ISO14001.
Visual Impact	There are no specific requirements in relation to any potential visual impacts relating to the works.
Ecosystems	The Contractor shall be aware and demonstrate compliance with the ecological working restrictions as identified for the site and the mitigation measures required to be implemented as part of the works as stated in the Preliminary Ecological Appraisal Report (Atkins, 2022) included in Appendix B2 of the Site Information [24].
Neighbours (impact from)	Potential impacts to residents and businesses shall be minimised, as far as is reasonably practicable, and provision shall be made for responding to complaints and general community relations requirements before and during the project works.
Housekeeping	The Contractor shall maintain the site in a safe, tidy and methodical manner. Materials, wastes, plant and equipment to be stored in appropriate storage containers. The Contractor to ensure the site is set-up with clean and dirty areas, and a decontamination unit/ shower must be present on site for the duration of the works.
Incident Reporting	Incident response procedures and emergency contact details will be contained within the EMP. All environmental incidents and near misses shall be reported via the National Grid reporting system and to the statutory authorities if/as appropriate.

9. References

- [1] Environment Agency, "Land Contamination Risk Management," 2021.
- [2] WSP, "Surplus Land and Holder Site Bradford Road Factual Site Investigation Report," 2003.
- [3] WYG, "Data Review Report Bradford Road Gasholder Station and Surplus Land, Manchester," 2012.
- [4] WYG, "Ground Investigation Factual Report, Bradford Road NGG Land," 2014.
- [5] WYG, "Factual Preliminary Dismantling Assessment Report for Gasholder No. 2, A074754-430-0049-Final," 2017.
- [6] Environmental Essentials Limited, "Asbestos Re-inspection Survey, Bradford Road, Manchester," 23 August 2021.
- [7] Atkins Limited, "Controlled Waters Gasholder Infill Acceptance Criteria," 2022.
- [8] Atkins Limited, "Bradford Road, Manchester, Preliminary Infilling Assessment," 2022.
- [9] Atkins Limited, "Bradford Road Gasholder, Preliminary Ecological Appraisal Report," 2022.
- [10] Englobe UK, "Bradford Road No. 2 Gasholder – Factual Technical Summary of Holder Overflow Water Methane Management," 22 September 2022.
- [11] British Geological Society, "GeoIndex Onshore," [Online]. Available: <https://mapapps2.bgs.ac.uk/geoindex/home.html>. [Accessed 02 11 2022].
- [12] British Geological Society, "Lexicon of Named Rock Units," [Online]. Available: <https://webapps.bgs.ac.uk/lexicon/>. [Accessed 02 11 2022].
- [13] DEFRA, "Magic Maps," [Online]. Available: <https://magic.defra.gov.uk/magicmap.aspx>. [Accessed 02 11 2022].
- [14] Environment Agency, "Protect Groundwater and Prevent Groundwater Pollution," 2017.
- [15] DEFRA, "Flood Risk Mapping," [Online]. Available: <https://flood-map-for-planning.service.gov.uk/>. [Accessed 02 11 2022].
- [16] Environmental Essentials, "Asbestos Re-inspection Survey with additional Management Survey, P-256754," 2017.
- [17] Journal of the European Union, "Directive 2006/118/EC of the European Parliament and of the Council on the Protection of Groundwater Against Pollution and Deterioration," 12 December 2006 .
- [18] Atkins Limited, "Controlled Waters Gas Holder Infill Acceptance Criteria, Bradford Road, Manchester (Site Code 0049)," June 2022.
- [19] CIRIA, "Contaminated Land Risk Assessment: A Guide to Good Practice (C552)," 2001.
- [20] UK Government, "The Control of Asbestos Regulations," 2012.
- [21] Environment Agency , "WRAP Quality Protocol: Aggregates from Inert Waste," 2013.
- [22] CL: AIRE, Definition of Waste: Development Industry Code of Practice. Version 2. March 2011, 2011.
- [23] Institute of Air Quality Management (IAQM), "Guidance on the Assessment of Odour for Planning, Rev. 1.1," July 2018.
- [24] Atkins, "Bradford Road, Manchester, Gasholder Demolition and Infilling - Site Information," 2023.
- [25] Parkman Environmental, "Former Bradford Road Gasworks, Manchester, Environmental Assessment Factual Report," 1997.
- [26] Parkman Environmental, "Bradford Road, Manchester Validation Report - Factual," 1998.

- [27] Asbestos Consultants to the Environment Ltd, "Asbestos Survey Report, NW00002-1," 2004.
- [28] "Trade Effluent - Water Industry Act 1991 - Gasholder Station Number 2 North Bradford Road, Miles Platting, Manchester M40 7AZ, 694TLN26NGP02," 2014.
- [29] Environmental Essentials, "Asbestos Re-inspection Survey, P-308906," 2018.
- [30] Environmental Essentials, "Asbestos Re-inspection Survey, P-401550," 2021.
- [31] Environmental Essentials, "Asbestos Re-inspection Survey, P-346816," 2019.
- [32] Environmental Essentials, "Asbestos Re-inspection Survey, P-375618," 2020.
- [33] HMSO, Statutory Instrument 2015 No. 51. Health and Safety. The Construction (Design and Management) Regulations, 2015.
- [34] HSE, Control of Asbestos Regulations, 2012.

Figures

Figure 1 – Site Location Plan

Figure 2 – Site Layout Plan

Figure 3 – Conceptual Site Model

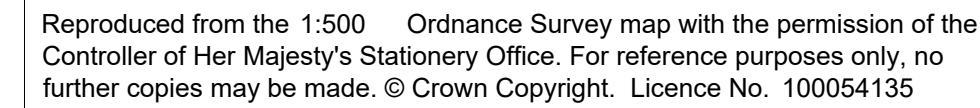
Figure 4 – Constraints Plan

Figure 5 – Demolition Plan

Figure 6 – Plant Protection Plan

Figure 7 – Infilling Plan

Figure 8 – Final Site Conditions



1. DO NOT SCALE FROM THIS DRAWING.
2. THIS DRAWING SHOULD BE READ IN FULL COLOUR.

Drawing Status	FOR INFORMATION	Suitability	S2
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SITE LOCATION PLAN

Scale 1:2,500	Designed AD	Drawn CW	Checked MC	Authorised RG
Original Size A1	Date 23/05/2022	Date 23/05/2022	Date 23/05/2022	Date 27/07/2022
Drawing Number				Revision
FIGURE 1				02

FIGURE 1

02

CLASSIFICATION - Baseline (Low Risk)