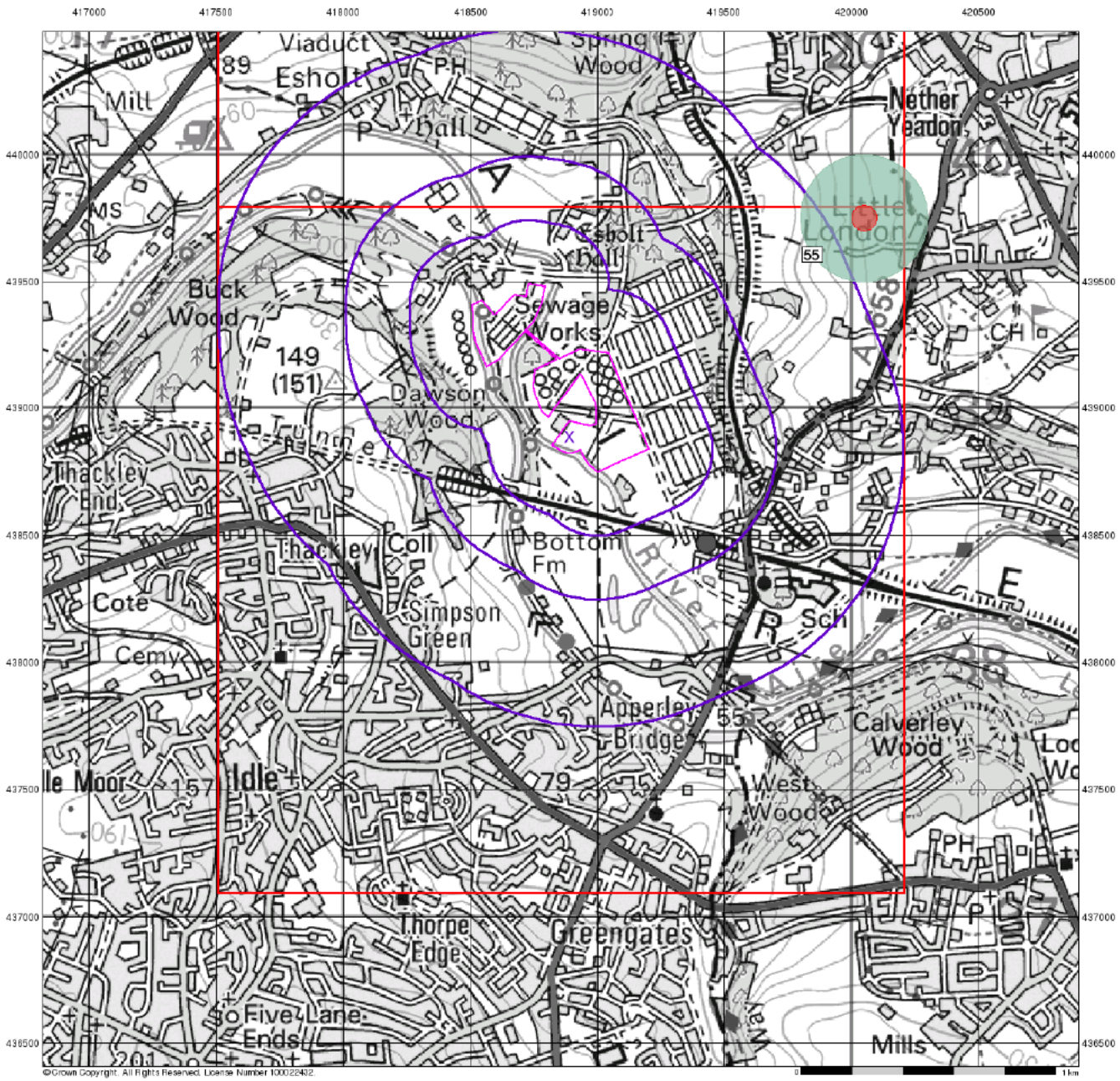


Envirocheck

LANDMARK INFORMATION GROUP

Source Protection Zones

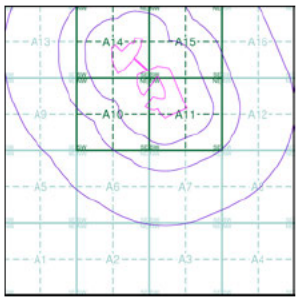
General

Specified Site | Specified Buffer(s) | Bearing Reference Point
Slice | Map ID

Agency and Hydrological

- Inner zone (Zone 1)
- Inner zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)

Site Sensitivity Context Map - Slice A



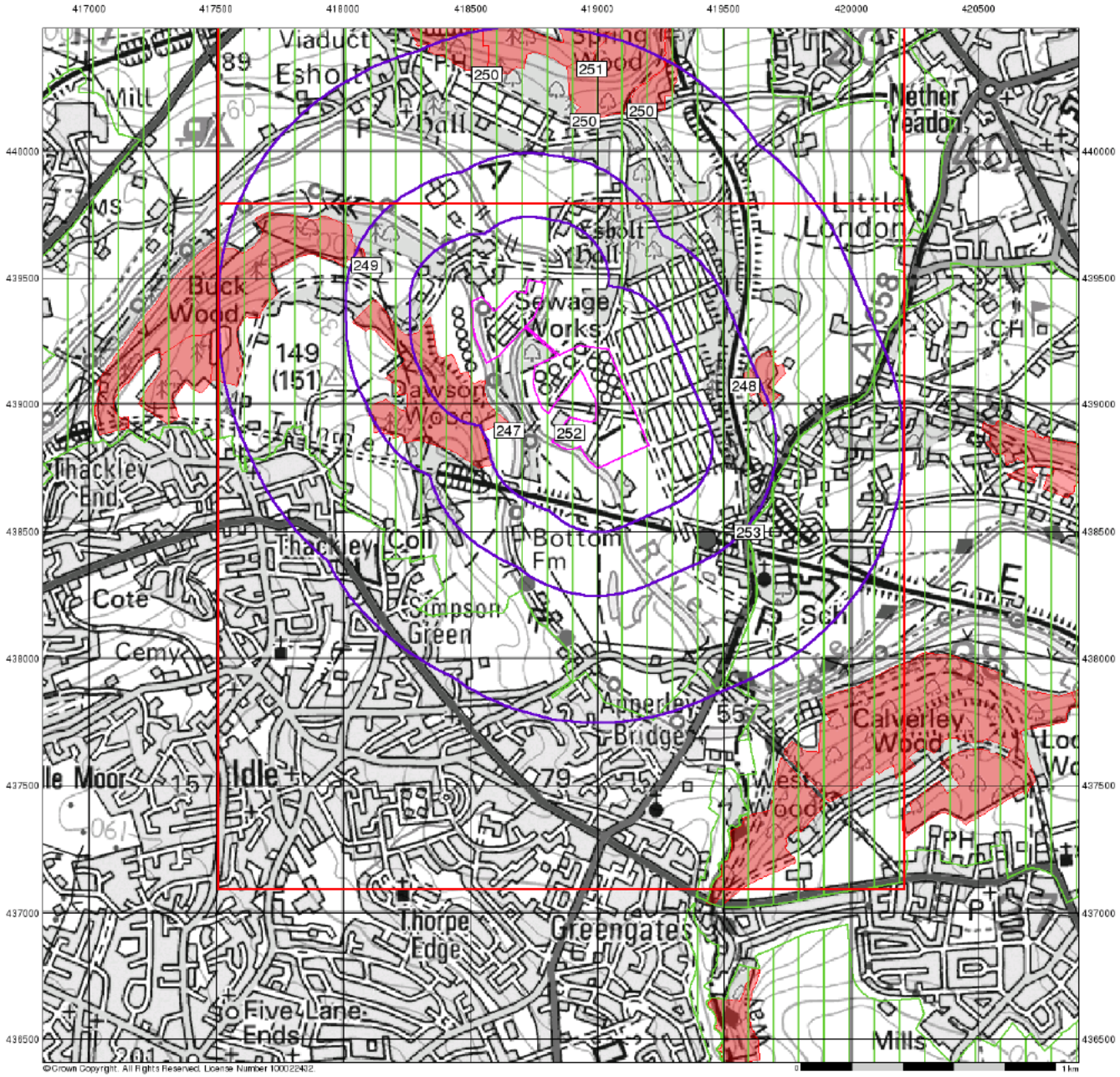
Order Details

Order Number:	263439473_1_1
Customer Ref:	41527313
National Grid Reference:	418890, 438890
Slice:	A
Site Area (Ha):	16.56
Search Buffer (m):	1000

Site Details

Site at 418940, 439490

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Envirocheck®

LANDMARK INFORMATION GROUP®

Sensitive Land Uses

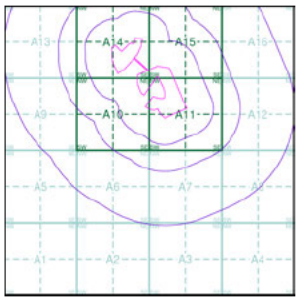
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

Sensitive Land Uses

- Ancient Woodland
- Area of Adopted Green Belt
- Area of Unadopted Green Belt
- Area of Outstanding Natural Beauty
- Environmentally Sensitive Area
- Forest Park
- Local Nature Reserve
- Marine Nature Reserve
- National Nature Reserve
- National Park
- Nitrate Sensitive Area
- Nitrate Vulnerable Zone
- Ramsar Site
- Site of Special Scientific Interest
- Special Area of Conservation
- Special Protection Area
- World Heritage Sites

Site Sensitivity Context Map - Slice A



Order Details

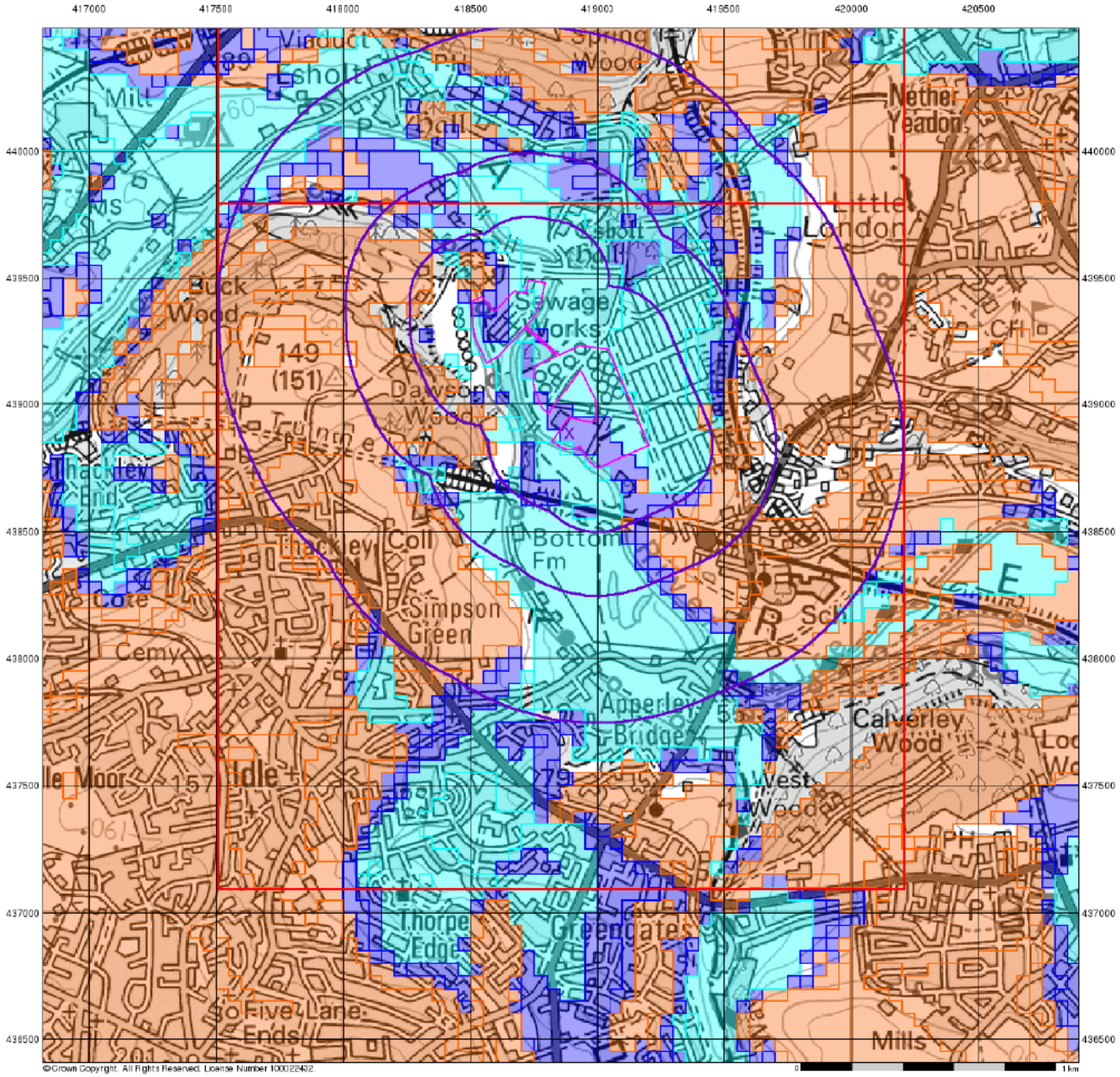
Order Number:	263439473_1_1
Customer Ref:	41527313
National Grid Reference:	418890, 438890
Slice:	A
Site Area (Ha):	16.56
Search Buffer (m):	1000

Site Details

Site at 418940, 439490

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Envirocheck®

LANDMARK INFORMATION GROUP®

BGS Flood GFS Data

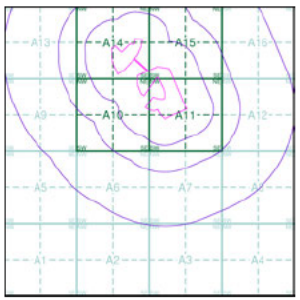
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice

Agency and Hydrological (Flood)

- Limited Potential for Groundwater Flooding to Occur
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Potential for Groundwater Flooding to Occur at Surface

Site Sensitivity Context Map - Slice A



Order Details

Order Number:	263439473_1_1
Customer Ref:	41527313
National Grid Reference:	418890, 438890
Slice:	A
Site Area (Ha):	16.56
Search Buffer (m):	1000

Site Details

Site at 418940, 439490

Landmark® INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix 2 Coal Authority Report

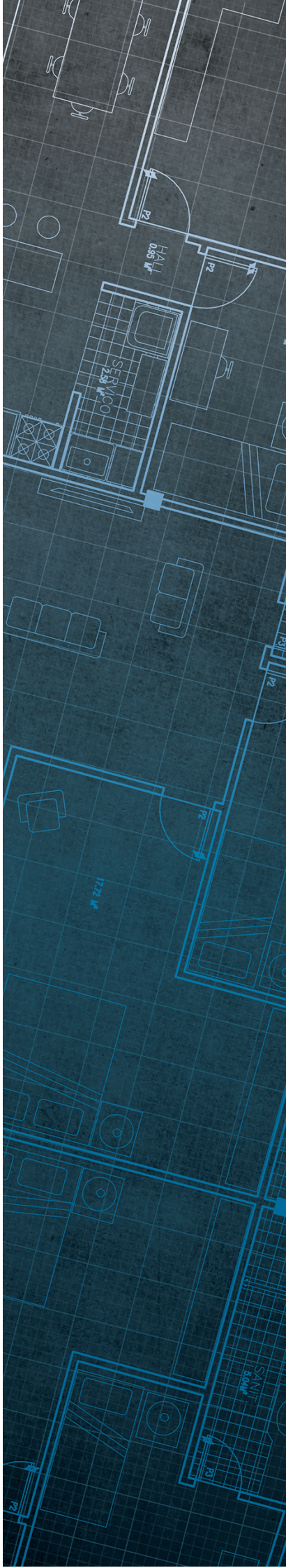
The Coal Authority

Consultants

Coal Mining Report

Site At 418940, 439490
West Yorkshire

Date of enquiry:	**23 October 2020**
Date enquiry received:	**23 October 2020**
Issue date:	**23 October 2020**
Our reference:	**51002316939001**
Your reference:	**263832138_1**



Consultants

Coal Mining Report

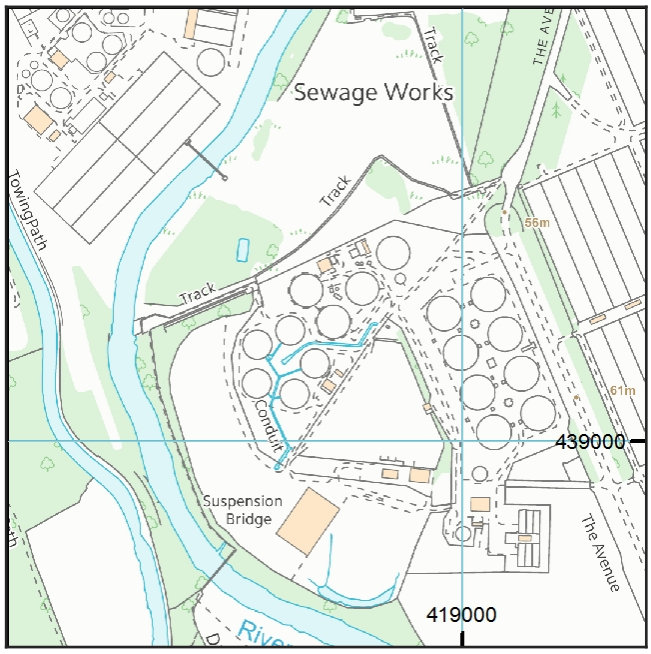
This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

NLIS Hub

Enquiry address

Site At 418940, 439490
West Yorkshire



Approximate position of property

How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

@coalauthority
/company/the-coal-authority
/thecoalauthority
/thecoalauthority

Section 1 – Mining activity and geology

Past underground mining
No past mining recorded.

Probable unrecorded shallow workings
None.

Spine roadways at shallow depth
No spine roadway recorded at shallow depth.

Mine entries
None recorded within 100 metres of the enquiry boundary.

Abandoned mine plan catalogue numbers
None available.

Outcrops
No outcrops recorded.

Geological faults, fissures and breaklines
No faults, fissures or breaklines recorded.

Opencast mines
None recorded within 500 metres of the enquiry boundary.

Coal Authority managed tips
None recorded within 500 metres of the enquiry boundary.

Section 2 – Investigative or remedial activity

Please refer to the 'Summary of findings' map (on separate sheet) for details of any activity within the area of the site boundary.

Site investigations
None recorded within 50 metres of the enquiry boundary.

Remediated sites
None recorded within 50 metres of the enquiry boundary.

Coal mining subsidence
The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine gas
None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes
None recorded within 500 metres of the enquiry boundary.

Section 3 – Licensing and future mining activity

Future underground mining
None recorded.

Coal mining licensing
None recorded within 200 metres of the enquiry boundary.

Court orders
None recorded.

Section 46 notices
No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

Withdrawal of support notices
The property is not in an area where a notice to withdraw support has been given.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

Payments to owners of former copyhold land
The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Section 4 – Further information

Based on the responses in this report, no further information has been highlighted.

Section 5 – Data definitions

The datasets used in this report have limitations and assumptions within their results. For more guidance on the data and the results specific to the enquiry boundary, please **call us on 0345 762 6848** or **email us at groundstability@coal.gov.uk.**

Past underground coal mining

Details of all recorded underground mining relative to the enquiry boundary. Only past underground workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination, will be included.

Probable unrecorded shallow workings

Areas where the Coal Authority believes there to be unrecorded coal workings that exist at or close to the surface (less than 30 metres deep).

Spine roadways at shallow depth

Connecting roadways either, working to working, or, surface to working, both in-seam and cross measures that exist at or close to the surface (less than 30 metres deep), either within or within 10 metres of the enquiry boundary.

Mine entries

Details of any shaft or adit either within, or within 100 metres of the enquiry boundary including approximate location, brief treatment details where known, the mineral worked from the mine entry and conveyance details where the mine entry has previously been sold by the Authority or its predecessors British Coal or the National Coal Board.

Abandoned mine plan catalogue numbers

Plan numbers extracted from the abandoned mines catalogue containing details of coal and other mineral abandonment plans deposited via the Mines Inspectorate in accordance with the Coal Mines Regulation Act and Metalliferous Mines Regulation Act 1872. A maximum of 9 plan extents that intersect with the enquiry boundary will be included. This does not infer that the workings and/or mine entries shown on the abandonment plan will be relevant to the site/property boundary.

Outcrops

Details of seam outcrops will be included where the enquiry boundary intersects with a conjectured or actual seam outcrop location (derived by either the British Geological Survey or the Coal Authority) or intersects with a defined 50 metres buffer on the coal (dip) side of the outcrop. An indication of whether the Coal Authority believes the seam to be of sufficient thickness and/or quality to have been worked will also be included.

Geological faults, fissures and breaklines

Geological disturbances or fractures in the bedrock. Surface fault lines (British Geological Survey derived data) and fissures and breaklines (Coal Authority derived data) intersecting with the enquiry boundary will be included. In some circumstances faults, fissures or breaklines have been known to contribute to surface subsidence damage as a consequence of underground coal mining.

Opencast mines
Opencast coal sites from which coal has been removed in the past by opencast (surface) methods and where the enquiry boundary is within 500 metres of either the licence area, site boundary, excavation area (high wall) or coaling area.

Coal Authority managed tips
Locations of disused colliery tip sites owned and managed by the Coal Authority, located within 500 metres of the enquiry boundary.

Site investigations
Details of site investigations within 50 metres of the enquiry boundary where the Coal Authority has received information relating to coal mining risk investigation and/or remediation by third parties.

Remediated sites
Sites where the Coal Authority has undertaken remedial works either within or within 50 metres of the enquiry boundary following report of a hazard relating to coal mining under the Coal Authority's Emergency Surface Hazard Call Out procedures.

Coal mining subsidence
Details of alleged coal mining subsidence claims made since 31 October 1994 either within or within 50 metres of the enquiry boundary. Where the claim relates to the enquiry boundary confirmation of whether the claim was accepted, rejected or whether liability is still being determined will be given. Where the claim has been discharged, whether this was by repair, payment of compensation or a combination of both, the value of the claim, where known, will also be given.

Details of any current 'Stop Notice' deferring remedial works or repairs affecting the property/site, and if so the date of the notice.

Details of any request made to execute preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991. If yes, whether any person withheld consent or failed to comply with any request to execute preventative works.

Mine gas
Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission.

Mine water treatment schemes
Locations where the Coal Authority has constructed or operates assets that remove pollutants from mine water prior to the treated mine water being discharged into the receiving water body.

These schemes are part of the UK's strategy to meet the requirements of the Water Framework Directive. Schemes fall into 2 basic categories: Remedial – mitigating the impact of existing pollution or Preventative – preventing a future pollution incident.

Mine water treatment schemes generally consist of one or more primary settlement lagoons and one or more reed beds for secondary treatment. A small number are more specialised process treatment plants.

Future underground mining
Details of all planned underground mining relative to the enquiry boundary. Only those future workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination will be included.

Coal mining licensing
Details of all licenses issued by the Coal Authority either within or within 200 metres of the enquiry boundary in relation to the under taking of surface coal mining, underground coal mining or underground coal gasification.

Court orders
Orders in respect of the working of coal under the Mines (Working Facilities and Support) Acts of 1923 and 1966 or any statutory modification or amendment thereof.

Section 46 notices
Notice of proposals relating to underground coal mining operations that have been given under section 46 of the Coal Mining Subsidence Act 1991.

Withdrawal of support notices
Published notices of entitlement to withdraw support and the date of the notice. Details of any revocation notice withdrawing the entitlement to withdraw support given under Section 41 of the Coal Industry Act 1994.

Payment to owners of former copyhold land
Relevant notices which may affect the property and any subsequent notice of retained interests in coal and coal mines, acceptance or rejection notices and whether any compensation has been paid to a claimant.

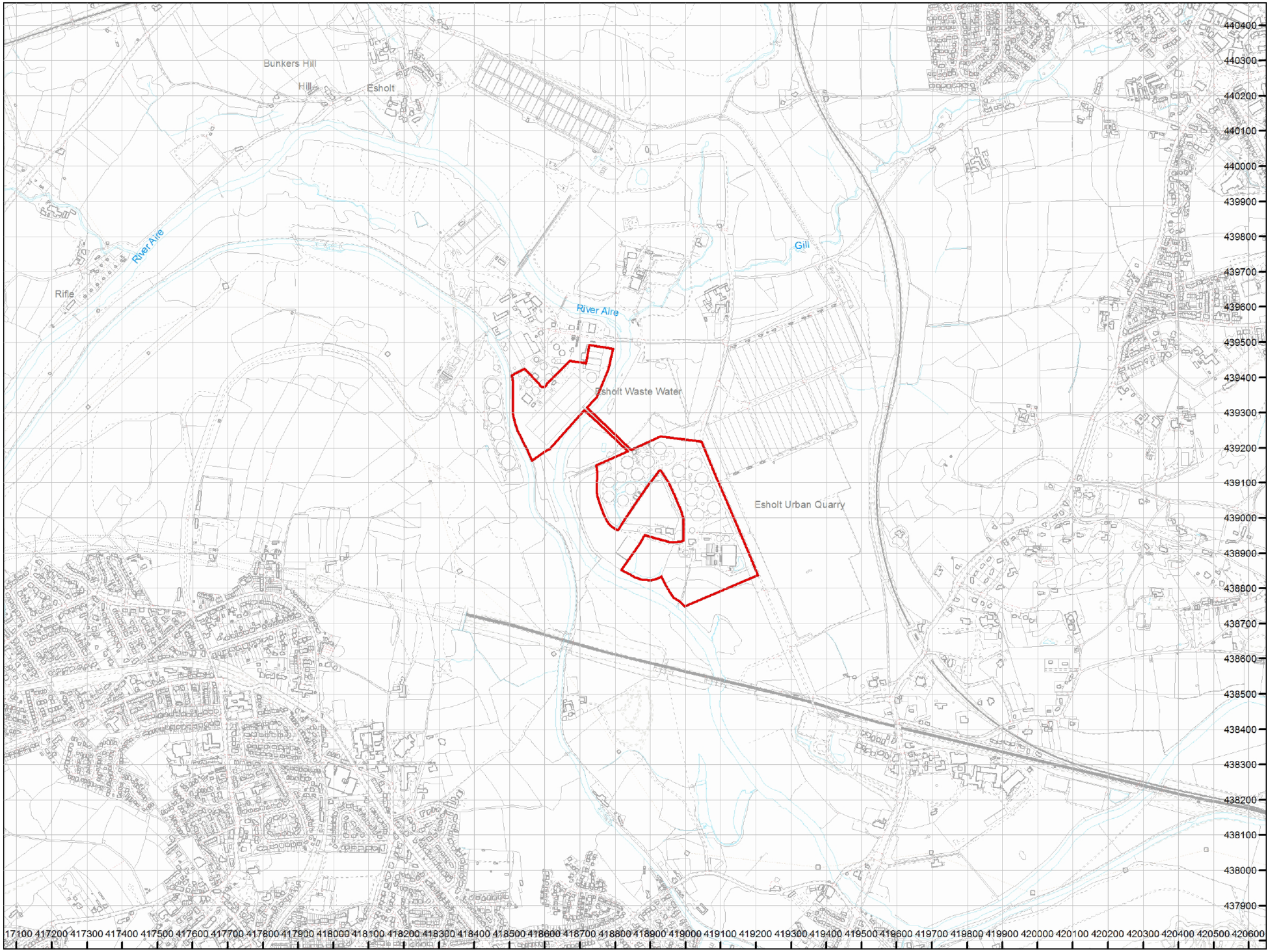
The Coal Authority

Summary of findings

The map highlights any specific surface or subsurface features within or near to the boundary of the site.

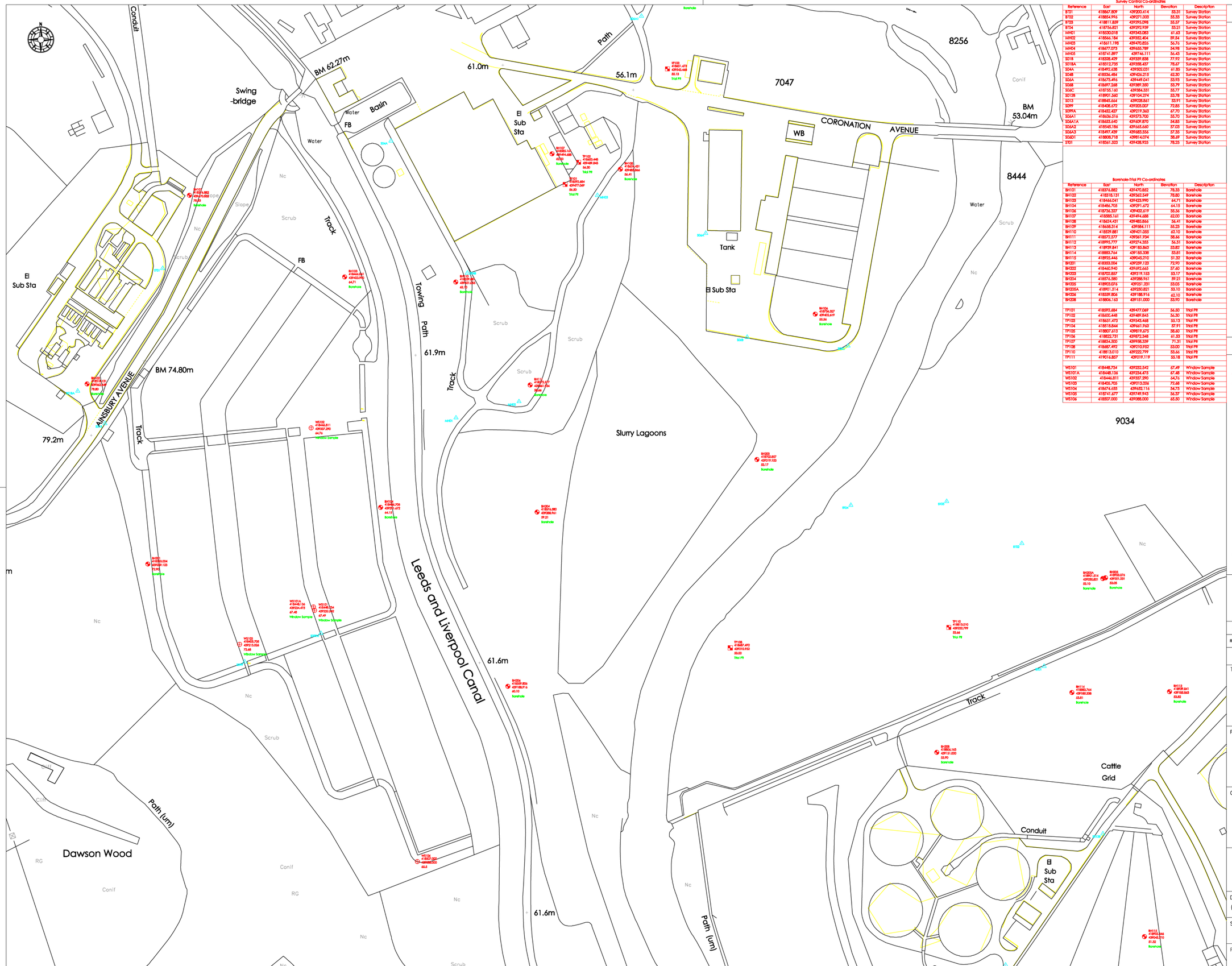
Key

Approximate position of the enquiry boundary shown



How to contact us
0345 762 6848 (UK)
+44 (0)1623 637 000 (International)
www.groundstability.com

Appendix 3 Locations of Previous Investigations



Survey Control Co-ordinates

Reference	East	North	Elevation	Description
B101	418867.809	439200.414	53.21	Survey Station
B102	418854.996	439271.035	55.35	Survey Station
B103	418811.809	439295.098	55.57	Survey Station
B104	418756.821	439292.939	53.21	Survey Station
MH01	418320.018	439343.283	61.63	Survey Station
MH02	418566.184	439352.404	59.54	Survey Station
MH03	418611.198	439470.825	56.76	Survey Station
MH04	418677.079	439455.789	54.98	Survey Station
MH05	418741.897	43974.6.111	56.43	Survey Station
SO1B	418328.429	439339.838	77.92	Survey Station
SO1BA	418312.735	439308.437	78.67	Survey Station
SO4A	418492.638	439502.031	61.85	Survey Station
SO4B	418536.484	439426.215	62.30	Survey Station
SO5A	418675.495	439449.241	53.93	Survey Station
SO6B	418697.268	439389.350	53.79	Survey Station
SO6C	418755.160	439384.331	55.77	Survey Station
SO12B	418901.560	439104.274	53.78	Survey Station
SO13	418845.664	439028.561	53.91	Survey Station
SO99	418408.572	439203.007	72.85	Survey Station
SO99A	418402.427	439219.365	67.70	Survey Station
SO6A1	418636.516	439573.700	55.70	Survey Station
SO6A1A	418603.640	439109.870	54.85	Survey Station
SO6A2	418548.186	439565.560	57.03	Survey Station
SO6A3	418497.439	439683.556	57.35	Survey Station
SO6D1	418808.718	439814.074	58.69	Survey Station
ST01	418561.323	439428.925	78.25	Survey Station

Borehole-Trial Pit Co-ordinates

Reference	East	North	Elevation	Description
BH101	418376.882	439470.852	78.33	Borehole
BH102	418316.131	439362.549	78.85	Borehole
BH103	418466.041	439423.990	64.71	Borehole
BH104	418486.705	439291.672	64.15	Borehole
BH106	418756.327	439402.619	55.56	Borehole
BH107	418585.161	439494.488	60.00	Borehole
BH108	418624.431	439480.866	56.41	Borehole
BH109	418658.314	439584.111	55.23	Borehole
BH110	418559.581	439421.055	62.10	Borehole
BH111	418572.577	439361.934	58.66	Borehole
BH112	418995.777	439274.355	56.51	Borehole
BH113	418939.841	439183.865	53.82	Borehole
BH114	418883.764	439185.338	53.81	Borehole
BH115	418925.446	439045.210	51.32	Borehole
BH201	418583.004	439239.123	72.90	Borehole
BH202	418400.940	439692.655	57.60	Borehole
BH203	418702.857	439319.153	53.17	Borehole
BH204	418574.280	439288.761	59.21	Borehole
BH205	418903.076	439251.231	53.05	Borehole
BH205A	418901.514	439250.821	53.10	Borehole
BH206	418559.806	439188.916	62.10	Borehole
BH208	418806.163	439151.000	53.90	Borehole
TP101	418592.684	439477.069	56.50	Trial Pit
TP102	418600.448	439489.845	56.30	Trial Pit
TP103	418651.475	439345.408	55.15	Trial Pit
TP104	418518.844	439661.963	57.91	Trial Pit
TP105	418807.613	439819.675	58.60	Trial Pit
TP106	418822.731	439572.348	41.35	Trial Pit
TP107	418854.500	439958.339	71.31	Trial Pit
TP108	418687.492	439210.952	53.00	Trial Pit
TP110	418813.010	439222.799	53.66	Trial Pit
TP111	419016.837	439219.119	55.18	Trial Pit
WS101	418448.734	439232.542	67.49	Window Sample
WS101A	418448.136	439234.475	67.48	Window Sample
WS102	418446.811	439337.290	64.76	Window Sample
WS103	418405.705	439213.205	72.68	Window Sample
WS104	418674.655	439652.116	54.75	Window Sample
WS105	418741.677	439749.943	56.37	Window Sample
WS106	418507.000	439588.000	65.80	Window Sample

GENERAL NOTES

LEGEND TO SYMBOLS

- Borehole Location
- Trial Pit Location
- Window Sample Location

Scale: 1:1000

0 10m 20 40 60 80

Rev	Drawn	Date	Approv.	Date	Modification Details
x	x	x	x	x	x

AMENDMENTS

Title

SITE PLAN

Project

Esholt WwTW

Client

Yorkshire Water

Soil Mechanics

Date	Drawn By	Approv. By
09/03/05	HS	JH

Sheet Size	Scale	Project No
A1	1:1000	A4178

Figure No	Rev
F2	0

...\drawings\A4178 Site plans.dwg 25/05/2006 15:09:28

Slurry Lagoons

Slurry Lagoons

Slurry Lagoon

Track

Outfall

Water

Pipe Lines

El Sub Sta

FB

Manhole

Water

Nc

Scrub

Track

MS
Leeds 10.5 miles
Liverpool 117 miles

Canal

Conduit

PL

PL

Conduit

61.6m

Tanks

Tank

FB

Water

Path

River Aire

61.0m

56.1m

BM 62.27m

Swing
-bridge

Water

Basin

FB

Water

Scrub

Nc

Slope

Scrub

Track

FB

El Sub Sta

Tow

El Sub Sta

Nc

Scrub

Nc

Path

Nc

Esholt Hall

Pond

FB

Conif

FB

Water

Water

Conif

Scru

Nc

Track

Nc

7047

8256

8444

BM 53.04m

CORONATION AVENUE

WB

Water

Scrub

Tank

El Sub Sta

Nc

1

2

Survey Control Co-ordinates

Reference	East	North	Elevation	Description
BT01	418867.809	439200.414	53.31	Survey Station
BT02	418854.996	439271.035	55.35	Survey Station
BT03	418811.809	439295.098	55.57	Survey Station
BT04	418756.821	439292.939	53.21	Survey Station
MH01	418320.018	439343.283	61.63	Survey Station
MH02	418566.184	439352.404	59.54	Survey Station
MH03	418611.198	439470.825	56.76	Survey Station
MH04	418677.073	439505.789	54.98	Survey Station
MH05	418741.897	439746.111	56.43	Survey Station
SO1B	418328.429	439339.838	77.92	Survey Station
SO1BA	418312.735	439308.437	78.67	Survey Station
SO4A	418492.638	439502.031	61.85	Survey Station
SO4B	418536.484	439426.215	62.30	Survey Station
SO5A	418675.496	439449.241	53.93	Survey Station
SO6B	418697.268	439389.350	53.79	Survey Station
SO6C	418755.160	439384.331	55.77	Survey Station
SO12B	418901.560	439104.274	53.78	Survey Station
SO13	418845.664	439028.561	53.91	Survey Station
SO99	418408.572	439203.007	72.85	Survey Station
SO99A	418402.427	439219.363	67.70	Survey Station
SO6A1	418636.516	439573.700	55.70	Survey Station
SO6A1A	418603.640	439109.870	54.85	Survey Station
SO6A2	418548.186	439565.560	57.03	Survey Station
SO6A3	418497.439	439683.556	57.35	Survey Station
SO6D1	418808.718	439814.074	58.69	Survey Station
ST01	418561.323	439428.925	78.25	Survey Station

Borehole-Trial Pit Co-ordinates

Reference	East	North	Elevation	Description
BH101	418374.882	439470.852	78.33	Borehole
BH102	418316.131	439362.549	78.80	Borehole
BH103	418466.041	439423.990	64.71	Borehole
BH104	418486.705	439291.672	64.15	Borehole
BH106	418736.327	439402.619	55.56	Borehole
BH107	418585.161	439494.608	60.00	Borehole
BH108	418624.431	439480.866	56.41	Borehole
BH109	418658.314	439584.111	55.23	Borehole
BH110	418559.581	439421.055	62.10	Borehole
BH111	418572.577	439361.934	58.66	Borehole
BH112	418995.777	439274.355	56.51	Borehole
BH113	418939.841	439183.865	53.82	Borehole
BH114	418883.764	439185.338	53.81	Borehole
BH115	418925.446	439045.210	51.32	Borehole
BH201	418583.004	439239.123	72.90	Borehole
BH202	418440.940	439692.665	57.60	Borehole
BH203	418702.837	439319.133	53.17	Borehole
BH204	418576.280	439288.961	59.21	Borehole
BH205	418903.076	439251.231	53.05	Borehole
BH205A	418901.514	439250.821	53.10	Borehole
BH206	418539.806	439188.916	62.10	Borehole
BH208	418806.163	439151.000	53.90	Borehole
TP101	418592.684	439477.069	56.50	Trial Pit
TP102	418600.448	439489.845	56.30	Trial Pit
TP103	418651.475	439545.468	55.13	Trial Pit
TP104	418518.844	439661.763	57.91	Trial Pit
TP105	418807.613	439819.675	58.60	Trial Pit
TP106	418852.731	439872.348	61.85	Trial Pit
TP107	418854.500	439958.339	71.31	Trial Pit
TP108	418587.492	439210.932	53.00	Trial Pit
TP110	418813.010	439222.799	53.65	Trial Pit
TP111	419016.837	439219.119	55.18	Trial Pit
WS101	418448.734	439232.542	67.49	Window Sample
WS101A	418448.136	439234.475	67.48	Window Sample
WS102	418446.811	439337.290	64.76	Window Sample
WS103	418405.705	439213.206	72.68	Window Sample
WS104	418674.655	439652.116	54.75	Window Sample
WS105	418741.677	439749.943	56.37	Window Sample
WS106	418507.200	439588.000	65.80	Window Sample

GENERAL NOTES

LEGEND TO SYMBOLS

- Borehole Location
- Trial Pit Location
- Window Sample Location

Scale: 1:1000

0 10m 20 40 60 80

Rev	Drawn	Date	Approv.	Date	Modification Details
x	x	x	x	x	x

AMENDMENTS

Title: SITE PLAN

Project: Esholt WwTW

Client: Yorkshire Water

Soil Mechanics

Date	Drawn By	Approv. By
09/03/05	HS	JH

Sheet Size	Scale	Project No
A1	1:1000	A4178

Figure No	Rev
F3	0

...\drawings\A4178 Site plans.dwg 25/05/2006 15:09:56

3 2 1

NTRIFUDGE
EED TANK

CENTRIFUDGE
FEED TANK

POST THP
CENTRATE
PST

TP11/1

RELOCATED
WEIGHBRIDGE

TP11/10

POST - THP SLUDGE
STORAGE AREA

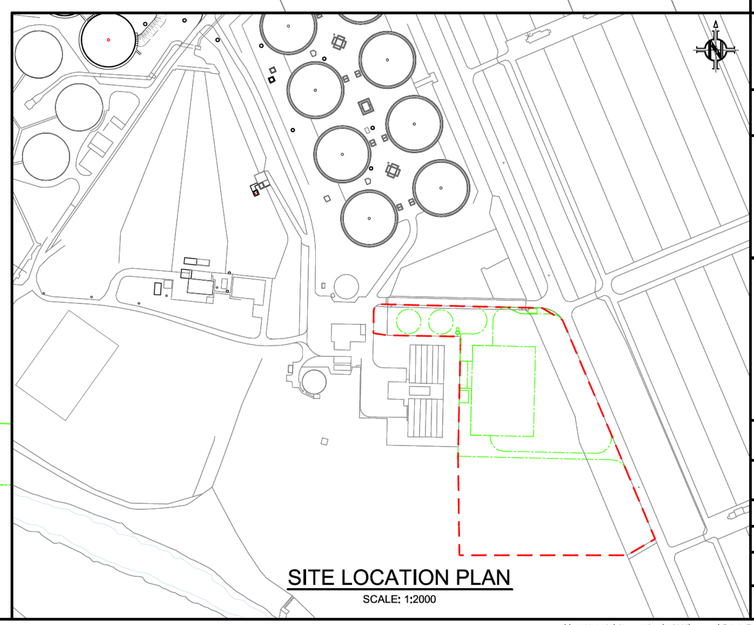
MCC 28
KIOSK

TP11/11

TP11/3

SITE PLAN
SCALE: 1:200

(100mm WHEN PRINTED AT A1)



SITE LOCATION PLAN
SCALE: 1:2000

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. ALL LEVELS ARE IN METRES RELATED TO ORDNANCE DATUM

LEGEND

- APPROXIMATE AREA FOR SITE INVESTIGATION
- BH11/20 — BOREHOLE LOCATION - 2011
- TP11/1 — TRIAL PIT LOCATION - 2011
- PROPOSED STRUCTURES /UNITS

REV	AMENDMENTS	BY	CHKD	APR'D	DATE
P2	ENVIROMENTAL PLANNING REPORT	CH			
P1	FOR INFORMATION	DJB	RJ	RDG	30.09.11

REVISIONS

MULTIDISCIPLINARY CHECK BOX

REV	DATE	CIVIL	PRO	MECH	ELEC	ICA	STRUC
P1	30.09.11	AJD	-	-	-	-	-

MORGAN SINDALL
Grontmij
JOINT VENTURE
Livingstone House, Chadwick Street, Leeds, LS10 1LJ

EMPLOYER
YORKSHIRE WATER SERVICES LTD.

YWS PROJECT NO.
D0104

YWS PROJECT TITLE / SITE
ESHOLT SLUDGE STRATEGY

TITLE
FIGURE 9
EXPLORATORY HOLE
LOCATION PLAN
CAKE STORAGE AREA

CATEGORY
MULTI-DISCIPLINE

STATUS
INVESTIGATION

DRAWN	CHECKED	APPROVED
R. Ebbs	R. Jones	R.D. Grant
DATE: August 2011	DATE: 30.09.11	DATE: 30.09.11

DRAWING SCALE: AS SHOWN
ORIGINAL DRAWING SIZE: 594 x 841 - A1

DRAWING No: 2011-D0104-01-06-3001-9
REV.: P2

\\ukgldsdat01\ShareNetData\IJ3060\nonproj\Esholt THP\Drawings\2007-3001\2011-D0104-01-06-3001-9 BH location plan cake storage area.dwg

BH11/9

BH11/13

TP1

TP2

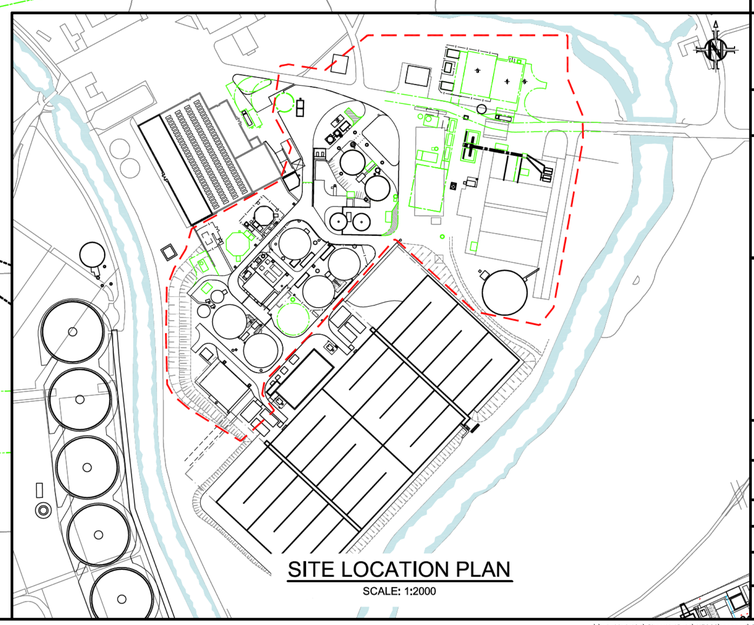
TP3

BH11/10

BH11/5

BH11/4

SITE PLAN
SCALE: 1:200



SITE LOCATION PLAN
SCALE: 1:2000

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. ALL LEVELS ARE IN METRES RELATED TO ORDNANCE DATUM

LEGEND

PROPOSED STRUCTURES / UNITS

BH11/1 BOREHOLE LOCATION - 2011

PROPOSED STRUCTURES /UNITS

REV	DESCRIPTION	ORIG	CHKD	APR'D	DATE
P1	FOR INFORMATION	RE	ND	ND	DEC.11

REVISIONS

MULTIDISCIPLINARY CHECK BOX

REV	DATE	CIVIL	PRO	MECH	ELEC	STRUC	

MORGAN SINDALL Grontmij

JOINT VENTURE

Livingstone House, Chadwick Street, Leeds, LS10 1LJ

EMPLOYER

YORKSHIRE WATER SERVICES LTD.

YWS PROJECT NO.

D0104

YWS PROJECT TITLE / SITE

ESHOLT BIO-ENERGY PLANT
BRADFORD ESHOLT/No2 STF

TITLE

FIGURE 6
EXPLORATORY HOLE LOCATION PLAN - MAIN SITE

CATEGORY

N/A

STATUS

OUTLINE DESIGN

ORIGINATOR	CHECKED	APPROVED
RE	ND	ND
DRAWN	DATE	DATE
RE	DEC. 11	DEC. '11

DRAWING SCALE	ORIGINAL DRAWING SIZE
AS SHOWN	594 x 841 - A1

DRAWING No	REV.
2011-D0104-01-06-3002-6	1

(100mm WHEN PRINTED AT A1)

\\ukgldsdat01\ShareNetData\U3060\nonproj\Esholt THP\Drawings\2007-3002\2011-D0104-01-06-3002-6 BH Location plan main site.dwg

Appendix 6 BAT Assessment

BAT No.	Topic	Brief Description	BAT	Applicable BAT- AEL	Compliant now?	Derogation needed?	Provide brief comments on how compliance with BAT is (or will be) achieved Where "N/A" or "other" is given, please explain why
General BAT conclusions							
1	Overall performance	EMS *Applicability* The scope (e.g. level of detail) and nature of the EMS (e.g. standardised or non-standardised) will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have (determined also by the type and amount of wastes processed).	In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features:				
			i) commitment of the management, including senior management;		Yes	No	Yes, this is an integral part of the ISO 14001 system. Refer to Section III: Supporting Information, Form C2, Question 3d Management systems
			ii) definition, by the management, of an environmental policy that includes the continuous improvement of the environmental performance of the installation;		Yes	No	Yes, this is an integral part of the ISO 14001 system. Refer to Section III: Supporting Information, Form C2, Question 3d Management systems
			iii) planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment;		Yes	No	Yes, this is an integral part of the ISO 14001 system. Refer to Section III: Supporting Information, Form C2, Question 3d Management systems
			iv) implementation of procedures paying particular attention to: (a) structure and responsibility, (b) recruitment, training, awareness and competence (c) communication, (d) employee involvement, (e) documentation, (f) effective process control, (g) maintenance programmes, (h) emergency preparedness and response, (i) safeguarding compliance with environmental legislation;		Yes	No	Yes, this is an integral part of the ISO 14001 system. Refer to Section III: Supporting Information, Form C2, Question 3d Management systems
			v) checking performance and taking corrective action, paying particular attention to: (a) monitoring and measurement (see also the JRC Reference Report on Monitoring of emissions to air and water from IED installations – ROM), (b) corrective and preventive action, (c) maintenance of records, (d) independent (where practicable) internal or external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;		Yes	No	Yes, this is an integral part of the ISO 14001 system. Refer to Section III: Supporting Information, Form C2, Question 3d Management systems
			vi) review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness;		Yes	No	Yes, this is an integral part of the ISO 14001 system. Refer to Section III: Supporting Information, Form C2, Question 3d Management systems
			vii) following the development of cleaner technologies;		Yes	No	The Innovations Team at YW undertakes regular monitoring and review of new and innovative technologies and equipment to ensure the business continually improves its operations and activities. This includes consideration of cleaner technologies and improved environmental performance. Refer to Section III: Supporting Information, Form C2, Question 3d Management systems
			viii) consideration for the environmental impacts from the eventual decommissioning of the plant at the stage of designing a new plant, and throughout its operating life;		Yes	No	Yes, this is an integral part of the ISO 14001 system. Refer to Section III: Supporting Information, Form C2, Question 3d Management systems. See also see Section V: Appendix 5 Site Condition Report.
			ix) application of sectoral benchmarking on a regular basis;		Yes	No	Yes, sectoral and cross-sector benchmarking also takes place as required. Refer to Section III: Supporting Information, Form C2, Question 3d Management systems
			x) waste stream management (see BAT 2);		Yes	No	ISO 14001 system. Refer to Section III: Supporting Information, Form C2, Question 3d Management systems. See also BAT 2 below.
			xi) an inventory of waste water and waste gas streams (see BAT 3);		Yes	No	Refer to Section III: Supporting Information, Form C3, Question 2 Point source emissions to air, water and land. See also BAT 3 below. YW is committed to undertake a period of monitoring to further characterise process liquors returned to Esholt WwTW and therefore no long term derogation is required. YW is committed to refurbish OCUs at Esholt (refer to BAT 8 and 34). A programme of ongoing monitoring of the OCUs will be undertaken after this work has been completed and therefore no long term derogation is required.
			xii) residues management plan (see description in Section 6.5);		Yes	No	Yes, this is an integral part of the ISO 14001 system. Refer to Section III: Supporting Information, Form C2, Question 3d Management systems and also information provided in response to Form C3, Question 6.
			xiii) accident management plan (see description in Section 6.5);		Yes	No	This is provided in response to Section III: Supporting Information, Form C2, Question 6-7
2	Overall performance	Improvement of overall environmental performance	In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.				
			a) Set up and implement waste characterisation and pre-acceptance procedures		Yes	No	Refer to Appendix 13 Waste pre-acceptance, acceptance and rejection Procedure. All sludges arriving at Esholt STF are either indigenous primary and secondary sludges from Esholt WwTW or imported sludge from other YW sites. The volume, % dry solids and source of imports to the site is recorded by WaSP loggers.
			b) Set up and implement waste acceptance procedures		Yes	No	Refer to Appendix 13 Waste pre-acceptance, acceptance and rejection Procedure. All sludges arriving at Esholt STF are either indigenous primary and secondary sludges from Esholt WwTW or imported sludge from other YW sites. The volume, % dry solids and source of imports to the site is recorded by WaSP loggers.
			c) Set up and implement a waste tracking system and inventory		Yes	No	Refer to Section II: Technical Description and Section III: Supporting Information, Form C2, Question 3d Management systems and comments noted above. The volume and source of imports to the site is recorded by WaSP loggers.
			d) Set up and implement an output quality management system		Yes	No	Refer to Section II: Technical Description and Section III: Supporting Information, Form C2, Question 3d Management systems. HACCP processes are in place to manage and maintain the quality of digested sludge to ensure its suitability for land spreading.
			e) Ensure waste segregation		N/A (explain)	No	Waste received on site comprises only sewage sludge. Waste segregation, sorting and waste compatibility considerations are not relevant
			f) Ensure waste compatibility prior to mixing or blending of waste		N/A (explain)	No	Waste received on site comprises only sewage sludge. Waste segregation, sorting and waste compatibility considerations are not relevant
			g) Sort incoming solid waste		N/A (explain)	No	Waste received on site comprises only sewage sludge. Waste segregation, sorting and waste compatibility considerations are not relevant
3	Overall performance	Inventory *Applicability* The scope (e.g. level of detail) and nature of the inventory will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have (determined also by the type and	In order to facilitate the reduction of emissions to water and air, BAT is to establish and to maintain an inventory of waste water and waste gas streams, as part of the environmental management system (see BAT 1), that incorporates all of the following features:				
			(i) information about the characteristics of the waste to be treated and the waste treatment processes, including: (a) simplified process flow sheets that show the origin of the emissions; (b) descriptions of process-integrated techniques and waste water/waste gas treatment at source including their performances;		Yes	No	Refer to Section II: Technical Description and Section III: Supporting Information, Form C3, Question 2 Point source emissions to air, water and land.

BAT No.	Topic	Brief Description	BAT	Applicable BAT- AEL	Compliant now?	Derogation needed?	Provide brief comments on how compliance with BAT is (or will be) achieved Where "N/A" or "other" is given, please explain why
General BAT conclusions							
		amount of wastes processed).	(ii) information about the characteristics of the waste water streams, such as: (a) average values and variability of flow, pH, temperature, and conductivity; (b) average concentration and load values of relevant substances and their variability (e.g. COD/TOC, nitrogen species, phosphorus, metals, priority substances/micropollutants); (c) data on bioeliminability (e.g. BOD, BOD to COD ratio, Zahn-Wellens test, biological inhibition potential (e.g. inhibition of activated sludge)) (see BAT 52);		Other (explain)	No	All liquor from sludge thickening and dewatering processes, condensate (e.g. from biogas handling), cleaning / washdown effluent and most surface water runoff (with the exception of some roofwater discharged to soakaway) is collected and discharged via underground drainage systems to Esholt WwTW for full treatment prior to discharge to the River Aire. As both Esholt STF and Esholt WwTW are owned and operated by YW, separate monitoring of Esholt STF discharges has not been necessary or required under any permitting regime. YW do not currently undertake any routine monitoring of these discharges (other than checks for process control purposes). YW recognises that there is a change in permitting regime and therefore commits to undertake initially a one-off programme of monitoring return liquors from emissions points S1, S2 and S3, in order to obtain further information about the characteristics of the waste streams. The monitoring programme will comprise collection of wastewater samples from each emission point over a 12 month period. Further information is provided in response to Form C2, Question 6-8.
			(iii) information about the characteristics of the waste gas streams, such as: (a) average values and variability of flow and temperature; (b) average concentration and load values of relevant substances and their variability (e.g. organic compounds, POPs such as PCBs); (c) flammability, lower and higher explosive limits, reactivity; (d) presence of other substances that may affect the waste gas treatment system or plant safety (e.g. oxygen, nitrogen, water vapour, dust).		Other (explain)	No	Refer to Section III: Supporting Information, Form C3, Question 2 Point source emissions to air, water and land. YW is committed to refurbish OCUs at Esholt (refer to BAT 34). A programme of ongoing monitoring of the OCUs will be undertaken after this work has been completed and therefore no long term derogation is required.
4	Overall performance	Techniques for storage of waste	In order to reduce the environmental risk associated with the storage of waste, BAT is to use all of the techniques given below.				
			a) Optimised storage location		Yes	No	Refer to Section II: Technical Description and Section III: Supporting Information, Form C3, Question 6e Describe how you avoid producing waste in line with Council Directive 2008/98/EC on waste. Waste materials are stored on site for the minimum period of time, in suitable, fit for purpose containers located on areas of hardstanding and away from sensitive receptors.
			b) Adequate storage capacity		Yes	No	Refer to Section II: Technical Description and Section III: Supporting Information, Form C3, Question 6e Describe how you avoid producing waste in line with Council Directive 2008/98/EC on waste. Waste materials are stored on site for the minimum period of time, in suitable, fit for purpose containers located on areas of hardstanding and away from sensitive receptors.
			c) Safe storage operation		Yes	No	Refer to Section II: Technical Description and Section III: Supporting Information, Form C3, Question 6e Describe how you avoid producing waste in line with Council Directive 2008/98/EC on waste. Waste materials are stored on site for the minimum period of time, in suitable, fit for purpose containers located on areas of hardstanding and away from sensitive receptors.
			d) Separate area for storage and handling of packaged hazardous waste		Yes	No	Refer to Section II: Technical Description and Section III: Supporting Information, Form C3, Question 6e Describe how you avoid producing waste in line with Council Directive 2008/98/EC on waste. Very limited quantities of hazardous waste are generated by site activities. These are segregated and stored in suitable, fit for purpose containers.
5	Overall performance	Techniques for handling and transfer of waste	In order to reduce the environmental risk associated with the handling and transfer of waste, BAT is to set up and implement handling and transfer procedures.		Yes	No	Refer to Section II: Technical Description and Section III: Supporting Information, Form C3, Question 6e Describe how you avoid producing waste in line with Council Directive 2008/98/EC on waste and Section III: Supporting Information, Form C2, Question 3d Management systems. Waste procedures are included within the YW management system and training is provided to staff as required.
6	Monitoring	Waste water - Monitor key parameters	For relevant emissions to water as identified by the inventory of waste water streams (see BAT 3), BAT is to monitor key process parameters (e.g. waste water flow, pH, temperature, conductivity, BOD) at key locations (e.g. at the inlet and/or outlet of the pre-treatment, at the inlet to the final treatment, at the point where the emission leaves the installation).		Other (explain)	No	No direct emissions to water other than small quantities of clean roof water runoff which is discharged to soakaway. No wastewater treatment is undertaken within the installation boundary. Wastewater is returned to Esholt WwTW for full treatment prior to discharge. In respect of characterisation monitoring for return liquors refer to commitments made in BAT 3 above and Section III: Supporting Information, Form C2, Question 6-8.
7	Monitoring	Waste water - Monitoring frequencies and standards	BAT is to monitor emissions to water with at least the frequency given below, and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	See 'Water emissions tables' tab	Other (explain)	No	All liquor from sludge thickening and dewatering processes, condensate (e.g. from biogas handling), cleaning / washdown effluent and most surface water runoff (with the exception of some roofwater discharged to soakaway) is collected and discharged via underground drainage systems to Esholt WwTW for full treatment prior to discharge to the River Aire. As both Esholt STF and Esholt WwTW are owned and operated by YW, separate monitoring of Esholt STF discharges has not been necessary or required under any permitting regime. YW do not currently undertake any routine monitoring of these discharges (other than checks for process control purposes). YW recognises that the inventory of emissions to sewer is currently incomplete and commits to undertake the sampling and analysis of effluent discharged to Esholt WwTW in line with BAT3 requirements. This emissions characterisation programme will be carried out by sampling every month for a 12-month period in order to fully characterise wastewater emissions. Further information is provided in response to Form C2, Question 6-8. The data will be used to undertake an environmental impact assessment in accordance with Environment Agency guidance. The findings of the monitoring, analysis and impact assessment will be provided to the Environment Agency within 18 months of permit issue. Requirements for ongoing monitoring will be established after this has been completed.
8	Monitoring	Channelled air emissions - Monitoring frequencies and standards	BAT is to monitor channelled emissions to air with at least the frequency given below, and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	See 'Air emissions tables' tab	Yes	No	Refer to Appendix 10 - Odour Management Plan in respect of monitoring provisions (olfactometric and process). YW is committed to refurbish the OCUs at Esholt (refer to BAT 34). A programme of ongoing monitoring of the OCUs will be undertaken after this work has been completed and therefore no long term derogation is required. This monitoring will be undertaken in accordance with BAT 8 requirements and will include emissions monitoring at all OCU stacks on a 6-monthly basis.
9	Monitoring	Diffuse emissions - Monitor organic compounds	BAT is to monitor diffuse emissions of organic compounds to air from the regeneration of spent solvents, the decontamination of equipment containing POPs with solvents, and the physico-chemical treatment of solvents for the recovery of their calorific value, at least once per year using one or a combination of the techniques given below.		N/A (explain)	NA	Relevant activities are not carried out at this site.
			a) Measurement		N/A (explain)	NA	Relevant activities are not carried out at this site.
			b) Emissions factors		N/A (explain)	NA	Relevant activities are not carried out at this site.
			c) Mass balance		N/A (explain)	NA	Relevant activities are not carried out at this site.
10	Monitoring	Odour - Monitor emissions *Applicability* The applicability is restricted to cases where an odour nuisance at sensitive receptors is expected and/or has been substantiated.	BAT is to periodically monitor odour emissions. (The monitoring frequency is determined in the odour management plan (see BAT 12).)		Other (explain)	No	Refer to Appendix 10 Odour Management Plan which provides details of the proposed programme of sniff testing.
11	Monitoring	Monitor annual consumption and generation of waste outputs	BAT is to monitor the annual consumption of water, energy and raw materials as well as the annual generation of residues and waste water, with a frequency of at least once per year.		Yes	No	Refer to Section II: Technical Description and Section III: Supporting Information, Form C2, Question 3d Management systems (sub-section 'Monitoring') and Form C3, Questions 6a, b, c, d and e

BAT No.	Topic	Brief Description	BAT	Applicable BAT- AEL	Compliant now?	Derogation needed?	Provide brief comments on how compliance with BAT is (or will be) achieved Where "N/A" or "other" is given, please explain why
General BAT conclusions							
12	Emissions to air	Odour Management Plan *Applicability* The applicability is restricted to cases where an odour nuisance at sensitive receptors is expected and/or has been substantiated.	In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an odour management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements: — a protocol containing actions and timelines; — a protocol for conducting odour monitoring as set out in BAT 10; — a protocol for response to identified odour incidents, e.g. complaints; —an odour prevention and reduction programme designed to identify the source(s); to characterise the contributions of the sources; and to implement prevention and/or reduction measures.		Yes	No	Refer to Appendix 10 Odour Management Plan
13	Emissions to air	Odour reduction techniques	In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to use one or a combination of the techniques given below.		Yes	No	Refer to Appendix 10 Odour Management Plan
			a) Minimising residence times		Yes	No	Refer to Appendix 10 Odour Management Plan
			b) Using chemical treatment		Yes	No	Refer to Appendix 10 Odour Management Plan. Chemical treatment is not routinely used but could be considered in order to respond to an abnormal / significant odour issue.
			c) Optimising aerobic treatment		N/A (explain)	NA	Relevant activities are not carried out at this site.
14	Emissions to air	Diffuse emission reduction techniques	In order to prevent or, where that is not practicable, to reduce diffuse emissions to air, in particular of dust, organic compounds and odour, BAT is to use an appropriate combination of the techniques given below. Depending on the risk posed by the waste in terms of diffuse emissions to air, BAT 14d is especially relevant.				
			a) Minimising the number of potential diffuse emission sources		Yes	No	Refer to Appendix 14 LDAR procedure and also Section II: Technical Description, Section III Supporting Information, Form C3, Question 3b General Requirements – LDAR programme, Section V: Appendix 8 Odour Risk Assessment, and Section V: Appendix 10 Odour Management Plan.
			b) Selection and use of high- integrity equipment		Yes	No	Plant is compliant with YW engineering standards and subject to ongoing formal inspection and maintenance regimes.
			c) Corrosion prevention		Yes	No	Plant is compliant with YW engineering standards and subject to ongoing formal inspection and maintenance regimes.
			d) Containment, collection and treatment of diffuse emissions		Other (explain)	No	Some, but not all, odour sources on site are covered and contained and meet the requirements of BAT 14d. The use of enclosed equipment or buildings for control of diffuse odour emissions from secondary maturation of digested cake on the cake pad is constrained by the volume of waste. YW commits to a series of improvements to meet BAT 14d requirements; these are listed in Proposed Improvement Programme section of the main application document.
			e) Dampening		N/A (explain)	NA	Materials are already wet or liquid
			f) Maintenance		Yes	No	Planned maintenance systems in place. Refer to Appendix 14 LDAR procedure and also Section II: Technical Description and Section III: Supporting Information, Form C2, Question 3d Management systems.
			g) Cleaning of waste treatment and storage areas		Yes	No	Regular cleaning is undertaken, where required and appropriate
			h) Leak detection and repair (LDAR) programme		Yes	No	Refer to Appendix 14 LDAR procedure and also Form C3, Question 3b General Requirements – LDAR programme
15	Emissions to air	Flare use minimisation techniques	BAT is to use flaring only for safety reasons or for non-routine operating conditions (e.g. start-ups, shutdowns) by using both of the techniques given below.				
			a) correct plant design		Yes	No	Refer to Section II: Technical Description (sub-section Biogas Storage and Use)
			b) Plant management		Yes	No	Refer to Section II: Technical Description (sub-section Biogas Storage and Use)
16	Emissions to air	Flare emissions minimisation techniques	In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use both of the techniques given below.				
			a) Correct design of flaring devices		Yes	No	Refer to Section II: Technical Description (sub-section Biogas Storage and Use)
			b) Monitoring and recording as part of flare management		Yes	No	Refer to Form C3, Question 4 Monitoring, Table C3: 4a-1 and 4a-2 .
17	Noise and vibrations	Noise management plan *Applicability* The applicability is restricted to cases where a noise or vibration nuisance at sensitive receptors is expected and/or has been substantiated.	In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to set up, implement and regularly review a noise and vibration management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:		N/A (explain)	NA	Noise or vibration nuisance at sensitive receptors is not expected and no substantiated noise and vibration nuisance complaints have been received. Noise and vibration management plan not required. Refer to Section V: Appendix 9 - Noise impact assessment. Complaints handling and response procedures are in place – refer to Section III: Supporting Information, Form C2, Question 3d Management systems.
			i) a protocol containing appropriate actions and timelines;		N/A (explain)	NA	See above
			ii) a protocol for conducting noise and vibration monitoring;		N/A (explain)	NA	See above
			iii) a protocol for response to identified noise and vibration events, e.g. complaints;		N/A (explain)	NA	See above
			iv) a noise and vibration reduction programme designed to identify the source(s), to measure/estimate noise and vibration exposure, to characterise the contributions of the sources and to implement prevention and/or reduction measures.		N/A (explain)	NA	See above
18	Noise and vibrations	Noise and vibration reduction techniques	In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to use one or a combination of the techniques given below.		Yes	No	Noise is minimised using a combination of techniques appropriate to the nature of installation activities and the risk of noise nuisance. Refer to Section V: Appendix 9 Noise impact assessment.
			a) Appropriate location of equipment and buildings		Yes	No	See above.
			b) Operational measures		Yes	No	See above
			c) Low-noise equipment		Yes	No	See above
			d) Noise and vibration control equipment		Yes	No	See above
			e) noise attenuation		Yes	No	See above
19	Emissions to water	Water management techniques	In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques given below.				
			a) water management		Yes	No	Measures are in place to ensure that water is used only where necessary, and preference is given to the use of final treated effluent rather than mains water. Refer to Section III: Supporting Information, Form C3, Question 6d Explain and justify the raw and other materials, other substances and water that you will use.
			b) water recirculation		N/A (explain)	No	Relevant activities are not carried out at this site. Measures are in place to ensure that water is used only where necessary, and preference is given to the use of final treated effluent rather than mains water.
			c) impermeable surface		Yes	No	For details of techniques to minimise accidental/unplanned discharges to the environment from surfacing, storage areas, tanks, vessels, drainage systems etc refer to the Accident Management Plan (Form C2, Q 6-7), Appendix 5: Site Condition Report and Appendix 11: Secondary Containment Risk Assessment.

BAT No.	Topic	Brief Description	BAT	Applicable BAT- AEL	Compliant now?	Derogation needed?	Provide brief comments on how compliance with BAT is (or will be) achieved Where "N/A" or "other" is given, please explain why
General BAT conclusions							
			d) Techniques to reduce the likelihood and impact of overflows and failures from tanks and vessels		Other (explain)	No	Refer to Appendix 11 Secondary Containment Risk Assessment. A secondary containment risk assessment has been undertaken to assess whether existing measures to protect the environment in the event of a failure of containment of primary storage tanks are adequate. This study has identified that some additional mitigation measures are required in order to enhance environmental protection for the identified sensitive receptors. YW will implement the required improvements in order to meet BAT 19d requirements, and therefore no long term derogation is necessary.
			e) Roofing of waste storage and treatment areas		Other (explain)	No	Digested sludge cake is transferred from the centrifuges onto the cake pad. One of the cake pads is covered with cake barn roof water (clean rainwater runoff) discharged to a soakaway. The second cake pad is not covered, but engineered to direct run-off generated (during periods of rainfall), via return liquor flows, to the Esholt WwTW for full treatment. This treatment provision is considered adequate and negates the need to cover the cake pad for the purpose of run-off reduction.
			f) Segregation of water streams		Other (explain)	No	In order to reduce pollution risks most rainwater runoff is collected and returned to Esholt WwTW for treatment (with the exception of some clean roof water runoff which is discharged to soakaway) in addition to process liquors and cleaning washwater etc. Roofwater runoff is limited due to small number/surface area of buildings within the installation boundary. Refer to Section II: Technical Description, Section III: Supporting Information, Form C3, Question 2 Point source emissions to air, water and land and Figure 4 Drainage Plan.
			g) Adequate drainage infrastructure		Yes	No	All process liquors, cleaning washwater and surface water runoff from the site (with the exception of limited areas of roofwater runoff which is discharged to soakwaway) are returned to Esholt WwTW for treatment. Refer to Section III: Supporting Information, Form C3, Question 2 Point source emissions to air, water and land and Figure 4 Drainage Plan.
			h) Design and maintenance provisions to allow detection and repair of leaks		Yes	No	Measures are in place for the protection of land and groundwater during operation of the permit - refer to Appendix 11 Secondary Containment Risk Assessment. This study has identified that some additional mitigation measures are required in order to enhance environmental protection for the identified sensitive receptors. YW will implement the required improvements in order to meet BAT 19h requirements, and therefore no long term derogation is necessary.
			i) Appropriate buffer storage capacity		Yes	No	Wastewater is returned for treatment at the co-located Esholt WwTW where there is adequate buffer storage capacity.
20	Emissions to water	Water emission reduction techniques	In order to reduce emissions to water, BAT is to treat waste water using an appropriate combination of the techniques given below.	See 'Water emissions tables' tab			Process liquor, including most surface water runoff is directed to Esholt WwTW for full treatment. Refer to Section II: Technical Description and Section III: Supporting Information, Form C3, Question 2 Point source emissions to air, water and land
			a) equalisation		Yes	No	Wastewater flow from the STF is mixed with UWwTD wastewater (outside of the installation in the wider WwTW), providing adequate balancing of flow and composition.
			b) neutralisation		Yes	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			c) Physical separation, e.g. screens, sieves, grit separators, grease separators, oil-water separation or primary settlement tanks		Yes	No	Sludge screens are located within the STF. UWWTD flow is screened at Esholt WwTW.
			d) adsorption		N/A (explain)	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			e) distillation/rectification		N/A (explain)	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			f) precipitation		N/A (explain)	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			g) chemical oxidation		N/A (explain)	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			h) chemical reduction		N/A (explain)	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			i) evaporation		N/A (explain)	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			j) ion exchange		N/A (explain)	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			k) stripping		N/A (explain)	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			l) activated sludge process		Yes	No	Undertaken at Esholt WwTW
			m) membrane bioreactor		N/A (explain)	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			n) Nitrification/denitrification when the treatment includes a biological treatment		Yes	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			o) coagulation and flocculation		N/A (explain)	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			p) sedimentation		Yes	No	Primary settlement tanks at Esholt WwTW enable solids settlement to occur.
			q) Filtration (e.g. sand filtration, microfiltration, ultrafiltration)		N/A (explain)	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
			r) floatation		N/A (explain)	No	Not applicable - treatment processes in place ensure that discharge permit conditions are met.
21	Emissions from accidents and incidents	Prevention and limitation techniques	In order to prevent or limit the environmental consequences of accidents and incidents, BAT is to use all of the techniques given below, as part of the accident management plan (see BAT 1).		Yes	No	Refer to Accident Management Plan Table C2: 6-7.
			a) protection measures		Yes	No	Refer to Accident Management Plan Table C2: 6-7.
			b) Management of incidental/accidental emissions		Yes	No	Refer to Accident Management Plan Table C2: 6-7.
			c) Incident/accident registration and assessment system		Yes	No	Refer to Accident Management Plan Table C2: 6-7.
22	Material efficiency	Material efficiency *Applicability* Some applicability limitations derive from the risk of contamination posed by the presence of impurities (e.g. heavy metals, POPs, salts, pathogens) in the waste that substitutes other materials. Another limitation is the compatibility of the waste substituting other materials with the waste input (see BAT 2).	In order to use materials efficiently, BAT is to substitute materials with waste.		Yes	No	Opportunities to substitute materials with waste are very limited. However, treated final effluent is used in preference to mains water supply wherever feasible. Refer also to Section III: Supporting Information, Form C3, Question 6e.
23	Energy efficiency	Energy efficiency techniques	In order to use energy efficiently, BAT is to use both of the techniques given below.		Yes	No	Refer to Section III: Supporting Information, Form C3, Question 6a and 6b
			a) energy efficient plant		Yes	No	Refer to Section III: Supporting Information, Form C3, Question 6a and 6b
			b) energy balance record		Yes	No	Refer to Section III: Supporting Information, Form C3, Question 6a and 6b
24	Reuse of packaging	Reuse of packaging *Applicability* Some applicability restrictions derive from the risk of contamination of the waste posed by the reused packaging.	In order to reduce the quantity of waste sent for disposal, BAT is to maximise the reuse of packaging, as part of the residues management plan (see BAT 1).		Yes	No	Limited opportunities exist as packaging waste arisings are very low. Refer to Section III: Supporting Information, Form C3, Question 6e for further information about residues management
General BAT conclusions for the biological treatment of waste							
33	Overall performance		In order to reduce odour emissions and to improve the overall environmental performance, BAT is to select the waste input.		Yes	No	Waste is only received from YW WwTW sites. Refer to Section II: Technical Description and Section III: Supporting Information, Form C2, Question 3d Management systems. Refer also to BAT 2 above.
34	Emissions to air		In order to reduce channelled emissions to air of dust, organic compounds and odorous compounds, including H2S and NH3, BAT is to use one or a combination of the techniques given below.	See 'Air emissions tables' tab	Other (explain)	No	YW commits to a series of improvements to reduce channelled emissions to air, including refurbishing and reinstating OCUs at Esholt STF; these are listed in Proposed Improvement Programme section of the main application document. This work will be completed by the end of 2024. OCU process and emissions monitoring will be undertaken in compliance with accordance with BAT 8 requirements.
			a) adsorption - see table 6.1		Yes	No	See above
			b) biofilter - see table 6.1		Yes		See above

BAT No.	Topic	Brief Description	BAT	Applicable BAT- AEL	Compliant now?	Derogation needed?	Provide brief comments on how compliance with BAT is (or will be) achieved Where "N/A" or "other" is given, please explain why
General BAT conclusions							
			c) fabric filter - see table 6.1		N/A (explain)		See above
			d) thermal oxidation - see table 6.1		N/A (explain)		See above
			e) wet scrubbing - see table 6.1		N/A (explain)		See above
35	Emissions to water and usage		In order to reduce the generation of waste water and to reduce water usage, BAT is to use all of the techniques given below.				
			a) segregation of water streams		Yes	No	Treated final effluent is used in preference to mains water supply wherever feasible. Surface water runoff is limited and is directed to Esholt WwTW for full treatment prior to discharge.
			b) water recirculation		Yes	No	Wastewater is minimised within the constraints of existing plant. Treated final effluent is used in preference to mains water supply wherever feasible.
			c) minimisation of the generation of leachate		Yes	No	Digested sludge is dewatered using centrifuges in order to minimise leachate generation from digested sludge cake. Sludge is contained within tanks and pipework at all other times.
BAT conclusions for the aerobic treatment of waste							
36	Overall environmental performance	control key waste and process parameters	In order to reduce emissions to air and to improve the overall environmental performance, BAT is to monitor and/or control the key waste and process parameters.		N/A (explain)	NA	Relevant activities are not carried out at this site.
37	Odour and diffuse emissions to air	reduce diffuse emissions to air of dust, odour and bioaerosols	In order to reduce diffuse emissions to air of dust, odour and bioaerosols from open-air treatment steps, BAT is to use one or both of the techniques given below.		N/A (explain)	NA	Relevant activities are not carried out at this site.
			a) use of semipermeable membrane covers		N/A (explain)	NA	Relevant activities are not carried out at this site.
			b) adaptation f operations to the meteorological conditions		N/A (explain)	NA	Relevant activities are not carried out at this site.
BAT conclusions for the anaerobic treatment of waste							
38	Emissions to air	Monitor and control key waste and process parameters	In order to reduce emissions to air and to improve the overall environmental performance, BAT is to monitor and/or control the key waste and process parameters.		Yes	No	YW carries out an extensive level of process monitoring (Refer to Section II: Technical Description and Section III: Form C3, Question 4a: Monitoring Table C3: 4a-2 Key process monitoring provision). Digester process operation is controlled, including control of foaming (refer to Section II: Technical Description, 'sludge digestion' sub-section). Process monitoring parameters for the OCU are established in the Odour Management Plan.
BAT conclusions for the mechanical biological treatment (MBT) of waste							
39	Emissions to air	Segregation and recirculation of waste gas streams	In order to reduce emissions to air, BAT is to use both of the techniques given below.		N/A (explain)	NA	Relevant activities are not carried out at this site.
			a) segregation of the waste gas streams		N/A (explain)	NA	Relevant activities are not carried out at this site.
			b) recirculation of waste gas		N/A (explain)	NA	Relevant activities are not carried out at this site.
BAT conclusions for the physico-chemical treatment of solid and/or pasty waste							
40	Monitor waste input	Monitoring of content of wastes during pre-acceptance and acceptance	In order to improve the overall environmental performance, BAT is to monitor the waste input as part of the waste pre-acceptance and acceptance procedures (see BAT 2).		N/A (explain)	NA	Relevant activities are not carried out at this site.
41	Emissions to air	Abatement systems and BAT-AELS	In order to reduce emissions of dust, organic compounds and NH3 to air, BAT is to apply BAT 14d and to use one or a combination of the techniques given below.	See 'Air emissions tables' tab	N/A (explain)	NA	Relevant activities are not carried out at this site.
			a) adsorption - see section 6.1				
			b) biofilter - see section 6.1				
			c) fabric filter - see section 6.1				
			d) wet scrubbing - see section 6.1				

Appendix 7 Air Quality Risk Assessment

Esholt Wastewater Treatment Works

Air Emissions Risk Assessment

On behalf of

Yorkshire Water

Project Ref:331001762/100.2101 | Rev: Final | Date: Jan 2023

Registered Office: Buckingham Court Kingsmead Business Park, London Road, High Wycombe, Buckinghamshire, HP11 1JU
Office Address: 10 Queen Square, Bristol, BS1 4NT
T: +44 (0)117 332 7840 E: PBA.Bristol@stantec.com

Document Control Sheet

Project Name: **Esholt Air Emissions Risk Assessment**

Project Ref: **331001762/100.2101**

Report Title: **Air Emissions Risk Assessment**

Doc Ref: **Final**

Date: **January 2023**

	Name	Position	Signature	Date
Prepared by:	Daniel Francis	Air Quality Consultant	D.F	Jan 2023
Reviewed by:	Laura Smart	Senior Air Quality Consultant	LS	Jan 2023
Approved by:	Philip Branchflower	Senior Associate	PB	Jan 2023
For and on behalf of Stantec UK Limited				

Revision	Date	Description	Prepared	Reviewed	Approved
Draft	Jan 2023	Draft for client comment	DF	LS	PB
Final	Jan 2023	Final	DF	LS	PB
Amendment	Jan 2023	Final with amendments	DF	LS	PB

Contents

Tables

Appendices

1 Introduction

1.1 Background

1.1.1 Yorkshire Water Services Ltd has commissioned Stantec UK Ltd (Stantec) to undertake an Air Emission Risk Assessment (AERA) to support the Environmental Permit (EP) application under the Industrial Emissions Directive (IED) for Anaerobic Digestion activities at Esholt Wastewater Treatment Works (WWTW).

1.1.2 The Installation is located within the administrative boundary of City of Bradford Metropolitan District Council (CoBMDC). The location of the Site is shown in **Figure 1, Appendix E**.

1.1.3 The Installation includes combustion plant comprising four Combined Heat and Power (CHP) plant units (4 x biogas, proposed 3 x biogas and 1 x natural gas), one non- combustion waste heat recovery boiler and two combustion boilers that are currently fuelled primarily with gas oil and biogas backup, but proposed to be replaced with natural gas with biogas backup fuel; further details are provided in the permit application.

1.2 Report Scope

1.2.1 The scope of the assessment is limited to the point source combustion emissions to air at the Installation (as defined above). Consistent with Environment Agency (EA) guidance (Environment Agency, 2021), for a gas engine fired on biogas, the principal release of oxides of nitrogen (NOx) have been assessed alongside sulphur dioxide (SO_2) due to the potential sulphur content of biogas.

1.2.2 Emissions of NOx (in the form of nitrogen dioxide (NO_2)) and SO_2 have been assessed against the relevant Air Quality Standards for NO_2 and SO_2 for the protection of human health. An assessment has also been carried out against the relevant Critical Levels (C_{Le}) for NOx and SO_2, and Critical Loads (C_{Lo}) for nitrogen and acid deposition which are designed for the protection of designated ecological sites.

1.2.3 This report outlines the approach, methodology and results of the AERA that has been undertaken, utilising atmospheric dispersion modelling, to support the EP application.

1.2.4 Two scenarios have been assessed to incorporate the ‘existing’ scenario and a ‘new’ scenario to incorporate the use of natural gas, updated boilers and a change in fuel use for one CHP; further detail are provided in the Permit application.

1.2.5 The results of the assessment have been interpreted in accordance with the requirements of the EA to identify if impacts represent ‘significant pollution’ as required by the EA to determine an EP application.

1.2.6 The AERA has been undertaken in accordance with relevant legislation, policy and guidance.

2 Legislation and Relevant Guidance

2.1 Environmental Permitting Guidance

2.1.1 Guidance Notes produced by DEFRA provide a framework for regulation of installations and additional technical guidance produced by the EA are used to provide the basis for permit conditions.

2.1.2 Of particular relevance to the assessment is the '*Air emissions risk assessment for your environmental permit*', also known as the AERA Guidance (Environment Agency, 2021). The purpose of the AERA Guidance is to assist operators to assess risks to the environment and human health when applying for a permit under the EP Regulations. Included in the AERA guidance are:

- an approach to screening assessment;
- guidance on when detailed atmospheric dispersion modelling is required; and
- Environmental Assessment Levels (EALs) for a range of pollutants not covered by other regulations, against which impact may be assessed.

2.2 National Air Quality Legislation and Guidance

Air Quality Standards

2.2.1 The Air Quality Standards Regulations 2010 (the AQSR) transposed the Air Quality Directive (2008/50/EC) and Fourth Daughter Directive (2004/107/EC). The Regulations include Limit Values, Target Values, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment.

2.2.2 Following the Transition Period after the UK's departure from the EU in January 2020, the Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019 (and subsequent amendments for the devolved administrations) have amended the AQ Standards Regulations 2010 to reflect the fact that the UK has left the EU, but do not change the pollutants assessed or the numerical thresholds.

National Air Pollution Plan for NO_2 in the UK

2.2.3 The national Air Quality Plan for NO_2 (DEFRA, 2018) sets out how the Government plans to deliver reductions in NO_2 throughout the UK, with a focus on reducing concentrations to below the EU Limit Values throughout the UK within the 'shortest possible time'.

2.2.4 The plan requires all Local Authorities (LAs) in England which DEFRA identified as having exceedances of the Limit Values in their areas past 2020 to develop local plans to improve air quality and identify measures to deliver reduced emissions, with the aim of meeting the Limit Values within their area within "*the shortest time possible*". Potential measures include changing road layouts, encouraging public and private ultra-low emission vehicle (ULEV) uptake, the use of retrofitting technologies and new fuels and encouraging public transport. In cases where these measures are not sufficient to bring about the required change within 'the shortest time possible' then LAs may consider implementing access restrictions on more polluting vehicles (e.g. Clean Air Zones (CAZs)). A CAZ is defined within the plan as being "*an area where targeted action is taken to improve air quality and resources are prioritised and coordinated in a way that delivers improved health benefits and supports economic growth*" and may be charging or non-charging.

Air Quality Strategy

2.2.5 The Air Quality Strategy (AQS) 2007 for England, Scotland, Wales and Northern Ireland sets out a comprehensive strategic framework within which air quality policy will be taken forward in the short to medium term, and the roles that Government, industry, the Environment Agency, local

government, business, individuals and transport have in protecting and improving air quality (DEFRA, 2007). The AQS contains Air Quality Objectives (AQOs) based on the protection of both human health and vegetation (ecosystems). The AQOs are maximum ambient pollutant concentrations that are not to be exceeded, either without exception or with a permitted number of exceedances allowable over a specified timescale. The AQOs are generally in accordance with the Limit Values specified in the AQSRs, however requirements for compliance differ slightly.

2.2.6 The Clean Air Strategy (2019) aims to lower national emissions of pollutants, thereby reducing background pollution and minimising human exposure to harmful concentrations of pollution. The Strategy aims to create a stronger and more coherent framework for action to tackle air pollution (DEFRA, 2019).

2.2.7 The Environment Agency's role in relation to the AQS is as follows:

"The Environment Agency is committed to ensuring that any industrial installation or waste operation we regulate will not contribute significantly to breaches of an AQS objective.

It is a mandatory requirement of EPR legislation that we ensure that no single industrial installation or waste operation we regulate will be the sole cause of a breach of an EU air quality limit value. Additionally, we have committed that no installation or waste operation will contribute significantly to a breach of an EU air quality limit value." (Environment Agency, 2008)

2.3 Standards for Air Quality

2.3.1 The standards applied in this assessment are taken from the AERA Guidance which are in accordance with the AQS and AQSR. The EALs that have been applied in this assessment are provided in **Table 2-1**.

Table 2-1 Applied EALs

Pollutant	Averaging Period	EAL (µg/m^3)	Source
Nitrogen dioxide (NO_2)	Annual Mean	40	AQS and AQSR
	1-hour Mean	200 (1-hour) not to be exceeded more than 18 times per year	AQS and AQSR
Sulphur Dioxide (SO_2)	15 minutes	266 µg/m^3 not to be exceed more than 35 times a year	AQS
	1-hour	350 µg/m^3 not to be exceeded more than 24 times a year	AQS and AQSR
	24-hour	125 µg/m^3 not to be exceeded more than 3 times a year	AQS and AQSR

2.3.2 DEFRA has published technical guidance for use in Local Air Quality Management (LAQM). According to LAQM.TG (22), air quality strategy objectives should only apply to locations where "*members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective*". Authorities should not consider exceedances of the objectives at any location where relevant public exposure would not be realistic. Thus, short term objectives such as the 1-hour objective should apply to footpaths and other areas which may be regularly frequented by the public even for a short period of time. Longer term objectives such as annual means, should apply at houses or other locations which the public can be expected to occupy on a continuous basis. These objectives do not apply to exposure at the workplace.

Table 2-2 Relevant Public Exposure

Averaging Period	Air quality objectives should apply at:	Air quality objectives don't apply at:
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24-hour and 8-hour mean	All locations where the annual mean NAQO would apply, together with hotels and gardens of residences.	Kerbside sites Any other location where public exposure is expected to be short term.
1-hour mean	Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer.	Kerbside sites where public would not be expected to have regular access
15-minute mean	All locations where members of the public might reasonably be regularly exposed for a period of 15 minutes or longer.	Locations where members of the public would not reasonably be expected to be regularly exposed for a period of 15 minutes or longer.

2.4 Protection of Ecological Receptors

2.4.1 Sites of nature conservation importance at a national and local level, are provided environmental protection from developments, including from atmospheric emissions. EALs for the protection of ecological receptors are known as Critical Levels (C_{Le}) for airborne concentrations and Critical Loads (C_{Lo}) for deposition to land from air.

2.4.2 The AERA Guidance requires that ecological habitats should be screened against relevant standards if they are located within the following set distances from the facility:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 10km of the Installation; and
- Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNR), Local Nature Reserves (LNR), Local Wildlife Sites (LWS) and Ancient Woodland (AW) within 2km of the Installation.

Critical Levels (C_{Le})

2.4.3 C_{Le} are a quantitative estimate of exposure to one or more airborne pollutants in gaseous form, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. The relevant C_{Le} for the protection of vegetation and ecosystems are specified within the UK Air Quality Regulations and AERA Guidance (see **Table 2-3**).

Table 2-3 Relevant C_{Le} for the Protection of Vegetation and Ecosystems

Pollutant	Concentration (µg/m^3)	Habitat and Averaging Period	Source
Nitrogen Oxides (NOx)	30	Annual mean (all ecosystems)	AQSR
	75	Daily mean (all ecosystems)	AERA
Sulphur Dioxide (SO_2)	10	Annual Mean (lichens and bryophytes)	AERA
	20	Annual Mean	AQSR

Critical Loads (C_{Lo})

2.4.4 C_{Lo} are a quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. Critical loads are set for the deposition of various substances to sensitive ecosystems. In relation to combustion emissions critical loads for eutrophication and acidification are relevant which can occur via both wet and dry deposition; however, on a local scale only dry (direct deposition) is considered significant.

2.4.5 Empirical C_{Lo} for eutrophication (derived from a range of experimental studies) are assigned based for different habitats, including grassland ecosystems, mire, bog and fen habitats, freshwaters, heathland ecosystems, coastal and marine habitats, and forest habitats and have been obtained from the UK Air Pollution Information System (APIS) website (APIS, 2023).

2.4.6 C_{Lo} for acidification have been set in the UK using an empirical approach for non-woodland habitats on a 1km grid square based upon the mineralogy and chemistry of the dominant soil series present in the grid square, and the simple mass balance (SMB) equation for both managed and unmanaged woodland habitats.

3 Assessment Methodology

3.1 Model Setup

3.1.1 Detailed atmospheric dispersion modelling has been undertaken using v.19191 of the AERMOD dispersion model which has been developed in conjunction with, and approved for use by, the US EPA. The dispersion modelling has been undertaken with due consideration to relevant guidance. The modelling approach is based upon the following stages:

- identification of sensitive receptors;
- review of process design and emission sources;
- compilation of the existing air quality baseline and review of LAQM status; and
- calculation of process contribution to ground level concentrations and evaluation against relevant environmental standards for both human and ecological receptors.

3.1.2 The AERMOD model calculates time-averaged ground level concentrations over any set of distances from the source. A Cartesian grid with 20m spacing up to 3 km was used to predict the maximum predicted contribution to ground level (1.5m) concentrations. The pollutant concentrations were also predicted at specific human and ecological receptor locations.

3.1.3 The model requires inputs for:

- building effects;
- nature of the surface;
- physical characteristics of the emissions; and
- meteorology.

Building Effects

3.1.4 Buildings can influence the dispersion of pollutants from sources and can increase the maximum predicted ground level concentrations. The main effect of a building is to entrain pollutants into the cavity region in the immediate leeward side of the building, bringing them rapidly down to ground level. Therefore, concentrations near the building are increased but further away concentrations are decreased.

3.1.5 The buildings that are nearest (or attached) to the sources have been considered in the model. Buildings located horizontally within the distance equivalent to five stack heights of the stack and taller than approximately a third of the stack height have been included, in accordance with advice from the software provider. Details of buildings input to the model are provided in **Table 3-1** and **Table 3-2** below and shown in **Figure 2, Appendix E**. Building heights were obtained from OS Mastermap.

Table 3-1 Building Parameters – Rectangular Buildings

Building ID	X	Y	X Length (m)	Y Length (m)	Height above Ground (m)
1	418727.2	439552.8	24	17.7	6.2

Terrain

3.1.6 Topographical data covering the extent of the receptor grid and specific receptor locations has been included in the model and was obtained from the OS Land-Form Panorama dataset.

Meteorology

3.1.7 The model utilises a meteorological dataset that contains hourly values for wind speed, wind direction, and atmospheric stability to compute the dispersion of the emissions.

3.1.8 The assessment has used the five-year (2016 to 2020) sequential meteorological data from Numerical Weather Prediction (NWP) datasets which is considered to be representative of meteorological conditions at the Site. The 2016 to 2020 wind roses for Esholt are provided in **Appendix A**. Measured data from Leeds and Bingley met sites was considered unsuitable due to differences in elevation between measured site and stack location.

3.2 Emissions to Atmosphere

3.2.1 The technical specifications of the combustion plant modelled in the 'existing' scenario are:

- Two Guascor 200125/26 Biogas fired CHPs (1530 kWth input) (CHP1 and 2)
- Two TCG 2020V16 Biogas fired CHPs (3628 kWth input)(CHP3 and 4); and
- Two Cochran 49/5533-34 Fuel oil as main, biogas backup (modelled as 100% fuel oil) fired boilers (6200 kWth input)

3.2.2 The technical specifications of the combustion plant modelled in the 'new' scenario are:

- One Guascor 200125 Natural Gas fired CHP (1530 kWth input) (CHP1)
- One Guascor 200126 Biogas fired CHP (1530 kWth input) (CHP2)
- Two TCG 2020V16 Biogas fired CHPs (3628 kWth input) (CHP3 and 4); and
- Two Cochran 49/5533-34 with Natural gas as main, Biogas as backup (modelled as 100% Biogas) fired boilers (maximum 6500 kWth input)

3.2.3 Whilst the boilers in the 'new' scenario will predominately use natural gas, they have been assumed as 100% Biogas with the maximum firing rate of the new burners to present a worst-case assessment (i.e. greater SO_2 emissions) with ELVs applied for 'existing plant' as the conversion to gas fuel is not considered to constitute 'new' MCP.

3.2.4 The quantification of the pollutant emission rates for the CHPs and boilers has been based on physical discharge characteristics and stack emission monitoring data as well as typical physical discharge characteristics and the manufacturers specification.

3.2.5 The emission release rates have been calculated from the 'normalised' flue gas flow rates (see **Table 3-3** for the 'existing' operational scenario and **Table 3-4** for the 'New' operational scenario) and the relevant ELVs.

3.2.6 As a worst-case scenario, the boilers and CHP plant have been assumed to operate throughout the year for 24-hours a day (8,760 hours per annum). This assumption is considered conservative; real-world boiler use is below this level of utilisation. This site is different to others as the boilers are used to provide steam for the THP process (rather than at other sites where boilers provide supplementary heat to the digesters and on many sites are used very infrequently). All plant is periodically taken off-line for servicing which would also reduce total available annual operating hours.

3.2.7 The dispersion model requires input relating to the emissions. The source parameters and emission rates used for the assessment of emissions are shown in **Table 3-3**. Emissions from each CHP plant and the boilers are discharged via individual stacks (i.e. six stacks in total within one windshield).

Table 3-3 Applied Physical Discharge Characteristics to Estimate Emissions and Estimated Emission Rates in the 'Existing' Operational Scenario

Parameter / Source	CHP1 Flue	CHP2 Flue	CHP3 Flue	CHP4 Flue	Boiler 1	Boiler 2
Fuel Assumed	Biogas	Biogas	Biogas	Biogas	Fuel Oil	Fuel Oil
Stack Locations (x, y)	418747, 439543	418747, 439543	418746, 439542	418747, 439542	418747, 439542	418748, 439542
Stack Height (m AGL)	15	15	15	15	15	15
Emission Temperature (ºC)	150	150	150	150	100	100
Stack Internal Diameter (m)	0.25	0.25	0.48	0.48	0.48	0.48
Emission Velocity (m/s)	12.43	12.43	7.96	7.96	22.25	22.25
Actual flow rate (Am^3/s)	0.61	0.61	1.44	1.44	4.03	4.03
Normalised flow rate, dry, 15% oxygen (Nm^3/s)	0.58	0.59	1.48	1.39	N/A	N/A
Normalised flow rate, dry, 3% oxygen (Nm^3/s)	N/A	N/A	N/A	N/A	1.78	1.78
NOx MCPD ELV (mg/Nm^3)	190	190	190	190	200	200
NOx Emission Rate (g/s)	0.11	0.11	0.28	0.26	0.36	0.36
SO_2 MCPD ELV (mg/Nm^3)	60	60	60	60	N/A	N/A
SO_2 Emission Rate (g/s)	0.03	0.04	0.09	0.08	N/A	N/A

Table 3-4 Applied Physical Discharge Characteristics to Estimate Emissions and Estimated Emission Rates in the 'New' Operational Scenario

Parameter / Source	CHP1 Flue	CHP2 Flue	CHP3 Flue	CHP4 Flue	Boiler 1	Boiler 2
Fuel Assumed	Natural Gas	Biogas	Biogas	Biogas	Biogas	Biogas
Stack Locations (x, y)	418747, 439543	418747, 439543	418746, 439542	418747, 439542	418747, 439542	418748, 439542
Stack Height (m AGL)	15	15	15	15	15	15
Emission Temperature (ºC)	150	150	150	150	100	100
Stack Internal Diameter (m)	0.25	0.25	0.48	0.48	0.48	0.48
Emission Velocity (m/s)	10.80	12.43	7.96	7.96	22.88	22.88
Actual flow rate (Am^3/s)	0.53	0.61	1.44	1.44	4.14	4.14
Normalised flow rate, dry, 15% oxygen (Nm^3/s)	0.51	0.59	1.48	1.39	N/A	N/A
Normalised flow rate, dry, 3% oxygen (Nm^3/s)	N/A	N/A	N/A	N/A	1.83	1.83
NOx MCPD ELV (mg/Nm^3)	190	190	190	190	250	250
NOx Emission Rate (g/s)	0.10	0.11	0.28	0.26	0.46	0.46
SO_2 MCPD ELV (mg/Nm^3)	N/A	60	60	60	170	170
SO_2 Emission Rate (g/s)	N/A	0.04	0.09	0.08	0.31	0.31

3.3 Assessment of Impacts on Air Quality

NOx to NO_2 Conversion

3.3.1 Emissions of NOx from combustion sources include both NO_2 and NO, with the majority being in the form of NO. In ambient air, NO is oxidised to form NO_2, and it is NO_2 which has the greater potential health impacts. For this assessment, the conversion of NO to NO_2 has been estimated using the worst-case assumptions set out in EA AERA guidance, namely that:

- For the assessment of long term (annual mean) impacts at receptors, 70% of NOx is NO_2; and

- For the assessment of short term (hourly mean) impacts at receptors, 35% of NOx is NO_2.

3.3.2 The oxidation of NO to NO_2 is not, however, an instantaneous process and where the maximum impacts occur within up to 1km of the stacks the EA AERA guidance assumptions lead to a conservative assessment.

15-minute SO_2 Concentrations

3.3.3 In this assessment, the 99.9th percentiles of 1-hour mean SO_2 concentrations have been converted into 99.9th percentiles of 15-minute mean concentrations using a conversion factor 1.34, as recommended in the EA AERA guidance.

Assessment of Impact and Significance

3.3.4 To assess the potential impact on air quality, the predicted exposure is compared to the EALs, and the results of the dispersion modelling have been presented in the form of:

- tabulated concentrations at discrete receptor locations to facilitate the discussion of results; and
- illustrations of the impact as isopleths (contours of concentration) for the criteria selected enabling determination of impact at any locations within the study area.

3.3.5 In accordance with the EA's AERA guidance, the impact is considered to be insignificant or negligible if:

- the long-term process contribution is <1% of the long term EAL; and
- the short-term process contribution is <10% of the short term EAL.

3.3.6 For process contributions that cannot be considered insignificant further assessment has been undertaken and the Predicted Environmental Concentration (PEC: PC + existing background pollutant concentration) determined for comparison as a percentage of the relevant EAL. DEFRA 2018-based background maps for 2019 (DEFRA, 2021) have been applied to calculate the NO_2 PECs at receptor locations, whilst background monitoring data from DEFRA's Leeds Centre (UKA00222) Automatic Urban and Rural Network (AURN) monitoring site has been applied to calculate the SO_2 PECs at receptor locations.

3.3.7 The EA's AERA guidance indicates that no further assessment is required, and impacts do not constitute 'significant pollution' if the resulting PEC is below the EAL and the applied emission levels comply with the BAT requirements.

3.4 Assessment of Impacts on Vegetation and Ecosystems

Calculation of Deposition Rates

3.4.1 Deposition rates were calculated using empirical methods recommended by the EA AQTAG06 (EA, 2014). Dry deposition flux was calculated using the following equation:

Dry deposition flux ($\mu g/m^2/s$) = ground level concentration ($\mu g/m^3$) x deposition velocity (m/s)

3.4.2 Wet deposition occurs via the incorporation of the pollutant into water droplets which are then removed in rain or snow and is not considered significant over short distances (AQTAG06) compared with dry deposition. Therefore, for the purposes of this assessment, wet deposition has not been considered.

3.4.3 The dry deposition velocities and conversion factors for NO_2 and SO_2 were taken from the EA's guidance document AQTAG 06 (EA, 2014) and are set out in **Table 3-4**.

Table 3-4 Applied Deposition Velocities

Chemical Species	Habitat	Recommended deposition velocity (m/s)	Conversion µg/m²/s to kgN/ha/yr	Conversion µg/m²/s to keq/ha/yr
NO_2	Grassland	0.0015	96.0	6.84
	Woodland	0.003		
SO_2	Grassland	0.012	-	9.84
	Woodland	0.024		

Assessment of Impact and Significance

3.4.4 In addition to the AERA guidance, the EA's Operational Instruction 66_12 (EA, 2012a) details how the air quality impacts on ecological sites should be assessed. This guidance provides risk-based screening criteria to determine whether impacts will have 'no likely significant effects (alone and in-combination)' for European sites, 'no likely damage' for SSSI's and 'no significant pollution' for other sites, as follows:

- PC <1% long-term C_{Le} and/or C_{Lo} or that the PEC <70% long-term C_{Le} and/or C_{Lo} for European sites and SSSIs;
- PC <10% short-term C_{Le} for NOx for European sites and SSSIs;
- PC <100% long-term C_{Le} and/or C_{Lo} other conservation sites; and
- PC <100% short-term C_{Le} for NOx (if applicable) for other conservation sites.

3.4.5 Where impacts cannot be classified as resulting in 'no likely significant effect', more detailed assessment may be required depending on the sensitivity of the feature in accordance with EAs Operational Instruction 67_12 (EA, 2012b). This can require the consideration of the potential for in-combination effects, the actual distribution of sensitive features within the site, and local factors (such as the water table).

3.4.6 The guidance provides the following further criteria:

- if the PEC<100% of the appropriate limit, it can be assumed there will be no adverse effect;
- if the background is below the limit, but a small PC leads to an exceedance – decision based on local considerations;
- if the background is currently above the limit and the additional PC will cause a small increase – decision based on local considerations;
- if the background is below the limit, but a significant PC leads to an exceedance – cannot conclude no adverse effect; and
- if the background is currently above the limit and the additional PC is large - cannot conclude no adverse effect.

4 Baseline Environment

4.1 Site Setting and Sensitive Receptors

4.1.1 The Site location is shown in **Figure 1, Appendix E**. The River Aire bounds the site on the north, east and south boundaries, and the Leeds Liverpool Canal to the south and west. Thackley of Bradford is an area of residential use approximately 1 km to the southwest. Yeadon lies approximately 1.5 km to the northeast. There are a number of locally designated wildlife sites within 2 km of the site, as well as several ancient woodlands, shown in **Figure 4**, **Appendix E.** The modelled sensitive human and ecological receptor locations in proximity to the Site are detailed in the following sections.

Human Receptors

4.1.2 According to LAQM.TG(22), air quality standards should apply to locations where members of the public may be reasonably likely to be exposed to air pollution for the duration of the relevant limit value. The dispersion modelling has been completed using a receptor grid which allows the maximum ground level impact to be assessed including potential short-term exposure locations. As such, the impact concentration has been assessed at all potential exposure locations surrounding the Site. In addition, sensitive existing residential properties have been modelled, details of which are shown in **Table B-1, Appendix B** and their locations are shown in **Figure 3, Appendix E**.

Ecological Receptors

4.1.3 Local designated sites within the relevant AERA screening distances are presented in **Table B-2, Appendix B** and shown in **Figure 4, Appendix E**. South Pennine Moors SAC is located approximately 4.5 km to the northwest of the site and is shown in **Figure 5, Appendix E**.

4.2 Ambient Air Quality

Local Air Quality Management

4.2.1 CoBMDC has investigated air quality within its area as part of its responsibilities under the LAQM regime. The Council currently has four AQMAs, all declared due to exceedances of the annual mean NO_2 AQO. The nearest AQMA, AQMA no.2 is an area encompassing the junction of Manningham Lane and Queens Roads, approximately 5.5 km to the southwest of the site.

Local Air Quality Monitoring Data

4.2.2 CoBMDC and LCC carry out monitoring of NO_2 concentrations at a number of locations across the authorities. The closest and most representative locations are described below and shown in **Figure 1, Appendix E**. 2016-2020 monitoring data for these sites are presented in **Table 4-1**.

4.2.3 **Table 4-1** shows that there were no exceedances of the annual mean NO_2 AQO since 2017 at the closest monitoring locations to the Installation.

Table 4-1 Measured NO_2 concentrations 2016-2020

Site ID	Site Type	Annual Mean (µg/m³)				
		2016	2017	2018	2019	2020
CoBMDC Diffusion Tube						
DT92	Roadside	38	33	33	32	24.5
DT93	Kerbside	40	36	36	30	25.8
DT94	Roadside	27	26	25	23	18.4
DT95	Kerbside	**51**	**43**	39	34	23.4
DT96	Kerbside	38	36	34	33	24.1
DT165	Roadside	-	-	-	-	22
DT166	Roadside	-	-	-	-	21
LCC Diffusion Tube						
D284	Roadside	-	28	33	30	-
D285	Roadside	-	21	21	-	-
D488	Roadside	-	-	-	21	-
D490	Roadside	-	-	-	18	-
D505	Roadside	-	-	-	27	-
AQO		**40**				

CoBMDC data obtained from the CoBMDC 2022 Air Quality Annual Status Report (CoBMDC, 2021).
LCC data obtained from the LCC Air Quality Annual Results 2015 to 2019 (SCC, 2020).

4.3 Predicted Background Concentrations

4.3.1 Modelled background pollutant concentration data on a 1km x 1km spatial resolution is provided by DEFRA through the UK AIR website (DEFRA, 2020) and are routinely used to support LAQM and Air Quality Assessments.

4.3.2 The latest available background pollutant concentrations for NO_2 are based upon a 2018 base year and projected to future years. The projected 2019 background concentrations for the grid squares containing the Site and modelled receptor locations have been applied in this AERA and are shown in **Table 4-2**. Background NO_2 concentrations are well below the AQO.

Table 4-2 Estimated Annual Mean NO_2 Background Concentrations 2022 (µg/m³)

Location (x_y)	Annual Mean (µg/m³)	
	NOx	NO_2
418_439	15.6	11.7

4.3.3 The latest available modelled background pollutant data for SO_2 available from DEFRA is for 2001. Therefore, it has been considered more appropriate to use more recent SO_2 background monitoring data available from DEFRA's AURN.

4.3.4 The 2019 annual mean SO_2 concentration from the Leeds Centre background AURN monitoring site is provided in **Table 4-3**. The Leeds Centre AURN site is the closest and most representative SO_2 monitoring site to the Installation with sufficient data capture in 2019. The measured annual

mean SO_2 background concentration from the Leeds Centre monitoring site has been applied to all modelled human receptor locations in this AERA.

Table 4-3 Annual Mean SO_2 2019 Measured Background Concentration

Site Name	Location (x,y)	2019 Annual Mean SO_2 Concentration ($\mu g/m^3$)
Leeds Centre AURN	429967, 434260	1.75

4.4 Baseline Air Quality at Ecological Receptors

4.4.1 The APIS website, a support tool for assessment of potential effects of air pollutants on habitats and species developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology, has been used to provide information on relevant C_{Lo} and current deposition rates for nutrient nitrogen and for acidity. These are provided in **Table 4-4** and **Table 4-5**. Baseline concentrations of NOx and SO_2 are provided in **Table 4-6** and have also been obtained from the APIS website.

Table 4-4 Nitrogen and Acid Deposition Critical Loads

Receptor	Designated Site	Assigned Habitat	Critical Load	
			Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)
01	Hawkstone Wood LWS	Broadleaved, Mixed and Yew Woodland	10	0.357
02	Hawkstone Wood LWS	Broadleaved, Mixed and Yew Woodland	10	0.357
03	Spring and Jerrison Woods LWS	Broadleaved, Mixed and Yew Woodland	10	0.357
04	St Paul's Wood LWS	Broadleaved, Mixed and Yew Woodland	10	0.357
05	St Paul's Wood LWS	Broadleaved, Mixed and Yew Woodland	10	0.357
06	Spring and Jerrison Woods LWS	Broadleaved, Mixed and Yew Woodland	10	0.357
07	Spring and Jerrison Woods LWS	Broadleaved, Mixed and Yew Woodland	10	0.357
08	Spring and Jerrison Woods LWS	Broadleaved, Mixed and Yew Woodland	10	0.357
09	Nun Wood LWS	Broadleaved, Mixed and Yew Woodland	10	0.357
10	Millman Bridge Ox-bow LWS	Broadleaved, Mixed and Yew Woodland	10	0.357
11	Cragg Wood LWS	Broadleaved, Mixed and Yew Woodland	10	0.357

Receptor	Designated Site	Assigned Habitat	Critical Load	
			Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)
12	Shipley - Thackley Disused Railway LWS	Broadleaved, Mixed and Yew Woodland	10	0.142
13	Buck Wood West LWS	Broadleaved, Mixed and Yew Woodland	10	0.142
14	Buck Wood East LWS	Broadleaved, Mixed and Yew Woodland	10	0.357
15	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
16	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
17	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
18	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
19	South Pennine Moors SAC	Bogs	5	0.3
20	South Pennine Moors SAC	Bogs	5	0.3
21	South Pennine Moors SAC	Bogs	5	0.3
22	South Pennine Moors SAC	Bogs	5	0.3
23	South Pennine Moors SAC	Bogs	5	0.3
24	Buck Wood AW	Broadleaved, Mixed and Yew Woodland	10	0.357
25	Dawson/Poggy Wood AW	Broadleaved, Mixed and Yew Woodland	10	0.357
26	Spring/Hollins Wood AW	Broadleaved, Mixed and Yew Woodland	10	0.357
27	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
28	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
29	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
30	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
31	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
32	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
33	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a

Receptor	Designated Site	Assigned Habitat	Critical Load	
			Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)
34	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
35	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
36	Leeds Liverpool Canal LWS	Fen, Marsh and Swamp	10	n/a
37	St Leonard's Farm LWS	Hedgerows	10	0.357

Table 4-5 Baseline Deposition Rates

Receptor	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition	
		Nitrogen (keq N/ha/yr)	Sulphur (keq S/ha/yr)
1	42.0	3.00	0.30
2	42.0	3.00	0.30
3	42.0	3.00	0.30
4	42.0	3.00	0.30
5	42.0	3.00	0.30
6	42.0	3.00	0.30
7	42.0	3.00	0.30
8	42.0	3.00	0.30
9	38.4	2.74	0.34
10	38.4	2.74	0.34
11	38.4	2.74	0.35
12	38.4	2.74	0.34
13	38.4	2.74	0.34
14	38.4	2.74	0.34
15	23.5	1.68	0.29
16	23.5	1.68	0.29
17	23.5	1.68	0.29
18	23.5	1.68	0.29
19	24.9	1.8	0.2
20	25.2	1.8	0.3

Receptor	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition	
		Nitrogen (keq N/ha/yr)	Sulphur (keq S/ha/yr)
21	25.5	1.8	0.3
22	25.3	1.8	0.3
23	24.4	1.7	0.3
24	38.36	2.74	0.34
25	38.36	2.74	0.34
26	42	3	0.3
27	23.5	1.68	0.29
28	23.5	1.68	0.29
29	23.5	1.68	0.29
30	23.5	1.68	0.29
31	23.5	1.68	0.29
32	23.5	1.68	0.29
33	23.5	1.68	0.29
34	23.5	1.68	0.29
35	23.5	1.68	0.29
36	23.5	1.68	0.29
37	42.0	3.00	0.30

Table 4-6 Baseline Concentrations

Receptor	Annual Mean Concentration (µg/m^3)	
	NOx	SO_2
1	14.46	1.32
2	14.46	1.32
3	14.44	1.32
4	14.44	1.32
5	14.44	1.32
6	14.44	1.32
7	15.58	1.32
8	15.58	1.32
9	15.52	2.61

Receptor	Annual Mean Concentration (µg/m^3)	
	NOx	SO_2
10	17.54	2.61
11	16.48	1.93
12	19.06	2.61
13	15.82	2.61
14	15.82	2.61
15	17.57	2.61
16	17.57	2.61
17	17.57	2.61
18	17.57	2.61
19	10.1	0.97
20	10.29	0.98
21	10.55	0.99
22	10.31	0.96
23	10.38	0.97
24	17.57	2.61
25	17.57	2.61
26	14.44	1.32
27	17.57	2.61
28	17.57	2.61
29	17.57	2.61
30	17.57	2.61
31	17.57	2.61
32	17.57	2.61
33	17.57	2.61
34	17.57	2.61
35	17.57	2.61
36	17.57	2.61
37	14.46	1.32

5 Assessment Results

5.1.1 Dispersion modelling has been undertaken using the input data specified in this report. **Figure 6** to **Figure 10, Appendix E** should be referred to for graphical visualisations of modelling results; these figures relate to the 'new' scenario. The impacts at modelled human and ecological receptor locations are described in the following sections.

5.2 Impacts on Sensitive Human Receptors

Nitrogen Dioxide (NO_2)

5.2.1 **Figure 6, Appendix E** illustrates the predicted annual mean NO_2 PC contour whilst **Figure 7, Appendix E** shows the 1-hour mean NO_2 PC contour associated with the 'new' scenario. Contours are presented for the year of the maximum PC which is 2017 for annual mean NO_2 and 2018 for 1-hour mean NO_2. Predicted annual mean NO_2 concentrations at sensitive receptor locations are summarised in **Table C-1, Appendix C,** whilst predicted 1-hour mean NO_2 concentrations are provided in **Table C-2, Appendix C**. Results for the worst-case meteorological year of the five years assessed (2016 - 2020) are presented.

5.2.2 The predicted annual mean NO_2 PC exceeds 1% of the EAL at sensitive receptors R01, R02, R09, R11 and R13 in both the 'existing' and 'new' scenarios. For all remaining receptors, the predicted annual mean NO_2 PC is less than 1% of the EAL and can therefore be considered as 'insignificant'.

5.2.3 As the predicted annual mean NO_2 concentrations are below the relevant EAL at all sensitive human receptor locations, the predicted annual mean NO_2 impacts do not constitute 'significant pollution' in both scenarios.

5.2.4 The predicted 1-hour mean NO_2 PC only exceeds 10% of the EAL at receptor location R01 in both the 'existing' and 'new' scenarios 1. For all remaining receptors, the predicted 1-hour mean NO_2 PC is less than 10% of the EAL and can therefore be considered 'insignificant' in both scenarios.

5.2.5 For R01, the predicted 1-hour mean NO_2 concentrations are below the relevant EAL. Therefore, the predicted 1-hour mean NO_2 impacts do not constitute 'significant pollution' in both scenarios.

Sulphur Dioxide (SO_2)

5.2.6 **Figures 8, Appendix E** illustrates the predicted 24-hour mean SO_2 PC contour, **Figure 9, Appendix E** shows the 1-hour mean SO_2 PC contour and **Figure 10, Appendix E** shows the 15-minute mean SO_2 contour associated with the 'new' scenario. Contours are presented for the year of the maximum PC which is 2019 for 24-hour mean and 1-hour mean SO_2 and 2016 for 15-minute mean SO_2. Predicted SO_2 concentrations at sensitive receptor locations are summarised in **Table C-3 – C-6, Appendix C**. Results for the worst-case meteorological year of the five years assessed (2016 - 2020) are presented.

5.2.7 The predicted 24-hour mean,1-hour mean SO_2 PCs in the 'existing' scenario, do not exceed 10% of the EAL at any of the modelled sensitive receptor locations and can therefore be considered as being 'insignificant' in the 'existing' scenario.

5.2.8 The predicted 15-minute mean SO_2 PC in the 'existing' scenario exceed 10% of the EAL at sensitive receptor R01, however the PEC is less than 15% of the EAL. For all remaining receptors, the PCs are less than 10% of the EAL and can therefore be classified as 'insignificant' in accordance with EA guidance.

5.2.9 In the 'new' scenario, the predicted 24-hour and 15-minute mean SO_2 PCs exceed 10% of the EAL at sensitive receptors R01 and R11, however the PEC's are less than 30% of the EAL. For all remaining receptors, the PCs are less than 10% of the EAL and can therefore be classified as 'insignificant' in accordance with EA guidance.

5.2.10 In the 'new' scenario, the predicted 1-hour mean SO2 PCs exceed 10% of the EAL at sensitive receptor R01, however the PEC is less than 15% of the EAL and can therefore be classified as 'insignificant' in accordance with EA guidance.

5.2.11 Impact predictions have been based on a worst-case assessment scenario of the boilers and CHP plant operating constantly throughout the year and emitting the maximum permitted SO_2 concentration associated with biogas combustion. Therefore, the predicted concentrations presented in this report are likely to be overestimations of the actual impacts of the Installation.

5.2.12 In both scenarios, the predicted 24-hour, 1-hour and 15-minute mean SO_2 PECs are well below the relevant EALs and therefore do not constitute 'significant pollution'.

5.3 Impacts on Ecological Receptors

Nitrogen Oxides (NO_x)

5.3.1 Predicted annual and 24-hour mean NO_x concentrations at sensitive ecological receptor locations are summarised in **Table D-1** and **Table D-2, Appendix D.** Results for the worst-case meteorological year of the five years assessed (2016 - 2020) are presented.

5.3.2 The predicted annual mean NOx and 24-hr NOx PCs in both scenarios are less than 100% of the C_{Le} at all of the locally designated ecological receptor locations and can therefore be considered 'insignificant'.

5.3.3 The predicted annual mean and 24-hour mean NOx PCs in both scenarios do not exceed 10% of the CLe at any receptors within the SAC and therefore impacts are considered not to constitute 'likely significant effects (alone and in-combination)'.

Sulphur Dioxide (SO_2)

5.3.4 Predicted annual mean SO_2 concentrations at sensitive ecological receptor locations are summarised in **Table D-3, Appendix D.**

5.3.5 The predicted annual mean SO_2 PCs are less than 100% of the C_{Le} at all of the locally designated ecological receptor locations and can therefore be considered 'insignificant'.

5.3.6 The predicted annual mean SOx PCs in both scenarios do not exceed 10% of the CLe at any receptors within the SAC and therefore impacts are considered not to constitute 'likely significant effects (alone and in-combination)'.

Nitrogen and Acid Deposition

5.3.7 Predicted annual mean nitrogen and acid deposition rates at sensitive ecological receptor locations are summarised in **Table D-4** and **Table D-5, Appendix D.**

5.3.8 The predicted annual nitrogen and acid deposition PCs are less than 100% of the C_{Lo} at all modelled ecological receptor locations and can therefore be considered 'insignificant'.

5.3.9 The predicted annual mean nitrogen deposition rate PCs do not exceed 1% of the CLo at all receptors within the SACs and SPAs and can therefore be considered 'insignificant'.

5.3.10 Impact predictions have been based on a worst-case assessment scenario of the boilers and CHP plant operating constantly throughout the year and emitting the maximum permitted NOx and SO_2 concentrations associated with biogas combusiton. Therefore, the predicted concentrations and deposition rates presented in this report are likely to be overestimations of the actual impacts of the Installation.

6 Summary and Conclusions

6.1.1 An Air Emission Risk Assessment utilising atmospheric dispersion modelling has been undertaken to support the EP application under the IED for Anaerobic Digestion activities at Esholt Wastewater Treatment Works.

6.1.2 The Installation includes combustion plant comprising four Combined Heat and Power (CHP) plant units (4 x biogas, proposed 3 x biogas and 1 x natural gas), one non- combustion waste heat recovery boiler and two combustion boilers that are currently fuelled primarily with gas oil and biogas backup, but proposed to be replaced with natural gas with biogas backup fuel; further details are provided in the permit application.

6.1.3 In relation to human health, where impacts are not classified as 'insignificant' (i.e. PC less than 1% of the EAL for long-term concentrations or 10% for short-term) the predicted impacts of the Installation do not lead to any exceedances of EALs and do not constitute 'significant pollution'.

6.1.4 In relation to the impact of the Installation on ecologically sensitive sites, at all local designated sites in both scenarios, the predicted PCs from the Installation are less than 100% of the applicable annual C_{Le} or C_{Lo}. At the South Pennine Moors SAC the predicted PC's in both scenarios are less than 1% of the applicable C_{Le} or C_{Le} and therefore can be considered 'insignificant'. Therefore, the impacts of the Installation are considered 'insignificant' at all designated ecological sites.

References

Air Pollution Information System (APIS) (2021). The UK Air Pollution Information System. Available at: http://www.apis.ac.uk/

City of Bradford Metropolitian District Council (2021) Air Quality Annual Status Report

DEFRA in partnership with the Scottish Executive, Welsh Assembly Government and Department of Environment Northern Ireland (2007). *'The Air Quality Strategy for England, Scotland, Wales and Northern Ireland'*.

DEFRA in partnership with the Scottish Executive, The National Assembly for Wales and the Department of the Environment for Northern Ireland (2022). '*Local Air Quality Management Technical Guidance, LAQM.TG(22)'.* HMSO, London.

Department of the Environment, Food and Rural Affairs (DEFRA) (2018). '*UK Plan for tackling Roadside Nitrogen Dioxide Concentrations: Detailed Plan'.* Available at: https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017

Department of the Environment, Food and Rural Affairs (DEFRA) (2019). '*Clean Air Strategy 2019*'.

DEFRA (2020). '2018 Based Background Maps for NO_x, NO_2, PM_{10} and $PM_{2.5}$'.

Department of the Environment, Transport and the Regions (DETR, 2007) in Partnership with the Welsh Office, Scottish Office and Department of the Environment for Northern Ireland (2007). '*The Air Quality Strategy for England, Scotland, Wales, Northern Ireland'* HMSO, London.

Environment Agency (2008). '*Regulating to Improve Air Quality'*. AQPG3, version 1.

Environment Agency (2012a). *'Operational Instruction 66_12 - Simple assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation.'*

Environment Agency (2012b). '*Operational Instruction 67_12 - Detailed assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation'.*

Environment Agency (2014). '*AQTAG06 – Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air*.' March 2014 version.

Environment Agency (2020). '*Air Emissions Risk Assessment for your Environmental Permit'*. Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

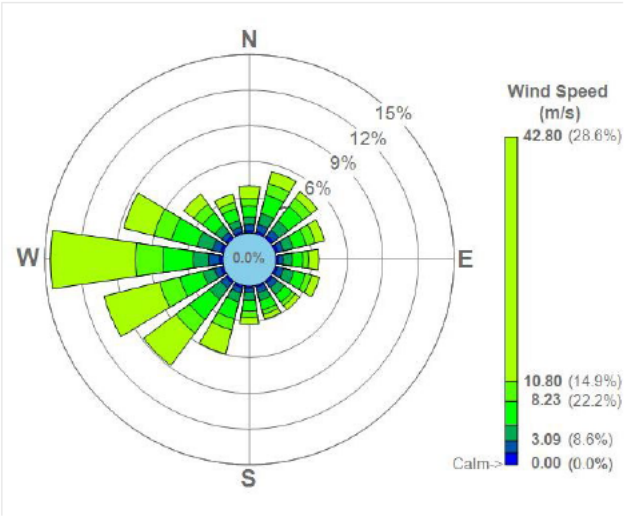
Environmental Act 1995, Part IV.

Leeds City Council (2020) Air Quality Annual Status Report

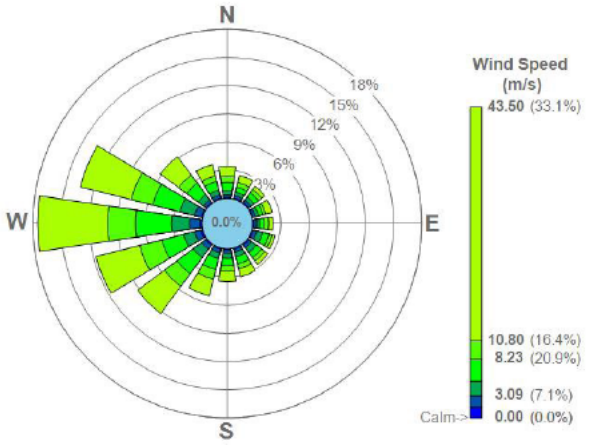
Medium Combustion Plant Directive. Directive (EU) 2015/2193 of the European Parliament and the Council of 25 November 2015

Statutory Instrument 2010, No 1001, '*The Air Quality Standards Regulations 2010'* HMSO, London.

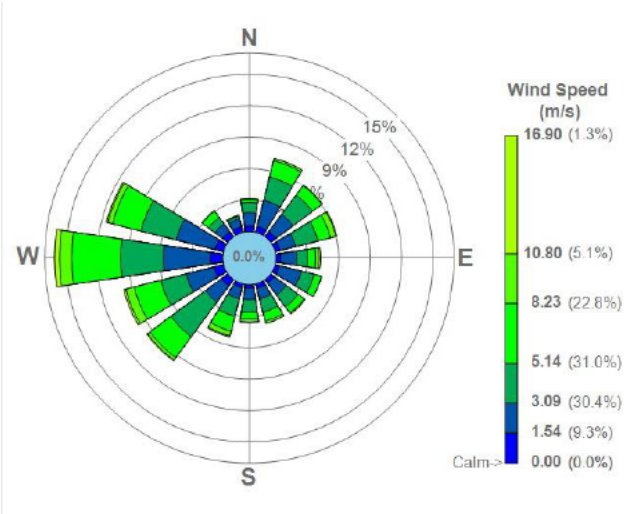
Appendix A Numerical Weather Prediction 2016 – 2020 Windroses



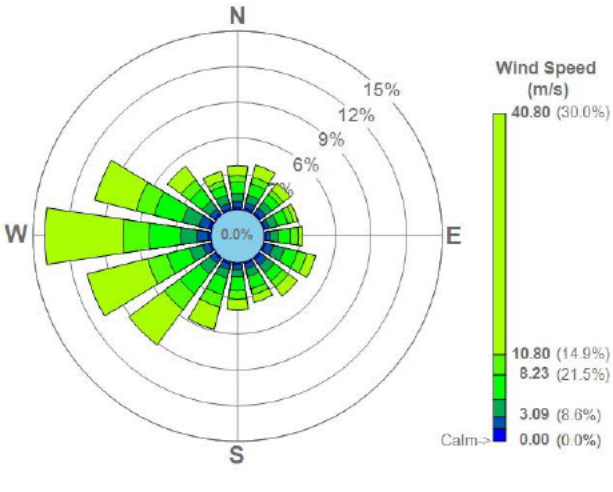
2016



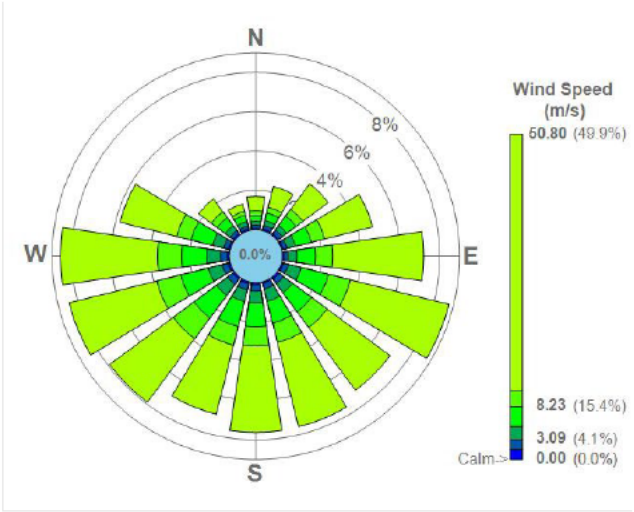
2017



2018



2019



2020

Appendix B Modelled Receptor Locations

Table B-1 Modelled Human Receptor Locations

Receptor	X Coordinate	Y Coordinate	Height (m)	Approximate Distance from Installation (m)
R1	418842.2	439655.5	1.5	147
R2	418248.9	440134.8	1.5	774
R3	418035.1	440182.2	1.5	957
R4	417744	440048.1	1.5	1123
R5	418041.7	438902.7	1.5	952
R6	418518.4	438164.8	1.5	1396
R7	418676.6	438481.3	1.5	1063
R8	419540.1	438541.3	1.5	1277
R9	419593.6	438954.3	1.5	1030
R10	420206.3	439538.4	1.5	1459
R11	419049	439614.9	1.5	310
R12	417407.8	439736.3	1.5	1353
R13	419946.1	439305.5	1.5	1222

Table B-2 Modelled Ecological Sites

Receptor	Grid Reference		Site Name (Designation)	Interest Status	Approximate Distance from Installation (m)
	X	Y			
1	417734	440733	Hawkstone Wood LWS	Local	1564
2	418089	440965	Hawkstone Wood LWS	Local	1568
3	418555	440301	Spring and Jerrison Woods LWS	Local	783
4	418378	440003	St Paul's Wood LWS	Local	590
5	418648	440016	St Paul's Wood LWS	Local	484
6	418885	440122	Spring and Jerrison Woods LWS	Local	596
7	419100	440136	Spring and Jerrison Woods LWS	Local	691
8	419346	440262	Spring and Jerrison Woods LWS	Local	936
9	419556	439164	Nun Wood LWS	Local	893
10	419037	438332	Millman Bridge Ox-bow LWS	Local	1244
11	420458	438925	Cragg Wood LWS	Local	1819
12	417468	438591	Shipley - Thackley Disused Railway LWS	Local	1594
13	417481	439277	Buck Wood West LWS	Local	1293
14	418439	439026	Buck Wood East LWS	Local	601
15	418506	439526	Leeds Liverpool Canal LWS	Local	241
16	418514	439271	Leeds Liverpool Canal LWS	Local	357
17	418638	438959	Leeds Liverpool Canal LWS	Local	593
18	418223	439699	Leeds Liverpool Canal LWS	Local	546
19	415269	444996	South Pennine Moors SAC	International	6470
20	415179	443798	South Pennine Moors SAC	International	5556
21	414732	442831	South Pennine Moors SAC	International	5191
22	413528	442227	South Pennine Moors SAC	International	5871

23	411741	442248	South Pennine Moors SAC	International	7513
24	418083	439556	Buck Wood AW	Local	664
25	418341	439339	Dawson/Poggy Wood AW	Local	454
26	418293	440414	Spring/Hollins Wood AW	Local	982
27	418275	439665	Leeds Liverpool Canal LWS	Local	487
28	418329	439631	Leeds Liverpool Canal LWS	Local	426
29	418387	439594	Leeds Liverpool Canal LWS	Local	363
30	418428	439557	Leeds Liverpool Canal LWS	Local	319
31	418489	439453	Leeds Liverpool Canal LWS	Local	272
32	418505	439392	Leeds Liverpool Canal LWS	Local	285
33	418507	439335	Leeds Liverpool Canal LWS	Local	317
34	418540	439209	Leeds Liverpool Canal LWS	Local	392
35	418570	439132	Leeds Liverpool Canal LWS	Local	447
36	418575	439027	Leeds Liverpool Canal LWS	Local	544
37	417785	440157	St Leonards Farm LWS	Local	1141

Appendix C Modelled Human Receptor Results

Table C-1 Predicted Annual Mean NO_2 Concentrations

Receptor	Annual Mean NO_2 Concentration (µg/m^3)							
	'Existing' Scenario				'New' Scenario			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
1	6.7	**16.7%**	19.4	48.5%	7.4	**18.4%**	20.1	50.2%
2	0.4	**1.1%**	11.2	27.9%	0.5	**1.2%**	13.2	33.0%
3	0.3	0.8%	11.1	27.7%	0.4	1.0%	13.1	32.8%
4	0.3	0.7%	11.0	27.5%	0.3	0.8%	13.0	32.6%
5	0.3	0.7%	12.9	32.1%	0.3	0.8%	13.0	32.6%
6	0.3	0.6%	12.8	32.1%	0.3	0.7%	13.0	32.5%
7	0.3	0.8%	12.9	32.3%	0.4	0.9%	13.1	32.7%
8	0.2	0.5%	13.1	32.7%	0.2	0.5%	12.9	32.3%
9	0.4	**1.1%**	13.3	33.3%	0.5	**1.3%**	13.2	33.0%
10	0.3	0.8%	13.8	34.4%	0.4	0.9%	13.1	32.7%
11	4.4	**10.9%**	15.8	39.4%	4.8	**12.0%**	17.5	43.8%
12	0.2	0.5%	11.7	29.3%	0.2	0.5%	12.9	32.3%
13	0.5	**1.2%**	11.9	29.7%	0.5	**1.4%**	13.3	33.1%

Table C-2 Predicted 1-hour Mean NO_2 Concentrations

Receptor	99.79%ile 1-hour Mean NO_2 Concentration (µg/m^3)							
	'Existing' Scenario				'New' Scenario			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
1	31.8	**15.9%**	57.2	28.6%	34.2	**17.1%**	59.6	29.8%
2	8.3	4.2%	29.8	14.9%	8.9	4.4%	34.3	17.1%
3	7.2	3.6%	28.7	14.3%	7.7	3.9%	33.2	16.6%
4	6.6	3.3%	28.1	14.1%	7.1	3.6%	32.6	16.3%
5	5.4	2.7%	30.5	15.3%	6.1	3.0%	31.5	15.8%
6	6.1	3.0%	31.2	15.6%	6.5	3.3%	31.9	16.0%
7	6.5	3.2%	31.6	15.8%	7.1	3.6%	32.6	16.3%
8	6.4	3.2%	32.2	16.1%	6.8	3.4%	32.2	16.1%

Receptor	99.79%ile 1-hour Mean NO_2 Concentration (µg/m^3)							
	'Existing' Scenario				'New' Scenario			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
9	11.2	5.6%	37.0	18.5%	11.8	5.9%	37.2	18.6%
10	2.8	1.4%	29.7	14.8%	3.1	1.6%	28.6	14.3%
11	18.0	9.0%	40.8	20.4%	19.4	9.7%	44.8	22.4%
12	5.0	2.5%	28.1	14.1%	5.7	2.8%	31.1	15.5%
13	4.4	2.2%	27.2	13.6%	5.0	2.5%	30.5	15.2%

Table C-3 Predicted 24-hour Mean SO_2 Concentrations

Receptor	99.19%ile 24-hour Mean SO_2 Concentration (µg/m^3)							
	'Existing' Scenario				'New' Scenario			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
1	12.2	9.8%	14.3	11.4%	28.8	**23.0%**	30.8	24.7%
2	1.3	1.0%	3.4	2.7%	2.8	2.2%	4.8	3.9%
3	1.1	0.9%	3.2	2.5%	2.9	2.3%	5.0	4.0%
4	0.9	0.7%	3.0	2.4%	2.4	1.9%	4.5	3.6%
5	0.6	0.5%	2.7	2.2%	1.9	1.5%	3.9	3.1%
6	0.7	0.6%	2.8	2.3%	2.3	1.8%	4.4	3.5%
7	1.2	1.0%	3.3	2.6%	2.8	2.2%	4.8	3.9%
8	0.7	0.5%	2.7	2.2%	1.6	1.3%	3.6	2.9%
9	1.4	1.2%	3.5	2.8%	3.5	2.8%	5.5	4.4%
10	0.4	0.3%	2.5	2.0%	1.1	0.9%	3.2	2.6%
11	5.5	4.4%	7.6	6.0%	13.2	**10.5%**	15.2	12.2%
12	0.6	0.5%	2.7	2.2%	1.7	1.4%	3.8	3.0%
13	0.7	0.5%	2.7	2.2%	1.9	1.5%	4.0	3.2%

Table C-4 Predicted 1-Hour Mean SO_2 Concentrations

Receptor	99.73%ile 1-hour Mean SO_2 Concentration (µg/m^3)							
	'Existing' Scenario				'New' Scenario			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
1	20.2	5.8%	23.7	6.8%	42.9	**12.2%**	46.4	13.3%
2	5.1	1.5%	8.6	2.5%	10.7	3.1%	14.2	4.1%
3	4.6	1.3%	8.1	2.3%	9.5	2.7%	13.0	3.7%
4	3.9	1.1%	7.4	2.1%	8.3	2.4%	11.8	3.4%
5	2.5	0.7%	6.1	1.7%	8.3	2.4%	11.8	3.4%
6	3.3	0.9%	6.8	1.9%	7.9	2.2%	11.4	3.3%
7	4.1	1.2%	7.6	2.2%	8.7	2.5%	12.2	3.5%
8	3.9	1.1%	7.5	2.1%	7.3	2.1%	10.8	3.1%
9	6.1	1.8%	9.6	2.8%	13.0	3.7%	16.6	4.7%
10	1.5	0.4%	5.0	1.4%	4.0	1.1%	7.5	2.1%
11	12.1	3.5%	15.6	4.5%	24.8	7.1%	28.3	8.1%
12	3.2	0.9%	6.7	1.9%	6.6	1.9%	10.1	2.9%
13	2.2	0.6%	5.7	1.6%	6.9	2.0%	10.4	3.0%

Table C-5 Predicted 15-minute Mean SO_2 Concentrations

Receptor	99.90%ile 15-minute Mean SO_2 Concentration ($\mu g/m^3$)							
	'Existing' Scenario				'New' Scenario			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
1	28.4	**10.7%**	33.1	12.4%	59.7	**22.5%**	64.4	24.2%
2	8.6	3.2%	13.3	5.0%	17.6	6.6%	22.3	8.4%
3	7.6	2.9%	12.4	4.6%	14.5	5.4%	19.2	7.2%
4	6.3	2.4%	11.0	4.2%	13.8	5.2%	18.5	6.9%
5	4.0	1.5%	8.7	3.3%	13.0	4.9%	17.7	6.7%
6	6.3	2.4%	11.0	4.1%	14.3	5.4%	19.0	7.2%
7	6.6	2.5%	11.3	4.3%	13.2	5.0%	17.9	6.7%
8	7.0	2.6%	11.7	4.4%	12.3	4.6%	17.0	6.4%
9	12.4	4.7%	17.1	6.4%	22.6	8.5%	27.3	10.3%
10	2.5	0.9%	7.2	2.7%	7.5	2.8%	12.2	4.6%
11	17.9	6.7%	22.6	8.5%	34.9	**13.1%**	39.6	14.9%
12	5.6	2.1%	10.3	3.9%	11.7	4.4%	16.4	6.2%
13	3.3	1.2%	8.0	3.0%	11.8	4.5%	16.6	6.2%

Appendix D Modelled Ecological Receptor Results

Table D-1 Predicted Annual Mean NO_x Concentrations

Receptor	Designated Site	Annual Mean NOx Concentration (µg/m³)							
		'Existing' Scenario				'New' Scenario			
		PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
1	Hawkstone Wood LWS	0.2	0.5%	14.6	48.7%	0.2	0.6%	14.6	48.8%
2	Hawkstone Wood LWS	0.1	0.5%	14.6	48.7%	0.2	0.5%	14.6	48.7%
3	Spring and Jerrison Woods LWS	0.8	2.5%	15.2	50.7%	0.8	2.8%	15.3	51.0%
4	St Paul's Wood LWS	1.0	3.4%	15.4	51.5%	1.1	3.7%	15.6	51.8%
5	St Paul's Wood LWS	1.5	5.1%	16.0	53.2%	1.7	5.6%	16.1	53.8%
6	Spring and Jerrison Woods LWS	1.0	3.3%	15.4	51.4%	1.1	3.6%	15.5	51.8%
7	Spring and Jerrison Woods LWS	1.0	3.3%	16.6	55.2%	1.1	3.6%	16.7	55.6%
8	Spring and Jerrison Woods LWS	0.6	2.0%	16.2	53.9%	0.7	2.3%	16.3	54.2%
9	Nun Wood LWS	1.1	3.5%	16.6	55.3%	1.2	3.9%	16.7	55.6%
10	Millman Bridge Ox-bow LWS	0.3	1.0%	17.9	59.5%	0.3	1.1%	17.9	59.6%
11	Cragg Wood LWS	0.4	1.3%	16.9	56.3%	0.4	1.5%	16.9	56.4%
12	Shipley - Thackley Disused Railway LWS	0.2	0.8%	19.3	64.3%	0.3	0.9%	19.3	64.4%
13	Buck Wood West LWS	0.2	0.6%	16.0	53.4%	0.2	0.7%	16.0	53.4%
14	Buck Wood East LWS	1.4	4.6%	17.2	57.3%	1.5	5.0%	17.3	57.8%
15	Leeds Liverpool Canal LWS	3.6	12.1%	21.2	70.7%	4.0	13.5%	21.6	72.0%
16	Leeds Liverpool Canal LWS	2.5	8.1%	20.1	64.8%	2.8	8.9%	20.3	65.6%
17	Leeds Liverpool Canal LWS	1.1	3.4%	18.6	58.3%	1.2	3.7%	18.8	58.6%
18	Leeds Liverpool Canal LWS	1.1	3.3%	18.6	56.5%	1.2	3.6%	18.8	56.9%
19	South Pennine	0.0	0.04%	10.1	29.7%	0.0	0.0%	10.1	29.8%

Receptor	Designated Site	Annual Mean NOx Concentration (µg/m^3)							
		'Existing' Scenario				'New' Scenario			
		PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
	Moors SAC								
20	South Pennine Moors SAC	0.0	0.04%	10.3	29.4%	0.0	0.0%	10.3	29.4%
21	South Pennine Moors SAC	0.0	0.06%	10.6	29.4%	0.0	0.1%	10.6	29.4%
22	South Pennine Moors SAC	0.0	0.05%	10.3	27.9%	0.0	0.1%	10.3	27.9%
23	South Pennine Moors SAC	0.0	0.03%	10.4	27.3%	0.0	0.0%	10.4	27.3%
24	Buck Wood AW	0.6	1.6%	18.2	46.7%	0.7	1.9%	18.3	46.9%
25	Dawson/Poggy Wood AW	1.4	3.5%	19.0	47.4%	1.5	3.8%	19.1	47.8%
26	Spring/Hollins Wood AW	0.5	1.2%	14.9	36.4%	0.5	1.3%	15.0	36.6%
27	Leeds Liverpool Canal LWS	1.3	3.0%	18.8	44.9%	1.4	3.4%	19.0	45.2%
28	Leeds Liverpool Canal LWS	1.6	3.6%	19.1	44.5%	1.7	4.0%	19.3	44.9%
29	Leeds Liverpool Canal LWS	2.0	4.5%	19.6	44.4%	2.2	5.0%	19.8	45.0%
30	Leeds Liverpool Canal LWS	2.4	5.3%	19.9	44.3%	2.6	5.9%	20.2	44.9%
31	Leeds Liverpool Canal LWS	2.9	6.3%	20.4	44.5%	3.2	7.0%	20.8	45.2%
32	Leeds Liverpool Canal LWS	2.9	6.1%	20.4	43.5%	3.2	6.7%	20.7	44.1%
33	Leeds Liverpool Canal LWS	2.8	5.9%	20.4	42.5%	3.1	6.5%	20.7	43.1%
34	Leeds Liverpool Canal LWS	2.2	4.5%	19.8	40.3%	2.4	4.9%	20.0	40.8%
35	Leeds Liverpool Canal LWS	1.8	3.5%	19.3	38.7%	1.9	3.9%	19.5	39.0%
36	Leeds Liverpool Canal LWS	1.3	2.6%	18.9	37.0%	1.4	2.8%	19.0	37.3%
37	St Leonard's Farm LWS	0.4	0.8%	14.9	28.6%	0.5	0.9%	14.9	28.7%

Table D-2 Predicted 24-hour Mean NOx Concentrations

Receptor	Designated Site	24-hour Mean NOx Concentration (µg/m^3)							
		'Existing' Scenario				'New' Scenario			
		PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
1	Hawkstone Wood LWS	3.0	4.0%	31.9	42.5%	3.4	4.6%	32.3	43.1%
2	Hawkstone Wood LWS	1.7	2.3%	30.6	40.8%	1.7	2.3%	30.6	40.8%
3	Spring and Jerrison Woods LWS	13.0	17.3%	41.9	55.8%	13.9	18.6%	42.8	57.1%
4	St Paul's Wood LWS	12.3	16.4%	41.2	54.9%	13.3	17.7%	42.2	56.2%
5	St Paul's Wood LWS	13.3	17.8%	42.2	56.3%	14.5	19.3%	43.3	57.8%
6	Spring and Jerrison Woods LWS	11.8	15.7%	40.7	54.2%	13.6	18.1%	42.4	56.6%
7	Spring and Jerrison Woods LWS	10.8	14.4%	41.9	55.9%	12.0	16.0%	43.1	57.5%
8	Spring and Jerrison Woods LWS	6.7	8.9%	37.9	50.5%	7.5	9.9%	38.6	51.5%
9	Nun Wood LWS	10.6	14.2%	41.7	55.6%	11.4	15.3%	42.5	56.6%
10	Millman Bridge Ox-bow LWS	4.5	6.0%	39.6	52.8%	4.8	6.4%	39.9	53.2%
11	Cragg Wood LWS	4.2	5.6%	37.2	49.6%	5.0	6.7%	38.0	50.6%
12	Shipley - Thackley Disused Railway LWS	2.7	3.6%	40.8	54.4%	3.0	4.0%	41.1	54.9%
13	Buck Wood West LWS	2.4	3.1%	34.0	45.3%	2.6	3.5%	34.3	45.7%
14	Buck Wood East LWS	17.5	23.4%	49.2	65.6%	19.4	25.9%	51.1	68.1%
15	Leeds Liverpool Canal LWS	32.9	43.8%	68.0	90.7%	36.6	48.8%	71.7	95.6%
16	Leeds Liverpool Canal LWS	21.9	29.1%	57.0	76.0%	24.3	32.3%	59.4	79.2%
17	Leeds Liverpool Canal LWS	14.9	19.9%	50.0	66.7%	16.4	21.9%	51.6	68.8%
18	Leeds Liverpool Canal LWS	15.9	21.2%	51.0	68.1%	16.9	22.6%	52.1	69.4%
19	South Pennine Moors SAC	0.3	0.4%	20.5	27.4%	0.4	0.5%	20.6	27.4%
20	South Pennine Moors SAC	0.3	0.4%	20.8	27.8%	0.3	0.4%	20.9	27.8%

Receptor	Designated Site	24-hour Mean NOx Concentration (µg/m^3)							
		'Existing' Scenario				'New' Scenario			
		PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
21	South Pennine Moors SAC	0.4	0.5%	21.5	28.6%	0.4	0.5%	21.5	28.7%
22	South Pennine Moors SAC	0.4	0.5%	21.0	28.0%	0.4	0.5%	21.0	28.0%
23	South Pennine Moors SAC	0.2	0.3%	21.0	28.0%	0.3	0.4%	21.0	28.0%
24	Buck Wood AW	12.7	16.9%	47.8	63.7%	14.3	19.0%	49.4	65.9%
25	Dawson/Poggy Wood AW	24.3	32.3%	59.4	79.2%	26.4	35.2%	61.6	82.1%
26	Spring/Hollins Wood AW	10.2	13.5%	39.0	52.0%	11.0	14.7%	39.9	53.2%
27	Leeds Liverpool Canal LWS	17.4	23.2%	52.5	70.0%	18.5	24.6%	53.6	71.5%
28	Leeds Liverpool Canal LWS	18.5	24.6%	53.6	71.5%	19.8	26.4%	55.0	73.3%
29	Leeds Liverpool Canal LWS	22.1	29.5%	57.3	76.4%	24.7	33.0%	59.9	79.8%
30	Leeds Liverpool Canal LWS	25.1	33.4%	60.2	80.3%	27.2	36.2%	62.3	83.1%
31	Leeds Liverpool Canal LWS	32.6	43.4%	67.7	90.3%	36.2	48.3%	71.3	95.1%
32	Leeds Liverpool Canal LWS	31.9	42.5%	67.0	89.4%	33.6	44.8%	68.8	91.7%
33	Leeds Liverpool Canal LWS	25.4	33.9%	60.6	80.8%	27.2	36.2%	62.3	83.1%
34	Leeds Liverpool Canal LWS	22.4	29.8%	57.5	76.7%	24.1	32.1%	59.2	78.9%
35	Leeds Liverpool Canal LWS	21.9	29.2%	57.1	76.1%	23.7	31.6%	58.8	78.4%
36	Leeds Liverpool Canal LWS	15.5	20.6%	50.6	67.5%	16.8	22.4%	51.9	69.2%
37	St Leonard's Farm LWS	8.7	11.6%	37.6	50.2%	8.9	11.9%	37.8	50.5%

Table D-3 Predicted Annual Mean SO_2 Concentrations

Receptor	Designated Site	Annual Mean SO_2 Concentration (µg/m^3)							
		'Existing' Scenario				'New' Scenario			
		PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
1	Hawkstone Wood LWS	0.0	0.1%	1.3	6.7%	0.1	0.5%	1.4	7.1%
2	Hawkstone Wood LWS	0.0	0.1%	1.3	6.7%	0.1	0.4%	1.4	7.0%
3	Spring and Jerrison Woods LWS	0.1	0.7%	1.5	7.3%	0.4	2.0%	1.7	8.6%
4	St Paul's Wood LWS	0.2	0.9%	1.5	7.5%	0.5	2.6%	1.8	9.2%
5	St Paul's Wood LWS	0.3	1.4%	1.6	8.0%	0.8	4.0%	2.1	10.6%
6	Spring and Jerrison Woods LWS	0.2	0.9%	1.5	7.5%	0.5	2.5%	1.8	9.1%
7	Spring and Jerrison Woods LWS	0.2	0.9%	1.5	7.5%	0.5	2.5%	1.8	9.1%
8	Spring and Jerrison Woods LWS	0.1	0.5%	1.4	7.1%	0.3	1.7%	1.7	8.3%
9	Nun Wood LWS	0.2	1.0%	2.8	14.1%	0.6	2.8%	3.2	15.8%
10	Millman Bridge Ox-bow LWS	0.1	0.3%	2.7	13.4%	0.1	0.7%	2.8	13.8%
11	Cragg Wood LWS	0.1	0.3%	2.0	10.0%	0.2	1.1%	2.2	10.8%
12	Shipley - Thackley Disused Railway LWS	0.0	0.2%	2.6	13.2%	0.1	0.7%	2.7	13.7%
13	Buck Wood West LWS	0.0	0.2%	2.6	13.2%	0.1	0.5%	2.7	13.6%
14	Buck Wood East LWS	0.3	1.3%	2.9	14.3%	0.7	3.5%	3.3	16.5%
15	Leeds Liverpool Canal LWS	0.6	3.1%	3.3	15.5%	1.9	9.1%	4.5	21.6%
16	Leeds Liverpool Canal LWS	0.5	2.2%	3.1	14.1%	1.3	5.7%	3.9	17.6%
17	Leeds Liverpool	0.2	0.9%	2.8	12.2%	0.5	2.3%	3.1	13.7%

Receptor	Designated Site	Annual Mean SO_2 Concentration (µg/m^3)							
		'Existing' Scenario				'New' Scenario			
		PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
	Canal LWS								
18	Leeds Liverpool Canal LWS	0.2	0.8%	2.8	11.7%	0.6	2.4%	3.2	13.2%
19	South Pennine Moors SAC	0.0	0.0%	1.0	3.9%	0.0	0.0%	1.0	3.9%
20	South Pennine Moors SAC	0.0	0.0%	1.0	3.8%	0.0	0.0%	1.0	3.8%
21	South Pennine Moors SAC	0.0	0.0%	1.0	3.7%	0.0	0.0%	1.0	3.7%
22	South Pennine Moors SAC	0.0	0.0%	1.0	3.4%	0.0	0.0%	1.0	3.5%
23	South Pennine Moors SAC	0.0	0.0%	1.0	3.4%	0.0	0.0%	1.0	3.4%
24	Buck Wood AW	0.1	0.3%	2.7	9.0%	0.4	1.2%	3.0	9.9%
25	Dawson/Poggy Wood AW	0.3	0.8%	2.9	9.3%	0.7	2.3%	3.3	10.7%
26	Spring/Hollins Wood AW	0.1	0.3%	1.4	4.4%	0.3	0.8%	1.6	4.9%
27	Leeds Liverpool Canal LWS	0.2	0.7%	2.8	8.6%	0.7	2.1%	3.3	10.0%
28	Leeds Liverpool Canal LWS	0.3	0.8%	2.9	8.5%	0.8	2.4%	3.4	10.1%
29	Leeds Liverpool Canal LWS	0.3	1.0%	3.0	8.5%	1.1	3.0%	3.7	10.5%
30	Leeds Liverpool Canal LWS	0.4	1.2%	3.0	8.4%	1.3	3.5%	3.9	10.8%
31	Leeds Liverpool Canal LWS	0.5	1.4%	3.1	8.4%	1.5	4.1%	4.1	11.1%
32	Leeds Liverpool Canal LWS	0.5	1.4%	3.2	8.3%	1.4	3.8%	4.0	10.7%
33	Leeds Liverpool Canal LWS	0.5	1.4%	3.2	8.1%	1.4	3.6%	4.0	10.3%
34	Leeds Liverpool Canal LWS	0.4	1.0%	3.0	7.6%	1.1	2.7%	3.7	9.3%
35	Leeds Liverpool Canal LWS	0.3	0.8%	2.9	7.2%	0.9	2.2%	3.5	8.5%
36	Leeds Liverpool Canal LWS	0.2	0.6%	2.9	6.8%	0.7	1.6%	3.3	7.8%

Receptor	Designated Site	Annual Mean SO_2 Concentration (µg/m^3)							
		'Existing' Scenario				'New' Scenario			
		PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
37	St Leonard's Farm LWS	0.1	0.2%	1.4	3.3%	0.2	0.5%	1.5	3.6%

Table D-4 Predicted Annual Nitrogen Deposition Rates

Receptor	Designated Site	Annual Nitrogen Deposition (kgN/ha/yr)							
		'Existing' Scenario				'New' Scenario			
		PC	PC as % of C_{Lo}	PEC	PEC as % of C_{Lo}	PC	PC as % of C_{Lo}	PEC	PEC as % of C_{Lo}
1	Hawkstone Wood LWS	0.03	0.33%	42.0	420.3%	0.04	0.37%	42.0	420.4%
2	Hawkstone Wood LWS	0.03	0.29%	42.0	420.3%	0.03	0.33%	42.0	420.3%
3	Spring and Jerrison Woods LWS	0.15	1.54%	42.2	421.5%	0.17	1.71%	42.2	421.7%
4	St Paul's Wood LWS	0.20	2.03%	42.2	422.0%	0.22	2.24%	42.2	422.2%
5	St Paul's Wood LWS	0.31	3.08%	42.3	423.1%	0.34	3.41%	42.3	423.4%
6	Spring and Jerrison Woods LWS	0.20	1.99%	42.2	422.0%	0.22	2.20%	42.2	422.2%
7	Spring and Jerrison Woods LWS	0.20	2.00%	42.2	422.0%	0.22	2.20%	42.2	422.2%
8	Spring and Jerrison Woods LWS	0.12	1.21%	42.1	421.2%	0.14	1.37%	42.1	421.4%
9	Nun Wood LWS	0.21	2.14%	38.6	385.7%	0.24	2.36%	38.6	386.0%
10	Millman Bridge Ox-bow LWS	0.06	0.63%	38.4	384.2%	0.07	0.68%	38.4	384.3%
11	Cragg Wood LWS	0.08	0.80%	38.4	384.4%	0.09	0.91%	38.5	384.5%
12	Shipley - Thackley Disused Railway LWS	0.05	0.48%	38.4	384.1%	0.05	0.54%	38.4	384.1%
13	Buck Wood West LWS	0.04	0.38%	38.4	384.0%	0.04	0.42%	38.4	384.0%
14	Buck Wood East LWS	0.28	2.77%	38.6	386.4%	0.30	3.04%	38.7	386.6%
15	Leeds Liverpool Canal LWS	0.37	3.66%	23.9	238.9%	0.41	4.07%	23.9	239.3%

Receptor	Designated Site	Annual Nitrogen Deposition (kgN/ha/yr)							
		'Existing' Scenario				'New' Scenario			
		PC	PC as % of C_{Lo}	PEC	PEC as % of C_{Lo}	PC	PC as % of C_{Lo}	PEC	PEC as % of C_{Lo}
16	Leeds Liverpool Canal LWS	0.25	2.54%	23.8	237.7%	0.28	2.79%	23.8	238.0%
17	Leeds Liverpool Canal LWS	0.11	1.08%	23.6	236.3%	0.12	1.19%	23.6	236.4%
18	Leeds Liverpool Canal LWS	0.11	1.08%	23.6	236.3%	0.12	1.21%	23.6	236.4%
19	South Pennine Moors SAC	0.00	0.03%	24.9	498.0%	0.00	0.03%	24.9	498.0%
20	South Pennine Moors SAC	0.00	0.03%	25.2	504.0%	0.00	0.03%	25.2	504.0%
21	South Pennine Moors SAC	0.00	0.04%	25.5	510.0%	0.00	0.05%	25.5	510.0%
22	South Pennine Moors SAC	0.00	0.04%	25.3	506.0%	0.00	0.04%	25.3	506.0%
23	South Pennine Moors SAC	0.00	0.02%	24.4	488.0%	0.00	0.02%	24.4	488.0%
24	Buck Wood AW	0.13	1.29%	38.5	384.9%	0.15	1.46%	38.5	385.1%
25	Dawson/Poggy Wood AW	0.28	2.80%	38.6	386.4%	0.31	3.09%	38.7	386.7%
26	Spring/Hollins Wood AW	0.10	1.00%	42.1	421.0%	0.11	1.11%	42.1	421.1%
27	Leeds Liverpool Canal LWS	0.13	1.29%	23.6	236.5%	0.14	1.44%	23.7	236.6%
28	Leeds Liverpool Canal LWS	0.16	1.58%	23.7	236.8%	0.18	1.75%	23.7	237.0%
29	Leeds Liverpool Canal LWS	0.20	2.00%	23.7	237.2%	0.22	2.23%	23.7	237.4%
30	Leeds Liverpool Canal LWS	0.24	2.39%	23.8	237.6%	0.27	2.67%	23.8	237.9%
31	Leeds Liverpool Canal LWS	0.29	2.90%	23.8	238.1%	0.32	3.23%	23.8	238.4%
32	Leeds Liverpool Canal LWS	0.29	2.90%	23.8	238.1%	0.32	3.19%	23.8	238.4%
33	Leeds Liverpool Canal LWS	0.29	2.87%	23.8	238.1%	0.32	3.15%	23.8	238.4%
34	Leeds Liverpool Canal LWS	0.22	2.21%	23.7	237.4%	0.24	2.43%	23.8	237.6%
35	Leeds Liverpool Canal LWS	0.18	1.77%	23.7	237.0%	0.20	1.95%	23.7	237.2%

Receptor	Designated Site	Annual Nitrogen Deposition (kgN/ha/yr)							
		'Existing' Scenario				'New' Scenario			
		PC	PC as % of C_{Lo}	PEC	PEC as % of C_{Lo}	PC	PC as % of C_{Lo}	PEC	PEC as % of C_{Lo}
36	Leeds Liverpool Canal LWS	0.13	1.31%	23.7	236.5%	0.14	1.44%	23.7	236.6%
37	St Leonard's Farm LWS	0.09	0.88%	42.1	420.9%	0.10	0.97%	42.1	421.0%

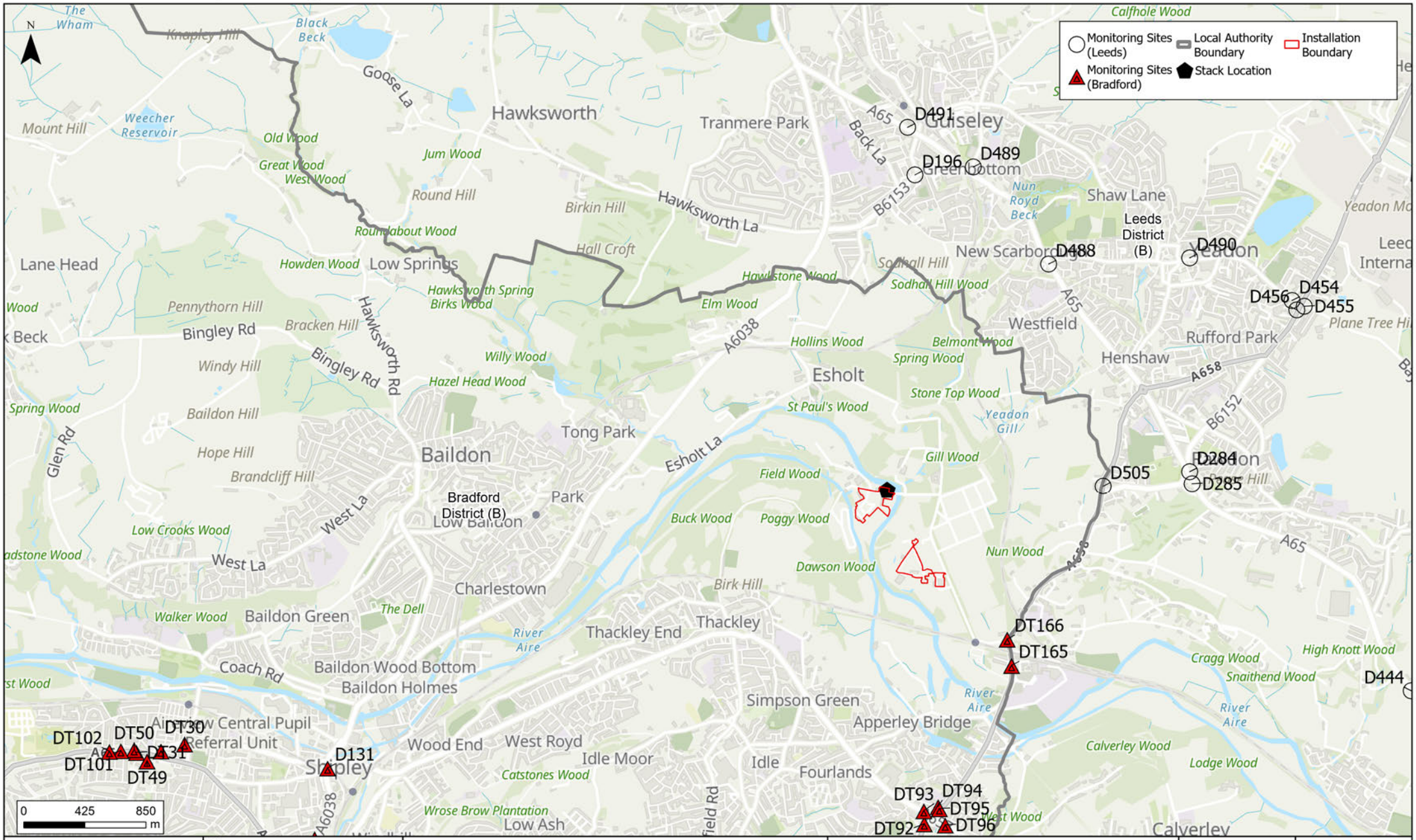
Table D-5 Predicted Annual Acid Deposition Rates

Receptor	Designated Site	Annual Acid Deposition (keq/ha/yr)							
		'Existing' Scenario				'New' Scenario			
		PC	PC as % of C_{Lo}	PEC	PEC as % of C_{Lo}	PC	PC as % of C_{Lo}	PEC	PEC as % of C_{Lo}
1	Hawkstone Wood LWS	0.009	0.3%	3.3	108.3%	0.024	0.8%	3.3	108.8%
2	Hawkstone Wood LWS	0.008	0.3%	3.3	108.3%	0.021	0.7%	3.3	108.7%
3	Spring and Jerrison Woods LWS	0.043	1.4%	3.3	109.6%	0.107	3.5%	3.4	111.7%
4	St Paul's Wood LWS	0.059	1.9%	3.4	110.1%	0.138	4.5%	3.4	112.7%
5	St Paul's Wood LWS	0.087	2.9%	3.4	111.0%	0.212	7.0%	3.5	115.1%
6	Spring and Jerrison Woods LWS	0.057	1.9%	3.4	110.0%	0.136	4.4%	3.4	112.6%
7	Spring and Jerrison Woods LWS	0.058	1.9%	3.4	110.2%	0.135	4.4%	3.4	112.8%
8	Spring and Jerrison Woods LWS	0.031	1.0%	3.3	109.4%	0.090	3.0%	3.4	111.3%
9	Nun Wood LWS	0.063	2.1%	3.1	104.1%	0.147	4.9%	3.2	106.9%
10	Millman Bridge Ox-bow LWS	0.020	0.7%	3.1	102.7%	0.039	1.3%	3.1	103.3%
11	Cragg Wood LWS	0.021	0.8%	3.1	119.0%	0.060	2.3%	3.2	120.5%
12	Shipley - Thackley Disused Railway LWS	0.013	1.1%	3.1	271.8%	0.035	3.1%	3.1	273.7%
13	Buck Wood West LWS	0.010	0.9%	3.1	271.8%	0.028	2.4%	3.1	273.3%
14	Buck Wood East LWS	0.081	2.7%	3.2	104.5%	0.187	6.2%	3.3	108.0%
15	Leeds Liverpool Canal LWS	0.102	Not Sensitive	2.1	Not Sensitive	0.256	Not Sensitive	2.2	Not Sensitive
16	Leeds Liverpool Canal LWS	0.075	Not Sensitive	2.0	Not Sensitive	0.169	Not Sensitive	2.1	Not Sensitive
17	Leeds Liverpool Canal LWS	0.032	Not Sensitive	2.0	Not Sensitive	0.072	Not Sensitive	2.0	Not Sensitive

Receptor	Designated Site	Annual Acid Deposition (keq/ha/yr)							
		'Existing' Scenario				'New' Scenario			
		PC	PC as % of C_{Lo}	PEC	PEC as % of C_{Lo}	PC	PC as % of C_{Lo}	PEC	PEC as % of C_{Lo}
18	Leeds Liverpool Canal LWS	0.030	Not Sensitive	2.0	Not Sensitive	0.076	Not Sensitive	2.0	Not Sensitive
19	South Pennine Moors SAC	0.000	0.1%	2.0	333.4%	0.001	0.2%	2.0	333.5%
20	South Pennine Moors SAC	0.000	0.1%	2.1	350.1%	0.001	0.2%	2.1	350.2%
21	South Pennine Moors SAC	0.001	0.1%	2.1	350.1%	0.001	0.2%	2.1	350.2%
22	South Pennine Moors SAC	0.000	0.1%	2.1	350.1%	0.001	0.2%	2.1	350.2%
23	South Pennine Moors SAC	0.000	0.0%	2.0	333.4%	0.001	0.1%	2.0	333.5%
24	Buck Wood AW	0.034	1.1%	3.1	103.0%	0.096	3.2%	3.2	105.0%
25	Dawson/Poggy Wood AW	0.082	2.7%	3.2	104.6%	0.190	6.3%	3.3	108.1%
26	Spring/Hollins Wood AW	0.029	1.0%	3.3	109.1%	0.069	2.3%	3.4	110.4%
27	Leeds Liverpool Canal LWS	0.036	Not Sensitive	2.0	Not Sensitive	0.090	Not Sensitive	2.1	Not Sensitive
28	Leeds Liverpool Canal LWS	0.044	Not Sensitive	2.0	Not Sensitive	0.111	Not Sensitive	2.1	Not Sensitive
29	Leeds Liverpool Canal LWS	0.056	Not Sensitive	2.0	Not Sensitive	0.141	Not Sensitive	2.1	Not Sensitive
30	Leeds Liverpool Canal LWS	0.067	Not Sensitive	2.0	Not Sensitive	0.168	Not Sensitive	2.1	Not Sensitive
31	Leeds Liverpool Canal LWS	0.081	Not Sensitive	2.1	Not Sensitive	0.202	Not Sensitive	2.2	Not Sensitive
32	Leeds Liverpool Canal LWS	0.086	Not Sensitive	2.1	Not Sensitive	0.193	Not Sensitive	2.2	Not Sensitive
33	Leeds Liverpool Canal LWS	0.085	Not Sensitive	2.1	Not Sensitive	0.191	Not Sensitive	2.2	Not Sensitive
34	Leeds Liverpool Canal LWS	0.065	Not Sensitive	2.0	Not Sensitive	0.147	Not Sensitive	2.1	Not Sensitive
35	Leeds Liverpool Canal LWS	0.052	Not Sensitive	2.0	Not Sensitive	0.119	Not Sensitive	2.1	Not Sensitive
36	Leeds Liverpool Canal LWS	0.038	Not Sensitive	2.0	Not Sensitive	0.088	Not Sensitive	2.1	Not Sensitive
37	St Leonard's Farm LWS	0.026	0.8%	3.3	108.9%	0.059	1.9%	3.4	110.0%

Appendix E Figures

Document Path: J:\33100176\2\YorkshireWaterIED\Esholt\Plans and Figures\ArcGIS\Esholt\Esholt.aprx



Stantec

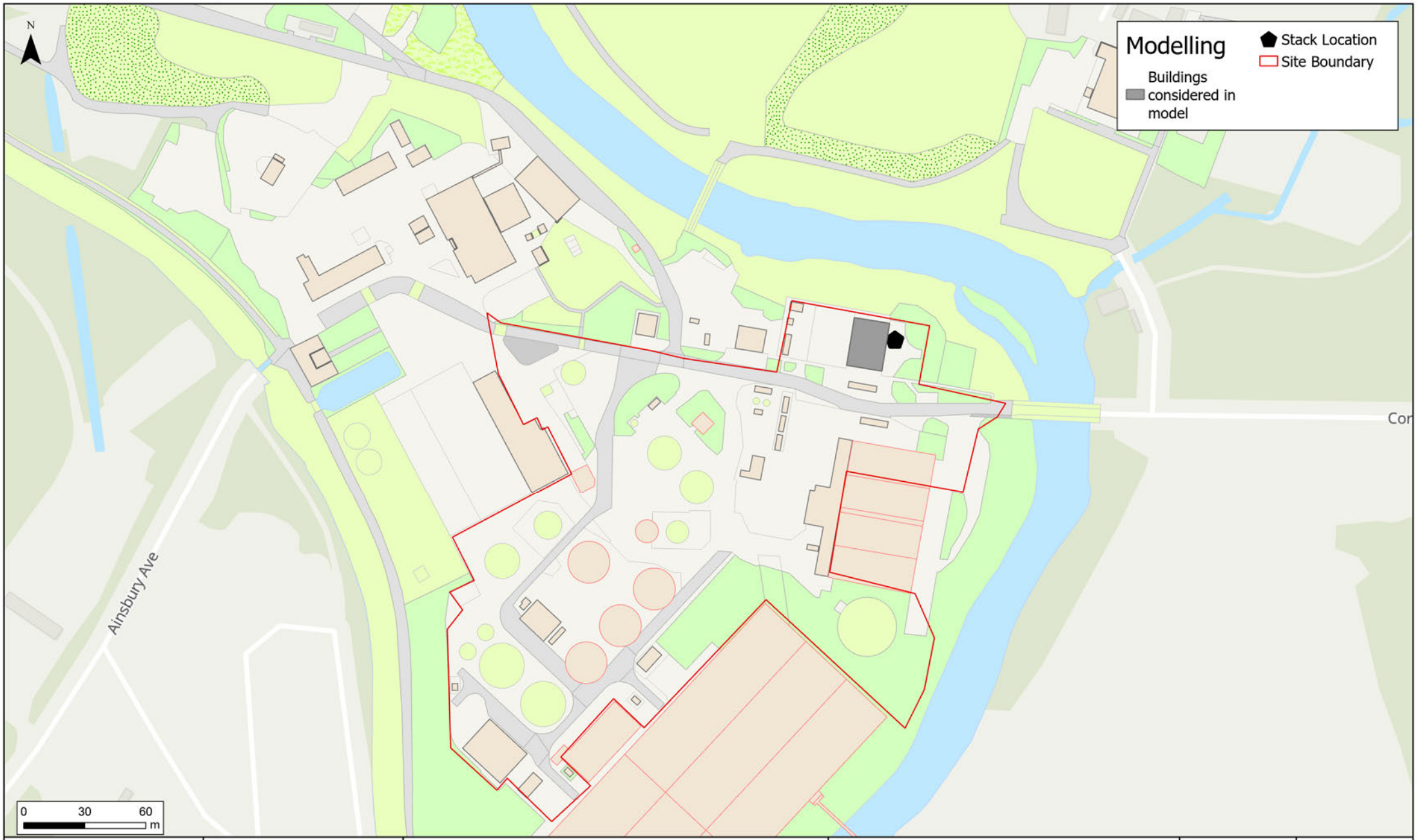
Client: YorkshireWater

Esholt Wastewater Treatment Works

Air Quality Monitoring Locations

1:33,875 @ A4	Date: 19/01/2023
Drawn: dafrancis	Checked: LS
Figure 01	Rev A

Document Path: J:\331001762\YorkshireWaterIED\Esholt\Plans and Figures\ArcGIS\Escholt\Escholt.aprx



Stantec

Client

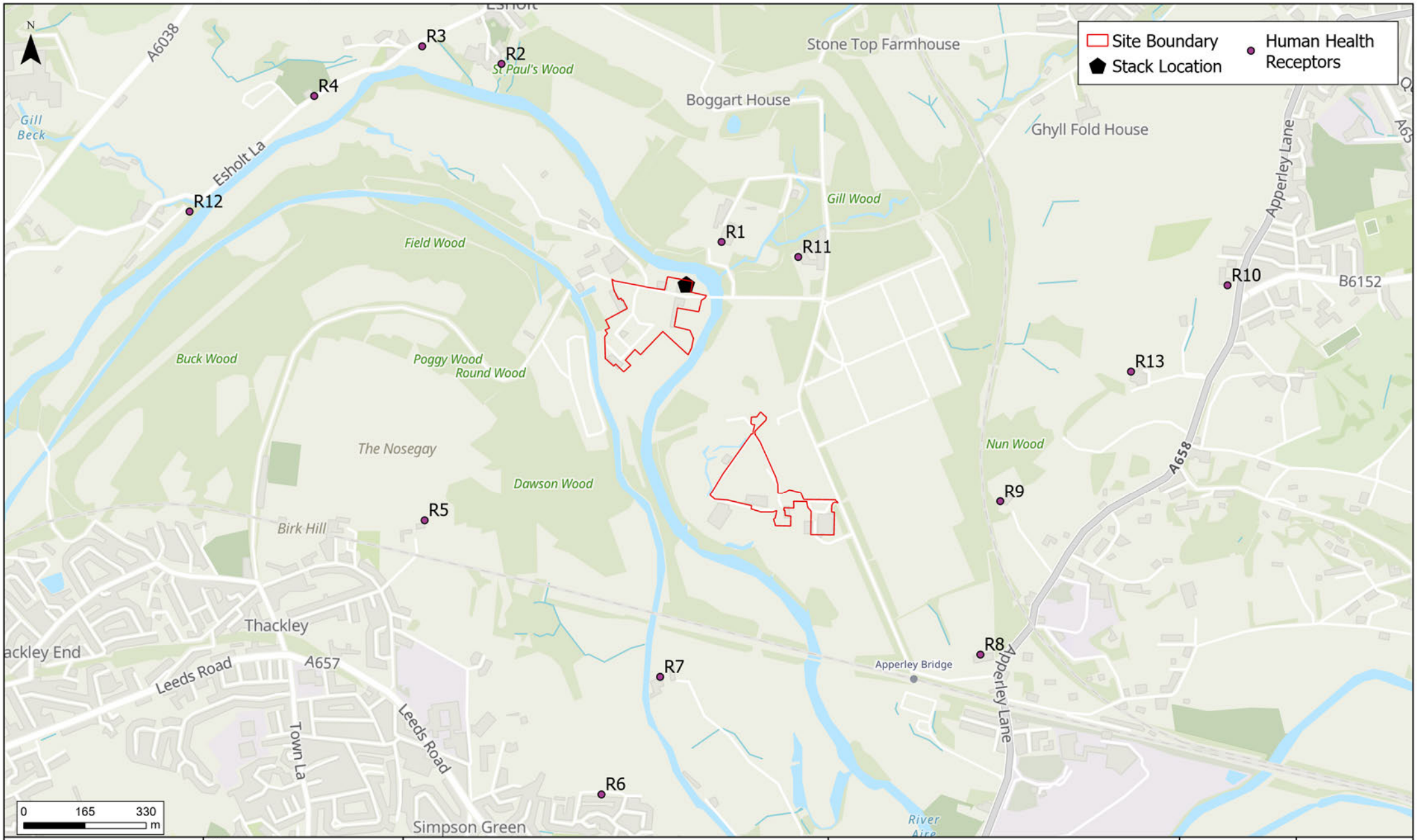
YorkshireWater

Esholt Wastewater Treatment Works

Modelled Building and Stack Locations

1:2,396 @ A4	Date: 19/01/2023
Drawn: dafrancis	Checked: LS
Figure 02	Rev A

Document Path: J:\33100176\2\YorkshireWaterIED\Esholt\Plans and Figures\ArcGIS\Esholt\Esholt.aprx



Stantec

Client

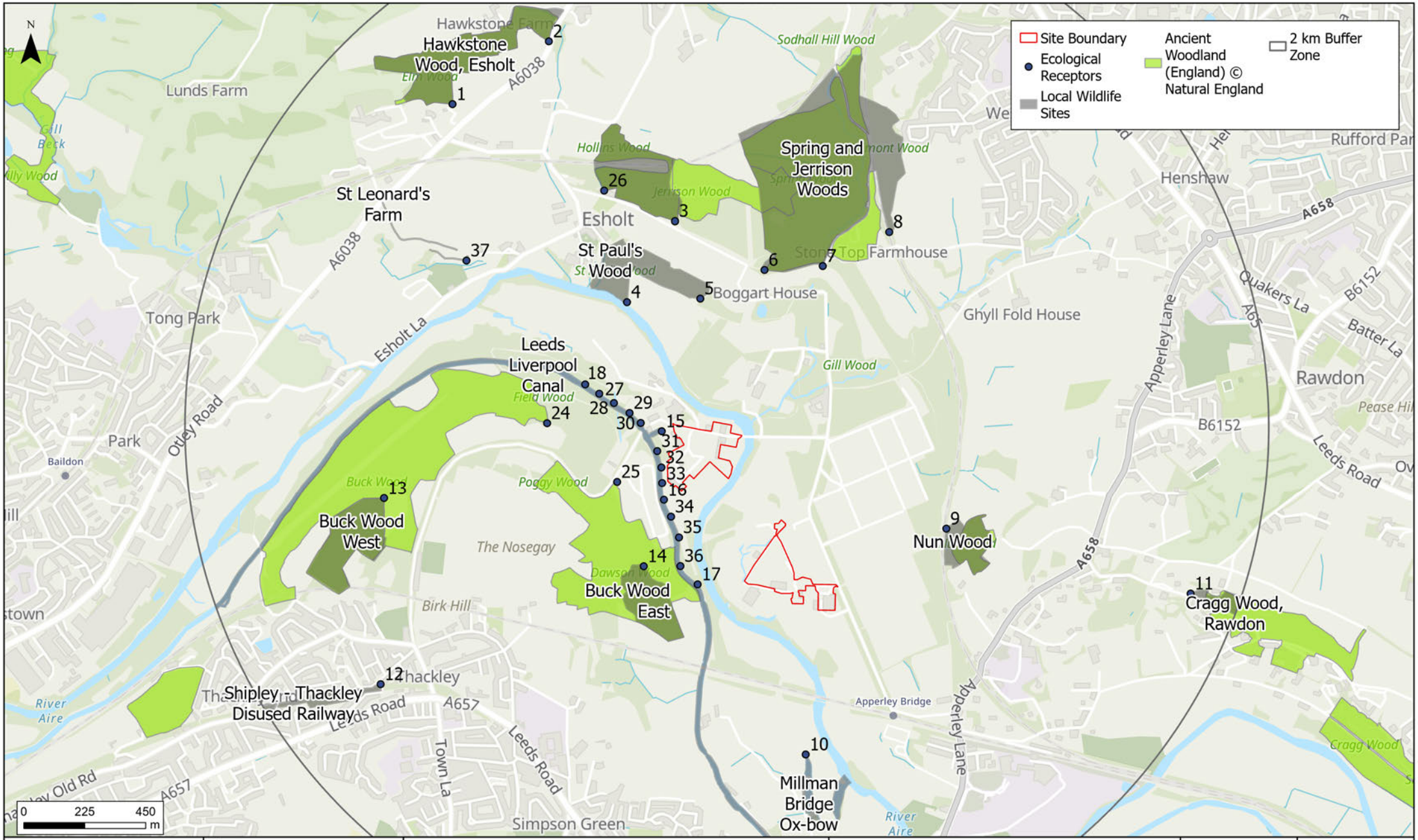
YorkshireWater

Esholt Wastewater Treatment Works

Human Health Receptors

1:13,140 @ A4	Date: 19/01/2023
Drawn: dafrancis	Checked: LS
Figure 03	Rev A

Document Path: J:\33100176\2\YorkshireWaterIED\Esholt\Plans and Figures\ArcGIS\Esholt\Esholt.aprx



Stantec

Client

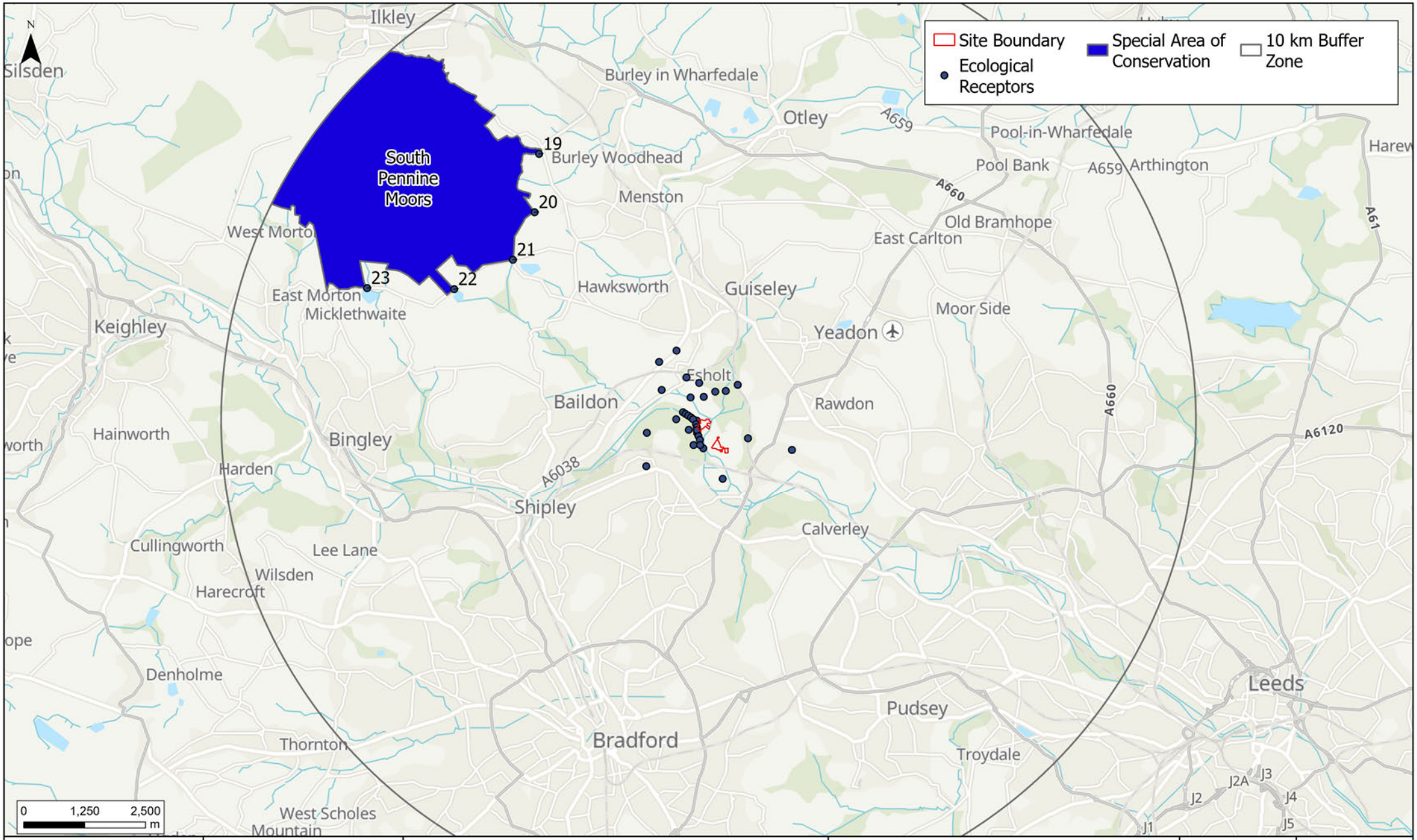
YorkshireWater

Esholt Wastewater Treatment Works

Ecological Receptors within 2km

1:18,000 @ A4	Date: 19/01/2023
Drawn: dafrancis	Checked: LS
Figure 04	Rev A

Document Path: J:\331001762\YorkshireWaterIED\Esholt\Plans and Figures\ArcGIS\Esholt\Esholt.aprx



Stantec

Client

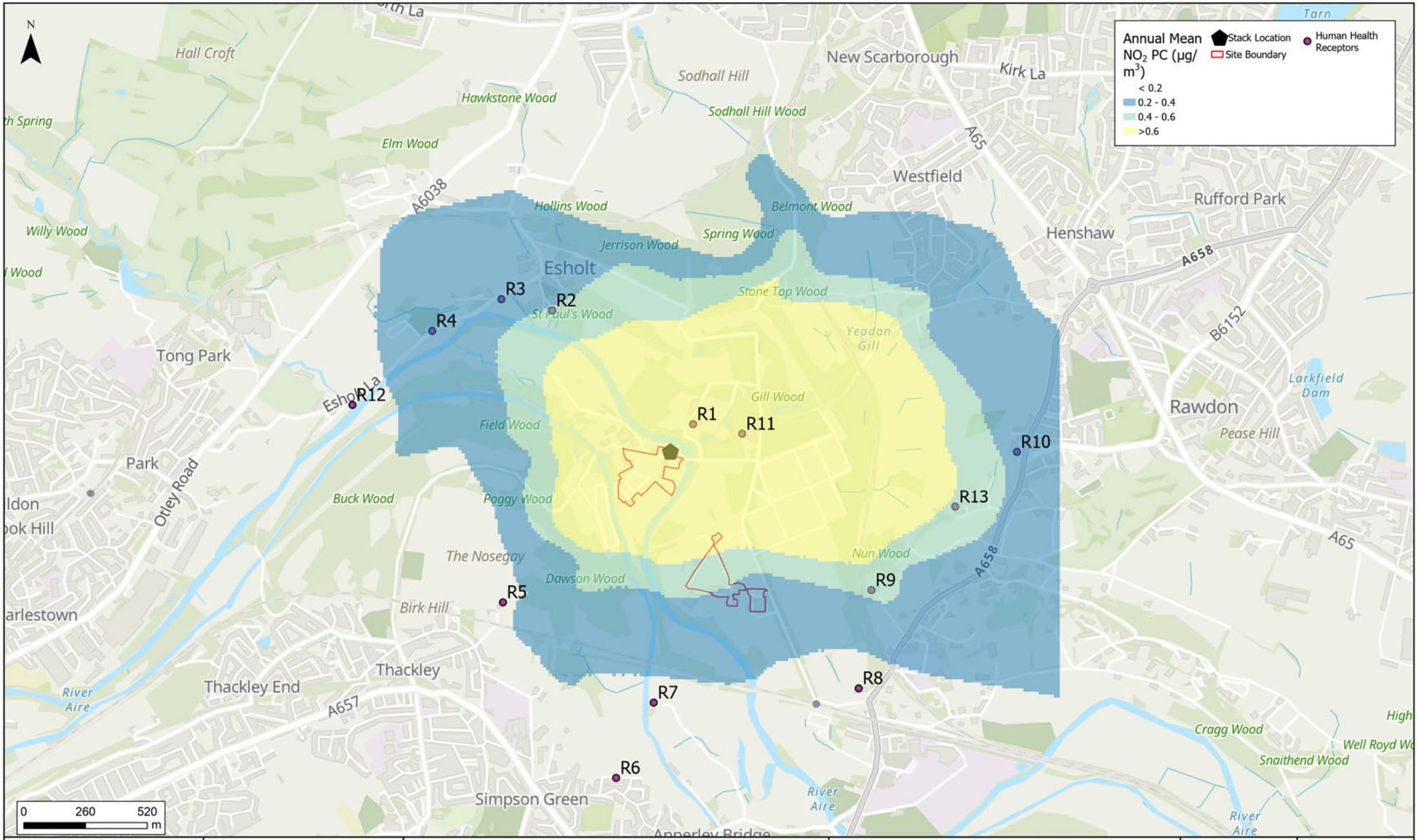
YorkshireWater

Esholt Wastewater Treatment Works

Ecological Receptors within 10 km

1:100,000 @ A4	Date: 19/01/2023
Drawn: dafrancis	Checked: LS
Figure 05	Rev A

Document Path: J:\33100176Z\YorkshireWaterIED\Esholt\Plans and Figures\ArcGIS\Escholt\Escholt.aprx



Stantec

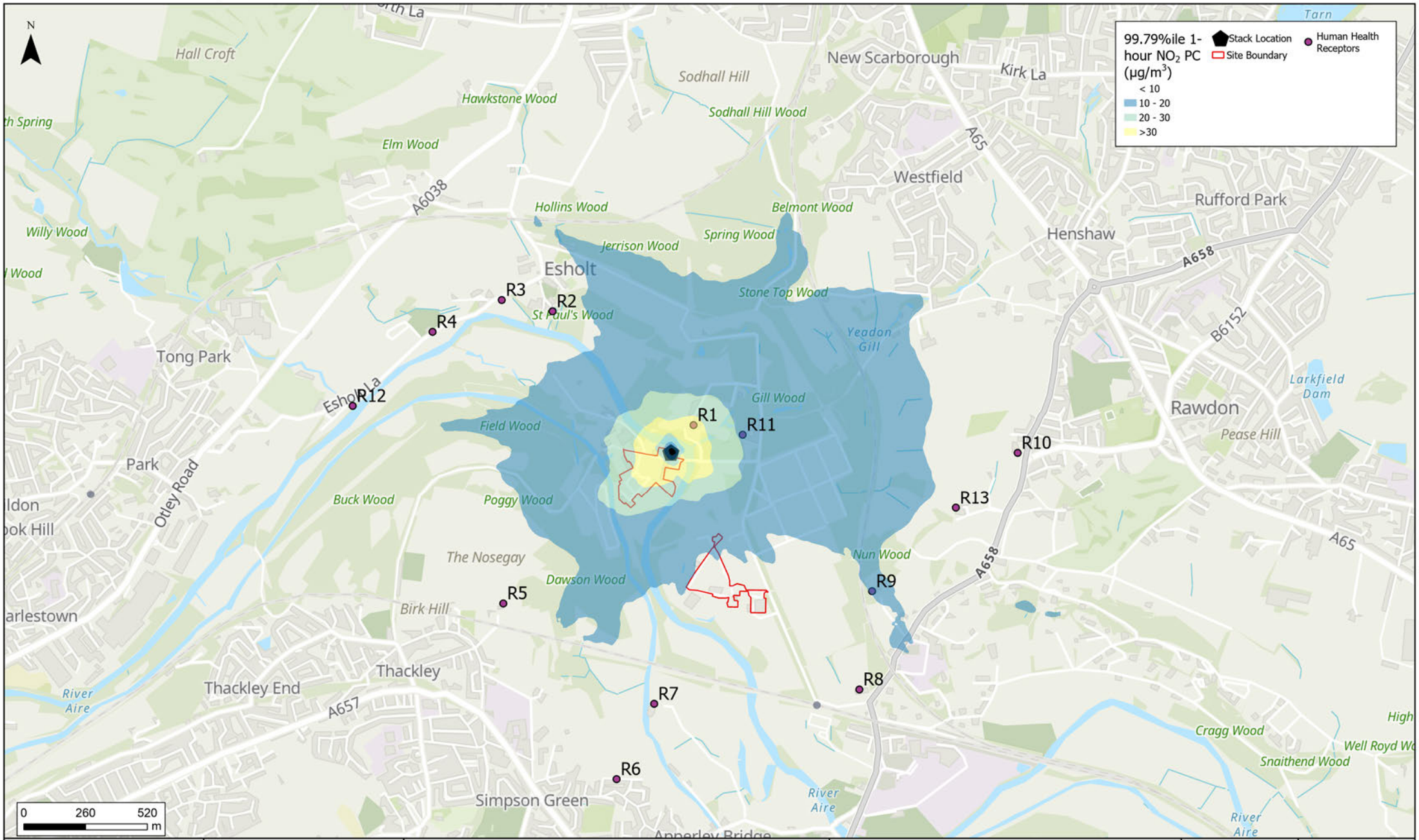
Client: YorkshireWater

Esholt Wastewater Treatment Works

2017 'New' Scenario Predicted Annual Mean NO_2 Process Contribution (PC) Contours

1:20,538 @ A4	Date: 19/01/2023
Drawn: dafrancis	Checked: PB
Figure 06	Rev A

Document Path: J:\33100176Z\YorkshireWaterIED\Esholt\Plans and Figures\ArcGIS\Escholt\Escholt.aprx



Stantec

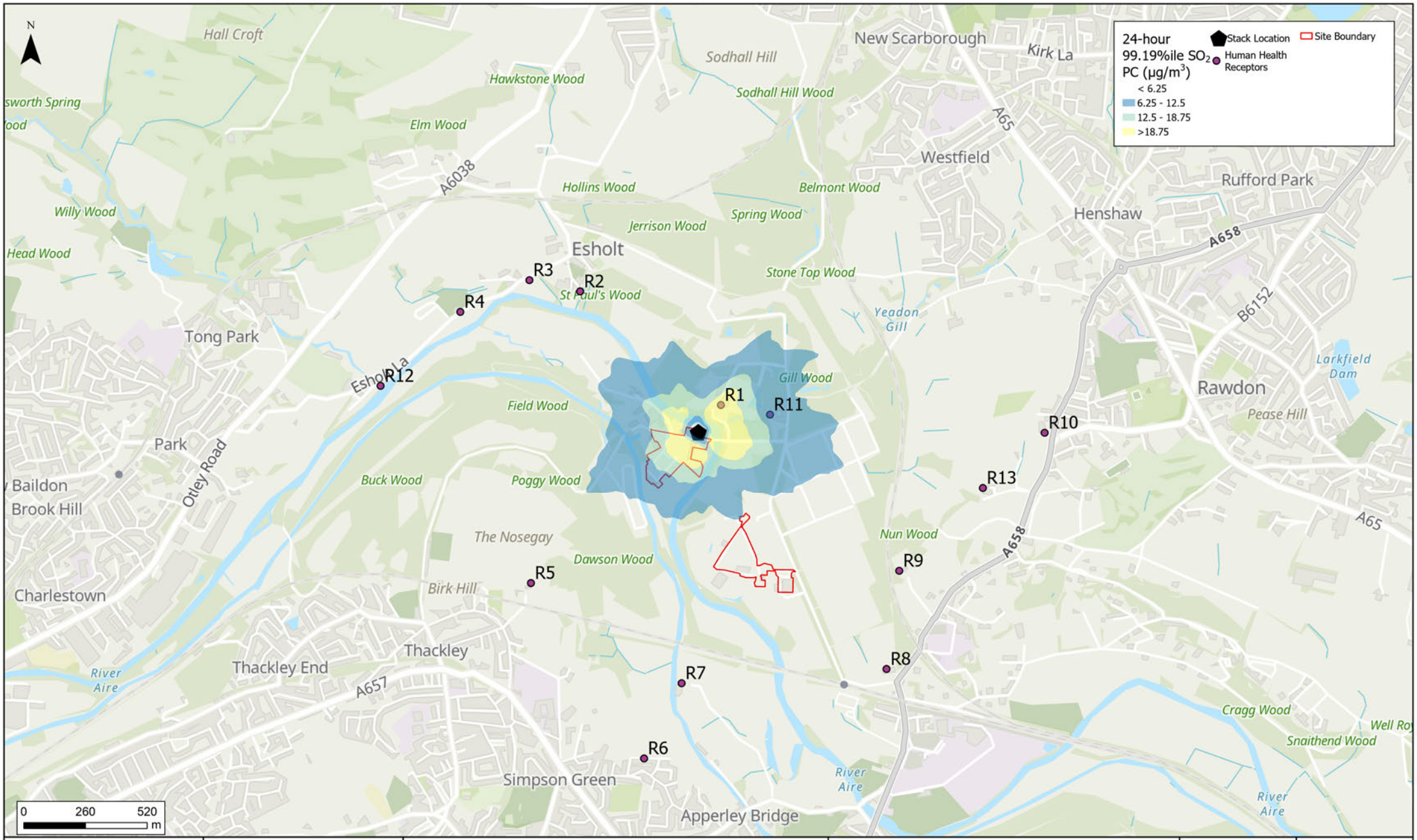
Client: YorkshireWater

Esholt Wastewater Treatment Works

2018 'New' Scenario Predicted 1-hour Mean NO_2 (99.79%ile) Process Contribution (PC) Contours

1:20,538 @ A4	Date: 19/01/2023
Drawn: dafrancis	Checked: PB
Figure 07	Rev A

Document Path: J:\33100176Z\YorkshireWaterIED\Esholt\Plans and Figures\ArcGIS\Escholt\Escholt.aprx



Stantec

Client

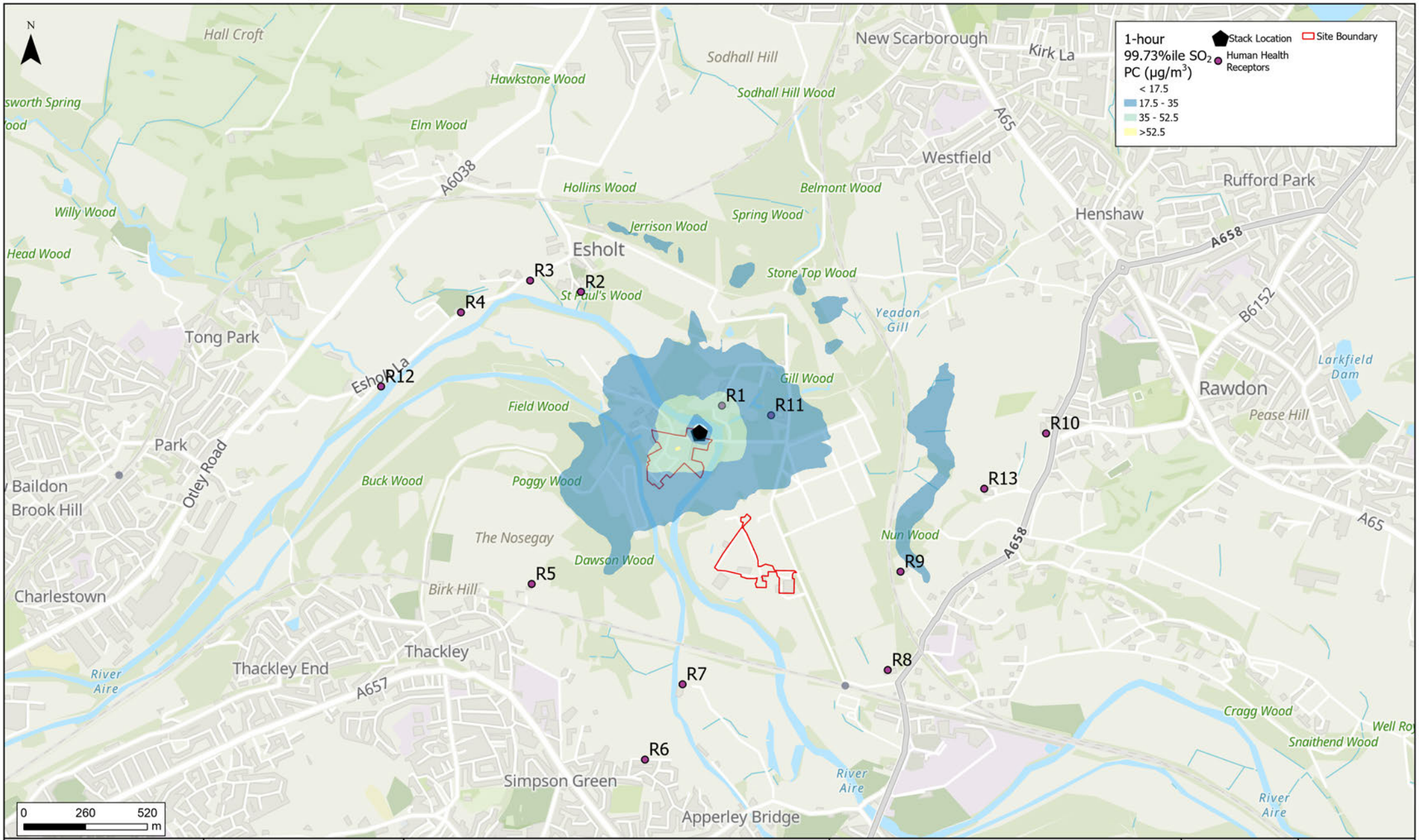
YorkshireWater

Esholt Wastewater Treatment Works

2019 'New' Scenario Predicted 24-hour Mean SO_2 (99.19%ile) Process Contribution (PC) Contours

1:20,538 @ A4	Date: 19/01/2023
Drawn: dafrancis	Checked: PB
Figure 08	Rev A

Document Path: J:\33100176Z\YorkshireWaterIED\Esholt\Plans and Figures\ArcGIS\Escholt\Escholt.aprx



Stantec

Client

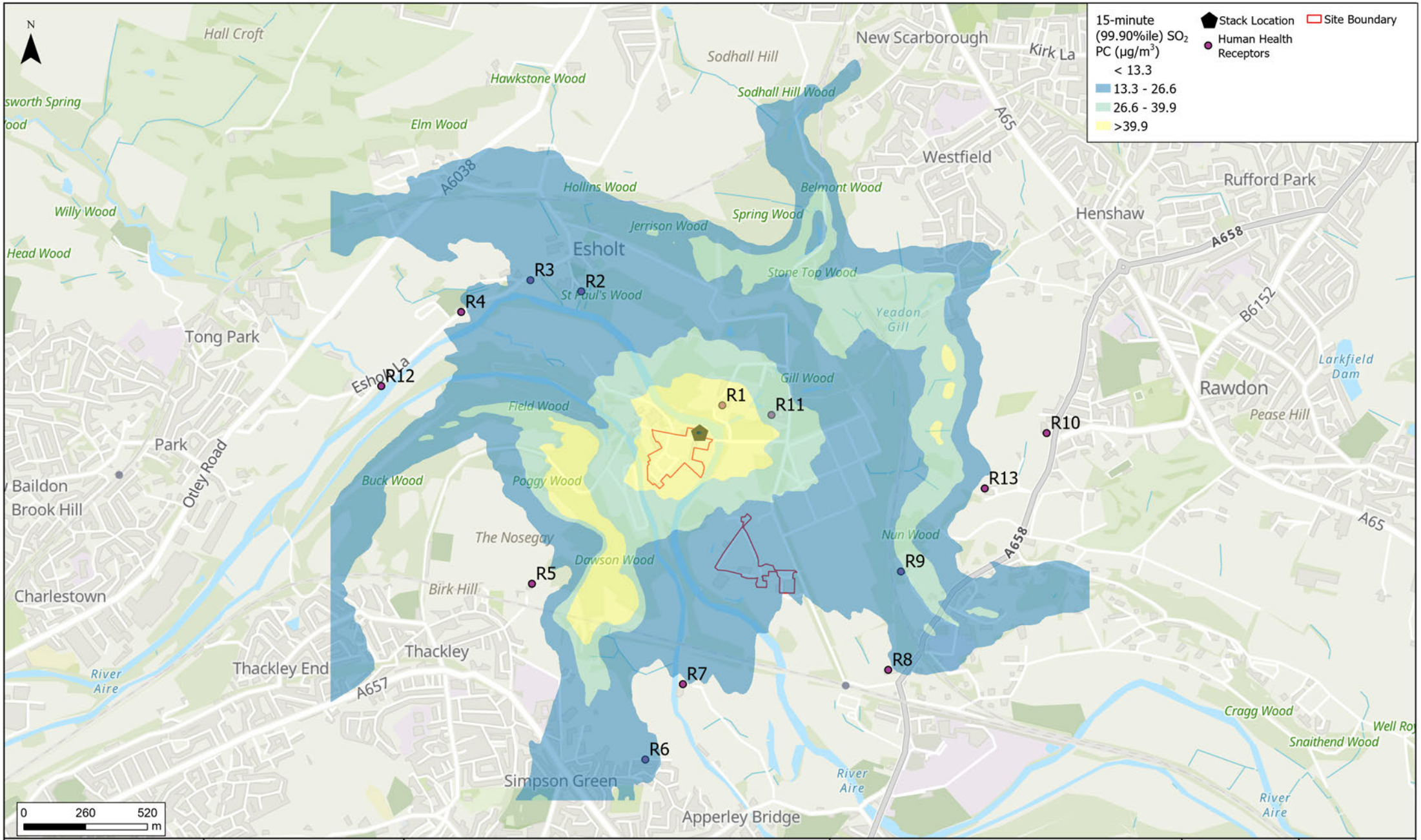
YorkshireWater

Esholt Wastewater Treatment Works

2019 'New' Scenario Predicted 1-hour Mean SO_2 (99.73%ile) Process Contribution (PC) Contours

1:20,538 @ A4	Date: 19/01/2023
Drawn: dafrancis	Checked: PB
Figure 09	Rev A

Document Path: J:\33100176Z\YorkshireWaterIED\Esholt\Plans and Figures\ArcGIS\Escholt\Escholt.aprx



Stantec

Client: YorkshireWater

Esholt Wastewater Treatment Works

2016 'New' Scenario Predicted 15-minute Mean SO_2 (99.90%ile) Process Contribution (PC) Contours

1:20,538 @ A4	Date: 19/01/2023
Drawn: dafrancis	Checked: PB
Figure 10	Rev A

Appendix 8 Odour Impact Assessment

Esholt STF Qualitative Odour Risk Assessment

Project reference: 31001762-100.2101-5

Prepared for:
Yorkshire Water

Prepared by:
Stantec

Report Date

11th January 2023

Revision	Description	Author		Quality Check		Review	
1.0	First Issue	A Saunders	09/06/21	A Shaikh	11/06/2021	G Baichoo	15/06/21
2.0	Second Issue	S Walmsley	21/06/21			G Baichoo	22/06/21
FINAL	Final issue	S Walmsley	29/06/21			PD	29/06/21
3.0	Third Issue	A Saunders	11/01/2023				

Table of Contents

1.0 EXECUTIVE SUMMARY

An Industrial Emissions Directive (IED) permit application is being developed for Yorkshire Water (YW) Esholt Sludge Treatment Facility (STF) due to changes to the Environment Agency (EA) interpretation of the environmental permitting exclusion for Urban Wastewater Activities (under Environmental Permitting (England and Wales) Regulations 2016 (EPR) Schedule 1, Part 2, Chapter 5, Section 5.4). The EA interpretation now requires that anaerobic digestion (AD) plants with a treatment capacity of over 100 tonnes/day (t/d) are classified as installations for the purposes of EPR. Furthermore, it has been determined that, in calculating digester capacity, there shall be no distinction between imported or indigenous sludges. Therefore, the Yorkshire Water (YW) Esholt STF exceeds the 100t/d capacity limit and it has been agreed that a variation to an existing permit is required to add Schedule 5.4 Part A(1)b(i) for AD treatment activities.

As part of the IED permit application, an odour assessment is required to assess the risk of odours from Esholt STF on the surrounding area. This has been developed in the form of a qualitative odour risk assessment.

The qualitative odour risk assessment for Esholt STF has indicated that two receptors considered sensitive are exposed to a moderate adverse odour effect with the remaining nine receptors exposed to either a slight adverse or negligible adverse odour effect. The two receptors exposed to a moderate adverse odour effect are Esholt Hall and Home Farm Industrial Park, located to the north-east of the site with both receptors representing residential receptors. YW has not received any odour complaint from these locations.

All sensitive receptors to the south of the STF are considered to have a negligible odour effect, attributed to the receptor distance from the site and subsequent ineffective odour pathway.

The site-specific odour survey has highlighted that whilst the digested sludge cake is stored in a partially covered barn or outside, it represents a low odour potential source due to the low odour emission rate. However, the cake storage pad has been considered a medium risk odour offensiveness due to the surface area occupied by the cake. The digested sludge cake emissions are typical of those observed on other sites which do not generate odour risk or complaints and as long as the process is healthy and sludge cake stockpiling is managed effectively, would not be considered a future risk of odour at surrounding receptors.

Whilst raw sludge cake was observed on site, the odour survey did not highlight it is a significant odour source and was comparable to the low odour emissions observed from the digested sludge cake.

Sniff testing from the odour survey highlighted that whilst cake odours were observed local to the cake pad, these were secondary to the odours coming from the compost area. No cake odours were observed downwind of the cake pad supporting the theory that if the process is healthy and

sludge cake stockpiling is managed effectively, would not be considered a future risk of odour at surrounding receptors.

For the overall site, it is considered that Esholt STF does not have an adverse odour effect on its surrounding receptors. However, based on the significant number of odour complaints received by the local environmental health officer, these complaints need to be investigated and determined if the STF is a contributing factor or if emissions are attributed to another source.

Appropriate levels of monitoring of the STF should be undertaken to ensure a healthy process is maintained and that there is no deterioration in odour emissions from the site.

Based on this assessment, it is considered that no additional odour mitigation is currently required above the existing measures already observed at the STF to reduce the risk of odour impact at surrounding receptors. YW have committed to an odour improvement plan for the STF that will improve containment and treatment of sludge emissions.

2.0 INTRODUCTION

An IED permit application is being developed for Esholt Sludge Treatment Facility (STF) due to changes to the Environment Agency (EA) interpretation of the environmental permitting exclusion for Urban Wastewater Activities (under Environmental Permitting (England and Wales) Regulations 2016 (EPR) Schedule 1, Part 2, Chapter 5, Section 5.4). The EA interpretation now requires that anaerobic digestion (AD) plants with a treatment capacity of over 100 tonnes/day (t/d) are classified as installations for the purposes of EPR. Furthermore, it has been determined that, in calculating digester capacity, there shall be no distinction between imported or indigenous sludges. Therefore, the Yorkshire Water (YW) Esholt STF exceeds the 100t/d capacity limit and it has been agreed that a variation to an existing permit is required to add Schedule 5.4 Part A(1)b(i) for AD treatment activities.

As part of the IED permit application, an odour assessment is required to assess the risk of odours from Esholt STF on the surrounding area. This has been developed in the form of a qualitative odour risk assessment.

3.0 SITE BACKGROUND

Esholt STF is located within the boundary of Esholt WwTW. The site is located approximately 4 km south-west of Leeds Bradford Airport with the River Aire passing adjacent to the STF. The site is primarily surrounded farmland and grass land to the north, east and west with residential areas towards in all directions beyond the local farmland. The works location is highlighted in Figure 1.

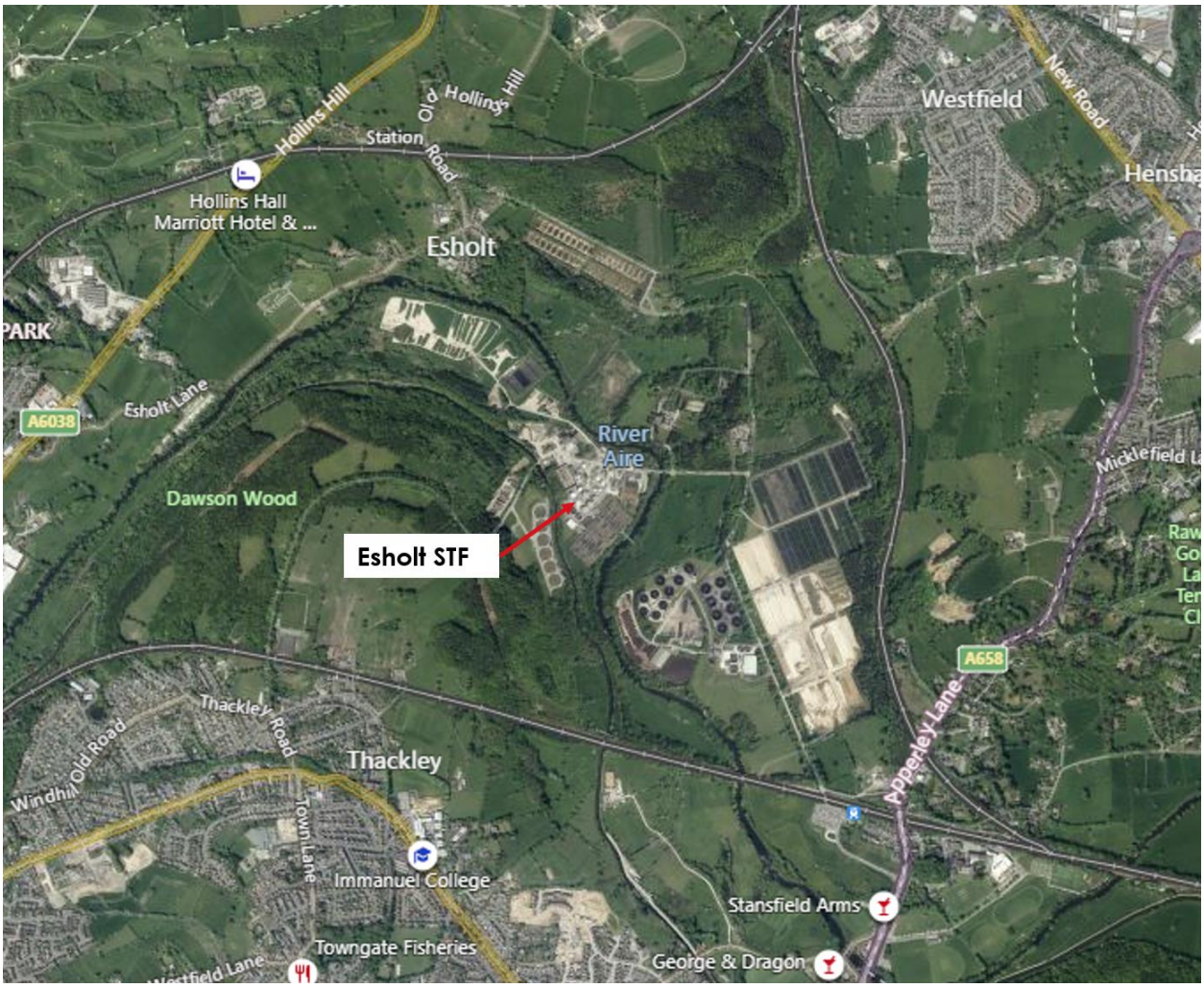


Figure 1: Esholt STF Site Location

4.0 PROCESS OVERVIEW

Liquid sludge and sludge cake treated within the STF originates from several sources:

- Indigenous sewage sludges, including indigenous primary sludge and indigenous surplus activated sludge (SAS) arising from sewage treatment processes operated within the wider Esholt WwTW are piped directly to the STF.
- Liquid sludges generated by other, smaller YW sewage works (with lower capacity or capability for treating sludges on-site) are imported to Esholt STF for additional treatment. These sludges may be received in the form of liquid sludge or sludge cake.

Imported sludge cake is delivered to the site by tanker / covered tipper lorry. Sludge cake is tipped from an enclosed wagon to the dedicated sludge cake reception unit which is fully enclosed when tipping operations are not taking place. Sludge is moved from the tipping area via enclosed belt conveyor and is rewetted with final treated effluent (to target ~6% dry solids) and pumped to the THP feed silos.

Imported liquid sludge is delivered to site by tanker. The tanker unloads at the dedicated sludge import area and sludge is pumped into the sludge screen feed tank where it is mixed with indigenous primary sludge pumped directly via underground pipework from Esholt WwTW. The sludge screen feed tank is covered with headspace air from the tank routed to a local Odour Control Unit (referred to as OCU 1). This OCU is currently operated as a dispersion only stack. The sludge is screened using two Huber enclosed rotating screens. Screenings drop into a skip and are disposed of off-site. Indigenous SAS and imported cake are not screened within the permitted installation.

After screening, sludge is pumped via sub-surface pipework, to the uncovered consolidation tank 5 where sludge is blended and mixed using air injection. From this tank, the sludge is pumped forward to the two covered mixed sludge tanks where it is mixed with the indigenous SAS sludge. Air from these tanks is extracted and routed to a local OCU (OCU 2). This OCU is currently operated as a dispersion only stack.

Indigenous SAS is pumped directly from the co-located Esholt WwTW to two SAS storage tanks (2 x 2000 m^3 uncovered concrete tanks). Sludge from the SAS tanks is transferred to the drum thickener building, via above and below ground pipework. There are four individual drum thickeners (with separate pipes feeding them) located within the building, which are operated manually as and when the process requires. Air is extracted from the drum thickeners and treated in a carbon filter OCU (referred to hereafter as OCU 4) prior to dispersal via twin dispersal stacks, approximately 7 m high and located to the north end of the SAS thickener building. Ambient air from the building is passively dispersed via louvre vents; ambient building air is not odorous under normal operating conditions due to the direct drum extraction. The thickened sludge is then transferred to the SAS transfer tanks (2 x 400 m^3 uncovered concrete tanks) before being pumped forward to the mixed sludge tanks (see below for more detail).

Sludge from the mixed sludge tanks is transferred to the 3 No. centrifuges for dewatering prior to digestion. The liquid centrate is transferred via the liquor pumping station and returned for full treatment to within Esholt WwTW. Dewatered sludge is passed forward to the thermal hydrolysis plant (THP) feed silos where it is joined with re-wetted imported sludge cake and the transferred

to the THP feed hopper. Headspace air from the THP feed silos and feed hopper is extracted and routed to a local OCU (OCU 3). This is currently operated as a dispersion only stack. The sludge is then treated first in the THP and then by anaerobic digestion.

Sludge extracted from the digesters is fed to the two covered degassing tanks prior to onward processing. These tanks are equipped with air mixing to introduce oxygen and prevent anaerobic generation of methane. The tanks are covered and headspace air is extracted and discharged via an odour dispersal unit with a stack, approximately 5 m high. Digested sludge is pumped from the degassing tanks to the digested sludge dewatering area located towards the south-east section of the site, across the River Aire.

There are two separate facilities for the digested sludge dewatering. The first of these, which is used preferentially, is known as the sludge export facility. Sludge is transferred from the degassing tanks to two uncovered export dewatering feed tanks which feed the dewatering centrifuges. The final digested and dewatered sludge cake is transferred via conveyors from the centrifuges up and over a push wall and into the covered cake export barn.

In addition to the export dewatering facility there is a second dewatering area, which provides additional capacity for digested sludge treatment and handling. This takes place in what is known as the conditioning area. When the THP/digestion plant are running at full capacity, sludge would typically be diverted to this second dewatering facility for approximately 5-10 minutes in each hour. During these periods' sludge is transferred from the degassing tanks to two uncovered conditioning feed tanks before being dewatered in dedicated centrifuges. Dewatered liquors drop from the centrifuge into the centrate sump and is pumped back to the head of the works for treatment via a leachate pumping station and two liquor balancing tanks.

The final digested and dewatered cake is transferred via conveyors onto the conditioning cake pad before being exported from site. The conditioning cake pad also serves certain contingency functions, both for operations at Esholt and for the wider strategic regional sewage infrastructure operated by YW. The cake pad may on a temporary basis, in circumstances such as the failure of assets or non-availability of normal disposal routes, be used for interim storage of digested sludge cake produced at other sites. It may also be used for interim storage of raw undigested sludge cake from Esholt or from other YW sites before being treated at Esholt STF, treated at another YW STF or sent off site to an alternative treatment/disposal route (subject to all applicable regulatory constraints).

There is a composting plant in operation on land adjacent to the conditioning cake pad. This plant is operated by a third party (Biowise); there is no technical connection between the composting operation and YW STF activities that are the subject of this variation application."

There are four odour control units (OCU) associated with Esholt STF that extract odorous air from the sludge screen feed tank, mixed sludge tanks, SAS thickener THP feed silos and THP feed hopper. Three of these OCUs are currently being operated as dispersion only stacks. In addition, the degassing tanks are covered with air extracted and dispersed via a ventilation stack.

5.0 METHODOLOGY

This qualitative odour risk assessment relies on subjective judgement but uses the generic guidance methodologies provided and referenced in documents such as the Institute of Air Quality Managements (IAQM) Guidance on the Assessment of Odour for Planning, the Scottish Environmental Protection Agency (SEPA) Odour Guidance 2010, the Environment Agency's Horizontal Guidance Note 1 H1 Environmental Risk Assessments for Permits, and Annex A of H1 – Amenity & accident risk from installations and waste activities.

These guidelines use the Source–Pathway-Receptor concept in which it evaluates the relationship between source(s) of odour, the pathway or transmission route by which exposure may occur at a given receptor(s) who may be affected/impacted.

How well a qualitative odour risk assessment predicts the odour impact for a scenario is dependent on how well the Source-Pathway-Receptor approach can be assessed and scored. This type of assessment is based on subjective judgement and therefore, robust assessment criteria are required. Where subjective judgement for a criterion could be considered broad, sub-criteria have been determined to provide a more detailed judgement.

The below sections outline the assessment criteria for each key area and how it will be applied.

5.1 SOURCE ODOUR POTENTIAL

The odour potential of a source can be broken down into three key considerations:

- How inherently odorous the compounds present are.
- The unpleasantness of the odour.
- The magnitude of the odour release

When trying to determine the offensiveness of an odour source, site-specific odour sampling should be considered in the first instance. In the absence of source odour emission data, the assessment criteria will consider the Environment Agency's Horizontal Guidance Note (H4). H4 looks to categorise how offensive odours are with sources/processes/activities that are considered 'most offensive' odours include septic effluent or sludge and biological landfill odours. All raw sludge treatment processes would be considered to have a high odour offensiveness unless source-specific odour sampling is undertaken demonstrating a low level of odorous compounds. Processes containing the below material are considered to represent a high odour offensiveness:

- Indigenous sludge
- Sludge imports (liquid and solid)
- Sludge liquors

Processes containing the below material are considered to represent a medium odour offensiveness:

- Rags and screenings
- Digested sludge
- Digested sludge liquors
- Digested sludge cake (stored)

No processes on a STF are considered to store material that represents a low odour offensiveness.

The unpleasantness of an odour can be used in defining the source odour offensiveness. This is typically achieved through source material hedonic tone assessments; however, these types of assessments are not typically available for a site. As no source material hedonic tone has been undertaken for Esholt STF, it has not been included in the assessment criteria.

The magnitude of the odour release considers the operation of the asset and how likely odours will be released. Whilst the magnitude of odour release is dependent on a number of factors such as source surface area, turbulence of source material, age of source material; the source odour mitigation and control measures have been determined as the defining criteria for magnitude of odour release. For conservatism, all open sources are considered to have a high magnitude of odour release regardless of process operation. Processes with good cover containment that have the headspace odours extracted via a fan are considered to have a low magnitude of odour release. Processes that are covered without fan extraction will have a magnitude of odour release dependant on the source odour offensiveness. This could vary between a low and high odour magnitude of odour release however, for this assessment, would be considered to represent a medium risk.

Table 1 includes the criteria risk scoring for determining the source odour potential.

Table 1: Source Odour Potential Criteria Risk Scoring

Criteria	Risk Ratings		
	High	Medium	Low
Odour Offensiveness	Very odorous compounds (H2S, Mercaptans) with low odour threshold. Unpleasant odour - "Most Offensive". Unpleasant hedonic tone. Large permitted process / Surface Area.	Compounds involved are moderately odorous. Unpleasantness - process classed in H4 as "Moderately Offensive" or where odours have neutral or slightly unpleasant hedonic tone. Smaller permitted process / Surface Area.	Compounds involved are only mildly offensive. Unpleasantness - process classed in H4 as "Less Offensive". Neutral to positive hedonic tone.
Mitigation / Control	Open air operation with no containment. Reliance solely on good management techniques and best practice.	Some mitigation measures in place but significant residual odour remains.	Effective mitigation measures in place (e.g. BAT, BPM) leading to little or no residual odour.

5.2 PATHWAY EFFECTIVENESS

When considering the effectiveness of the odour pathway as a source transport mechanism through the air to a receptor a number of factors need to be considered. Any factor that increases the source dilution or dispersion into atmosphere from source to receptor will reduce the odour concentration at the receptor, and hence reduce odour exposure. Several factors need to be considered including:

- The distance from source to receptor
- Wind direction and frequency
- Source release effectiveness at dispersion to atmosphere
- The effectiveness of odour mitigation / control
- Topography and terrain between source and receptor

The highest likelihood of impact for a given source will be present when the predominant wind direction is present, the sensitive receptor is close to the emission source, the emissions source is located at ground level with limited dispersion and there are no emission mitigation measures in place.

Table 2 includes the criteria risk scoring for determining the source pathway effectiveness.

Table 2: Source Pathway Effectiveness Criteria Risk Scoring

	Risk Ratings		
	High	**Medium**	**Low**
Receptor Distance from Site	< 50m	50 - 300m	> 300 m
Wind Direction Frequency	> 10%	5 - 10%	< 5%
Source Dispersion	Open processes with low level releases	Releases are elevated but compromised by building effects.	Releases are elevated and dispersed via stack/vent and not compromised by surrounding buildings.

When determining the odour risk criteria for a site, consideration should be given to any past studies that identify an odour impact boundary or any sensitive locations of odour complaints. As there is no history of odour complaints associated with the STF, generic risk values have been used for the receptors distance from site. It has been considered that any receptor within a 50 m radius from site would be considered in a higher risk location whereby any receptor beyond a 300 m radius would be considered in a lower risk location. Whilst it is recognised that receptors far enough away from site will not be subject to odour impact associated to the works, no maximum distance cap has been included. However, it has been loosely considered that any receptor more than 1 km away from the works will not be considered in the assessment.

When considering pathway effectiveness, consideration is given to whether the receptors are downwind of the source and what the predominant prevailing wind direction is. Whilst the main consideration is typically for the predominant prevailing wind direction, odour impact tends to occur with low wind speeds or stable atmospheric conditions. When conditions are not stable, it will be the downwind receptors that are affected. When considering prevailing wind conditions, annual meteorological data sets from representative meteorological stations local to the site containing wind direction and frequency should be considered.

When considering the source dispersion risk, consideration is given to whether there will be sufficient dilution in reducing the odours as they transverse towards the sensitive receptors. A source at ground level that is open to atmosphere would likely have poor dispersion of odours and be reliant on other factors such as distance from receptor or low odour offensiveness to manage the risk of likely odour effect at receptors. Sources at height would be considered to have an increased dispersion but could still present a risk. Sources that are either fully contained or fan extracted through an emission stack are considered to have a low dispersion risk.

The topography and terrain surrounding a site can influence the air movement and create an increased risk of odour effect at receptors. The presence of topographical features such as hills and valleys, or urban terrain features such as buildings can affect air flow and therefore increase or inhibit dispersion and dilution. For this assessment, the terrain surrounding the works has not been considered.

5.3 RECEPTOR SENSITIVITY

Within the IAQM guidance document, receptors are placed into one of three categories depending on land use, duration of exposure, and the anticipated level of amenity.

- High Sensitivity – High level of amenity expected, prolonged or continuously present within the area. Examples include residential dwelling, schools, hospitals.

- Medium Sensitivity – Reasonable level of amenity expected, no prolonged or continuous presence within the area. Examples include a place of work, commercial/retail, playing recreational fields.

- Low Sensitivity – No reasonable level of amenity expected or transient exposure. Examples include farms, industrial, footpaths/roads.

5.4 ASSESSMENT OUTPUT

For the above qualitative odour risk assessment, the risk of odour exposure at a receptor can be determined and when assessed against a receptor's sensitivity, a risk of 'likely odour effect' can be determined. The risk of odour exposure is summarised in the below expressions:

- Negligible Effect

- Slight Adverse Effect

- Moderate Adverse Effect

- Substantial Adverse Effect

As referenced by the IAQM when discussing qualitative odour risk assessments, "the EIA regulations require that an assessment reaches a conclusion on the likely significance of the effects. Where the overall effect is greater than "slight adverse" the effect is likely to be considered significant". Whilst this assessment will consider the risk of odour exposure for each receptor in the assessment, an overall judgement will be made for the whole site. As such, the result of the assessment will be considered binary on whether the site has significant or no significant risk of odour effect at surrounding receptors. The risk matrix approach outlined by the IAQM and adopted for this assessment is outlined in Table 3 and Table 4.

Table 3: Risk of Odour Exposure at Specified Receptor Locations

		Source Odour Potential		
		Low	**Medium**	**High**
Pathway Effectiveness	Highly Effective Pathway	Low Risk	Medium Risk	High Risk
	Moderately Effective Pathway	Negligible Risk	Low Risk	Medium Risk
	Ineffective Pathway	Negligible Risk	Negligible Risk	Low Risk

Table 4: Likely Magnitude of Odour Effect at the Specific Receptor Location

Risk of Odour Exposure	**Source Odour Potential**		
	Low	**Medium**	**High**
High Risk of Odour Exposure	Slight Adverse Effect	Moderate Adverse Effect	Substantial Adverse Risk
Medium Risk of Odour Exposure	Negligible Risk	Slight Adverse Effect	Moderate Adverse Effect
Low Risk of Odour Exposure	Negligible Effect	Negligible Effect	Slight Adverse Effect
Negligible Risk of Odour Exposure	Negligible Effect	Negligible Effect	Negligible Effect

6.0 ASSESSMENT

6.1 SOURCE ODOUR POTENTIAL RESULTS

6.1.1 Site Operation

As minimal odour sampling has been undertaken for Esholt STF, there is limited site-specific information regarding the odorous compounds present. As such, where there is no source odour emission data available, the Environment Agency's Horizontal Guidance Note (H4) has been adopted. H4 considers sources/processes/activities that are considered 'most offensive' odours include septic effluent or sludge and biological landfill odours.

As a number of sources are adjacent to each other, it is not realistic to consider the odour effect at a receptor based on individual sources. As such, the site has been split into two key locations which are the sludge treatment area and the digested sludge area. All sources are within the sludge treatment area excluding the 2 No. export dewatering feed tanks, 2 No. export centrifuges, export centrifuge sump and the sludge cake export barn which are located to the south and grouped as the export dewatering area. The digested sludge area also includes the conditioning area which includes the 2 No. conditioning feed tanks, 2 No. conditioning centrifuges, leachate pumping station, 2 No. liquor balancing tanks and the conditioning cake pad. Pathway effectiveness has been determined based on the receptor being closest in distance to either one of these two site areas. Figure 2 shows the separate source areas on site.

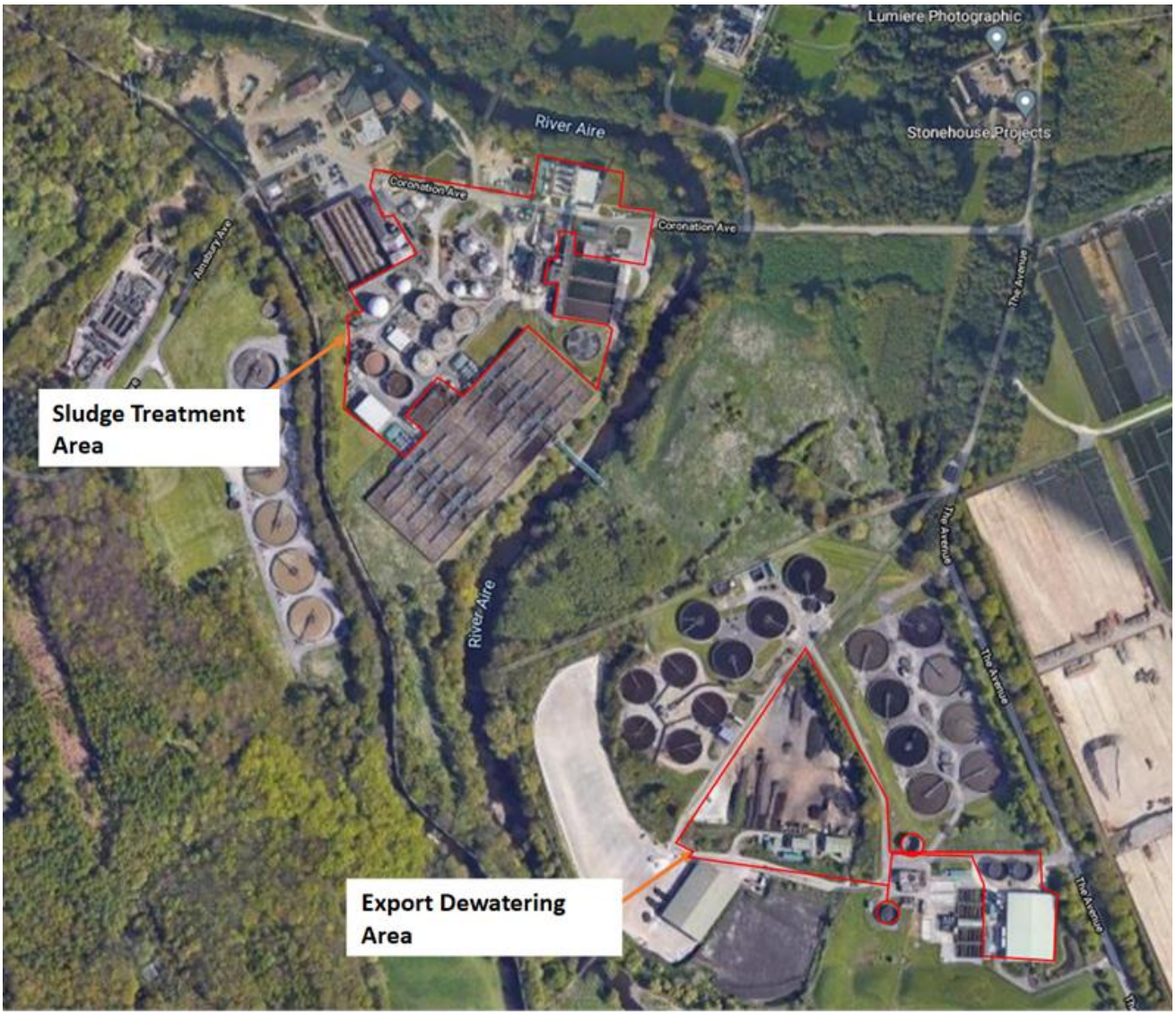


Figure 2: Esholt STF Odour Source Areas

Three odour control units on site extract odours from the sludge screen feed tank, 2 No. mixed sludge tanks, 2 No. THP silos and THP feed hopper. All of the above processes have been assessed to have a good cover containment and holding sufficient negative pressure to prevent fugitive emissions. However, the odour control units are currently being operated as dispersion only stacks and as such, have been included as an odour emission source in this assessment. A fourth OCU (single stage carbon filter) serving the SAS thickeners is currently operational and is treating odours from this source.

There are 2 No. degassing tanks that are connected to a ventilation stack which has been included as an emission source in this assessment.

The 2 No. sludge screens, 3 No. dewatering centrifuges, 2 No conditioning centrifuges and 2 No. export centrifuges are covered without extraction presenting only partial mitigation of odours.

The consolidation tank 5, screening skip, sludge cake reception unit when accepting sludges, liquor pumping stations and sumps, SAS storage tanks, SAS transfer tanks, export dewatering feed tanks, conditioning dewatering feed tanks, conditioning pad and liquor balancing tanks are all open to atmosphere with no mitigation of odours. The sludge cake export barn is covered and partially enclosed providing some mitigation to wind loading but still allowing for some dispersion to atmosphere.

6.1.2 Odour Survey Results

For the cake storage area, an odour survey of the sludge cake storage pad considering source and contaminant odour potential. The odour survey consisted of four samples over a three-day period between May and June 2021 and included samples from disturbed and static digested and raw sludge cakes. The results indicate that the sludge cake had low odour emissions rates and was comparable to typical emissions for digested sludge cakes. A summary of the survey results is included in Table 5.

Table 5: Odour Survey Averaged Results

Source	Odour Concentration	Odour Emission Rate	Hydrogen Sulphide	Di-methyl Sulphide	Mercaptans	Ammonia	Volatile Organic Compounds
	(ou_E/m^3)	($ou_E/m^2/s$)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
Digested Cake – Disturbed	476	4.9	0.018	ND*	ND*	24.5	2.0
Digested Cake – Static	263	2.7	0.010	ND*	ND*	1.8	0.2
Raw Cake – Disturbed	501	5.2	0.030	ND*	ND*	ND*	0.5

Source	Odour Concentration	Odour Emission Rate	Hydrogen Sulphide	Di-methyl Sulphide	Mercaptans	Ammonia	Volatile Organic Compounds
	(ou_E/m^3)	($ou_E/m^2/s$)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
Raw Cake - Static	961	10.0	0.077	< 0.1	ND*	ND*	0.5

*None Detected

Contaminant sampling was undertaken for hydrogen sulphide, mercaptans, di-methyl sulphide, ammonia and volatile organic compounds. Hydrogen sulphide is considered to be the main contaminant in sludge emissions to give rise to high source odour potential. Depending on the source material, the detection threshold for hydrogen sulphide is highly variable. Considering the Environment Agency's "Review of Odour Character and Threshold" to provide a compound detection threshold, for a hydrogen sulphide detection threshold of 0.0005 ppm with a recognition concentration of 0.0047 ppm, the results indicate that under all operating conditions, the hydrogen sulphide concentrations are within the detection range.

The results indicate that ammonia is only released from the digested sludge cake with none detected from the raw sludge cake. Whilst the results indicate a higher ammonia concentration when compared to other contaminants, the survey results indicated that only disturbed digested cake is above the detection limit of 17 ppm (Environment Agency's "Review of Odour Character and Threshold") but low enough not to result in nuisance for sensitive receptors.

As the stored sludge cake odorous compounds are in low concentrations, the concentrations are low enough not to cause nuisance or adverse effects local to the source and as such, would not be considered to cause adverse effects to local receptors. For the purpose of this assessment, and to add a level of conservatism, the digested and raw sludge cakes are considered to have a medium odour offensiveness.

As part of the odour survey, boundary monitoring and sniff tests have been undertaken local to the STF. The boundary monitoring has identified that at all sampled locations on the STF boundary, no sample has detected hydrogen sulphide (the main compound in sludge odours) above the recognition concentration of 0.0047 ppm. The odour description for the majority of samples was "no odour". A few samples were associated with a "faint", "distinct" or "strong" odour from compost or cake storage areas, located in the centre of the works. However, cake odours were not observed down wind of the cake pad area. The results of the boundary monitoring and sniff tests indicate that it is unlikely that the STF odours have an adverse effect on surrounding sensitive receptors.

The boundary survey results are located in Appendix B.

6.1.3 Source Odour Potential Assessment Results

Table 6 includes a summary of the likely magnitude of odour effects with the detailed assessment in Appendix A. This assessment has been based on the approach outlined in section 5.1

Table 6: Likely Magnitude of Odour Effect at the Specific Receptor Location

Source	Odour Offensiveness	Mitigation/Control Risk	Source Odour Potential
Sludge Treatment Area			
Sludge Screen Feed Tank	High	Low	Low
Consolidation tank 5	High	High	High
Huber Screens	High	Medium	Medium
Screening Skips	Medium	High	High
Mixed Sludge Tanks	High	Low	Low
Sludge Cake Wagon	High	High	High
Sludge Cake Reception Unit	High	Medium	High
SAS Storage Tanks	Medium	High	Medium
Drum Thickeners	Medium	Low	Low
SAS Transfer Tanks	Medium	High	Medium
Thickener Liquor Sump	Medium	High	Medium
THP Feed Silos	High	Low	Low
THP Feed Hopper	High	Low	Low
Dewatering Centrifuges	High	Medium	Medium
Liquor Pumping Station	High	High	High
Degassing Tanks	Medium	Low	Low
Degassing Tanks Ventilation Stack	Medium	Medium	Medium
OCU 1 (Imports)	High	Medium	High
OCU 2 (Mixed Tanks)	High	Medium	High
OCU 3 (THP Feed)	High	Medium	High
OCU 4 (SAS Thickeners)	Medium	Low	Low
Digested Sludge Area (Consisting of Export and Condition areas)			
Dewatering Feed Tanks	Medium	High	Medium
Centrifuges	Medium	Medium	Medium
Centrate Sump	Medium	High	Medium
Sludge Cake Export Barn	Medium	Medium	Medium
Leachate pumping station	Medium	High	Medium
Conditioning Cake Pad	Medium	High	Medium

Source	Odour Offensiveness	Mitigation/Control Risk	Source Odour Potential
Liquor Balancing Tanks	Medium	High	Medium

Of the twenty-eight processes on site, six are considered to have a low source odour potential, fourteen are considered to have a medium source odour potential and eight are considered to have a high source odour potential. The eight processes considered to have a high source odour potential are associated with uncovered processes and untreated stack emissions. Whilst the sludge cake reception wagons will only be a source of odour whilst tipping cake into the reception unit and likely to be considered as an intermittent odour source, it has been included in the assessment due to the typically observed high odour release of the activity.

Three OCUs have been included in this assessment as they are currently being operated as dispersion only stacks and whilst they would provide good dispersion, may give rise to odour effects. These OCUs stacks have all been assessed as having a high source odour potential, regardless of stack odour concentration, to provide a level of conservatism to the assessment.

The SAS thickener OCU stack has been included in this assessment and is understood to provide effective odour treatment.

Fugitive emissions from the sludge cake export barn have been included as it is not a fully contained building with direct pathway for odour emissions to atmosphere.

Raw sludge cake was seen to be stored on site during a site visit completed as part of the preparation of this application. This was due to a processing issue on surrounding local sites and is not normal operational procedure. Storage is used on a temporary basis as a contingency measure in circumstances such as the failure of assets or non-availability of normal disposal routes. To ensure key risks were considered, it was still felt that the storage of digested sludge cake on the conditioning cake pad should be assessed within this report.

Of the twenty-one processes within the sludge treatment area, it is considered that this area is best represented with an odour source potential of a high risk. Of the seven processes within the export dewatering area (including the conditioning area), it is considered this area is best represented with an odour source potential of a medium risk.

6.2 RECEPTOR SENSITIVITY RESULTS

For the assessment, before the pathway effectiveness can be determined, the discrete receptors need to be determined. Discrete receptors should typically consider complaint locations and areas of specific interest. Esholt WwTW has received odour complaints through the local environmental health officer that highlighted 2 main complainant areas located at the Apperley Bridge area close to the river and Greengates traffic junction. There are sewage pumping stations

local to the complaint areas which is understood to have a history of sewer septicity. Both receptors are located approximately 1.0km and 1.6km respectively, from the export dewatering area and are not in the prevailing wind direction. Yorkshire Water consider that these complaints are likely to be associated with an issue not linked with the STF. Based on this outcome, these locations have been excluded from this assessment however, receptors closer to the works have been included in this wind direction to assess potential risks.

As such, all discrete receptors considered in this assessment are based on receptor distance from the site and then categorised based on sensitivity. Where a number of discrete receptors are in the same location, a single receptor has been selected, considering the likely highest sensitivity receptor, to represent the area. Table 7 and Figure 3 highlight the receptor location, type and sensitivity. This assessment has been based on the approach outlined in section 5.3.

Table 7: Receptor Location, Type and Sensitivity

Receptor Name	Receptor Map Reference	Receptor Type	Receptor Sensitivity
Residential properties attached to Esholt Hall	D01	Residential	High
Home Farm Industrial Park (Home Farm House and Home Farm Cottage)	D02	Residential	High
Low Ash Farm	D03	Residential	High
St. Paul's Church	D04	Cultural	High
Church Lane	D05	Residential	High
Bottom Farm	D06	Farm	Low
Apperley Bridge Railway Station	D07	Commercial	Medium
Nunwood House	D08	Residential	High
Crow Tree House	D09	Residential	High
JCT600 Head Office	D10	Commercial	Medium

Figure 3: Location of Sensitive Receptors

Of the ten discrete receptors included, seven are considered to be highly sensitive, attributed to residential or cultural receptors. As the site is within a rural area, there is no single main area of residential receptors, with a number of receptors representing residential farms or cottages. The closest residential receptors to the site are located towards the north-east of the site boundary.

Two receptors are considered to be medium sensitivity receptors and include places of work and commercial areas. These receptors are located the to the south-east of the site. Whilst there are other commercial receptors in other directions, as these are over 1km from the site, it is considered that these would automatically represent a low risk and as such, not considered in this assessment.

Only one receptor is considered to be of low sensitivity and represents a working farm located to the south-west of the site.

6.3 PATHWAY EFFECTIVENESS RESULTS

6.3.1 Wind Direction

When considering the pathway effectiveness from source odours to an identified receptor, a number of factors have to be determined. Meteorological data from Leeds Braford Airport met. station (met. year 2017) has been used to predict the wind direction frequency for Esholt STF. Esholt STF is located approximately 4km south-west and therefore is likely to experience similar wind directions and frequencies and can be considered acceptable for this qualitative assessment. The distance between source and receptor is shown in Appendix A. The breakdown of the wind direction frequency and risk for Leeds Bradford Airport met. year 2017 are summarised in Table 8.

Table 8: Meteorological Data Wind Direction Frequency

Wind Direction	Sample Count	Frequency (%)	Wind Direction Frequency Risk
North to South	538	6.2%	Medium
North-East to South West	408	4.7%	Low
East to West	547	6.3%	Medium
South-East to North-West	719	8.3%	Medium
South to North	690	8.0%	Medium
South-West to North-East	1,428	16.5%	High
West to East	3,742	43.2%	High
North-West to South-East	596	6.9%	Medium

6.3.2 Source Dispersion

When considering the source dispersion risk, as the site has been separated into two areas, a dispersion risk needs to be defined for each area. Table 9 considers the dispersion risk from each individual process.

Table 9: Source Dispersion Risk

Source	Source Dispersion	Dispersion Risk
Sludge Treatment Area		
Sludge Screen Feed Tank	Covered and extracted process with limited dispersion risk	Low
Consolidation tank 5	Elevated and open to atmosphere	Medium
Huber Screens	Covered at ground level	Medium
Screening Skips	Open to atmosphere at ground low	High
Mixed Sludge Tanks	Covered and extracted process with limited dispersion risk	Low
Sludge Cake Reception Wagon	Open to atmosphere at ground low	High
Sludge Cake Reception Unit	Covered and extracted process with limited dispersion risk	Low
SAS Storage Tanks	Elevated and open to atmosphere	Medium
Drum Thickeners	Covered and extracted process with limited dispersion risk	Low
SAS Transfer Tanks	Open to atmosphere at ground low	High
Thickener Liquor Sump	Open to atmosphere at ground low	High
THP Feed Silos	Covered and extracted process with limited dispersion risk	Low
THP Feed Hopper	Covered and extracted process with limited dispersion risk	Low
Dewatering Centrifuges	Covered at ground level	Medium
Liquor Pumping Station	Open to atmosphere at ground low	High
Degassing Tanks	Covered and extracted process with limited dispersion risk	Low
Degassing Tanks Ventilation Stack	Elevated with high level of dispersion	Low
OCU 1 (imports)	Elevated with high level of dispersion	Low
OCU 2 (Mixed Tanks)	Elevated with high level of dispersion	Low

Source	Source Dispersion	Dispersion Risk
OCU 3 (THP Feed)	Elevated with high level of dispersion	Low
OCU 4 (SAS Thickeners)	Elevated with high level of dispersion	Low
Digested Sludge Area (Consisting of Export and Condition areas)		
Dewatering Feed Tanks	Elevated and open to atmosphere	Medium
Centrifuges	Covered at ground level	Medium
Centrate Sump	Open to atmosphere at ground low	High
Sludge Cake Export Barn	Partially contained enclosure	Medium
Leachate pumping station	Open to atmosphere at ground low	High
Conditioning Cake Pad	Open to atmosphere at ground low	High
Liquor balancing tanks	Elevated and open to atmosphere	Medium

For the sludge treatment area, it is considered that a medium dispersion risk would be most applicable. For the digested sludge area (including export dewatering area and the conditioning area), due to the limited source containment and dispersion, it is considered that a high dispersion risk would be most applicable.

6.3.3 Pathway Effectiveness Assessment Results

The pathway effectiveness for each defined sensitive receptor is summarised in Table 10 with detailed assessment in Appendix A.

Table 10: Pathway Effectiveness Assessment

Receptor Name	Distance Risk	Direction From Installation	Wind Direction Frequency	Main Odour Source	Source Dispersion Risk	Pathway Effectiveness
Esholt Hall	Medium	NE	High	Sludge Treatment Area	Medium	Moderately Effective Pathway
Home Farm Industrial Park (Home Farmhouse	Medium	NE	High	Sludge Treatment Area	Medium	Moderately Effective Pathway

Receptor Name	Distance Risk	Direction From Installation	Wind Direction Frequency	Main Odour Source	Source Dispersion Risk	Pathway Effectiveness
and Home Farm Cottage)						
Low Ash Farm	Low	SW	Low	Sludge Treatment Area	Medium	Ineffective Pathway
St Paul's Church	Low	NW	Medium	Sludge Treatment Area	Medium	Ineffective Pathway
Church Lane	Low	NW	Medium	Sludge Treatment Area	Medium	Ineffective Pathway
Bottom Farm	Low	S	Medium	Digested Sludge Area	High	Moderately Effective Pathway
Apperley Bridge Railway Station	Low	S	Medium	Digested Sludge Area	High	Ineffective Pathway
Nunwood House	Low	E	High	Digested Sludge Area	High	Moderately Effective Pathway
Crow Tree House	Low	E	High	Digested Sludge Area	High	Ineffective Pathway
JCT600 Head Office	Low	SE	Medium	Digested Sludge Area	High	Ineffective Pathway

7.0 ASSESSMENT RESULTS

The results of the qualitative odour risk assessment are summarised in Table 11 and based on section 5.4.

Table 11: Qualitative Odour Risk Assessment Results

Receptor	Source Odour Potential	Pathway Effectiveness	Odour Exposure	Receptor Sensitivity	Likely Odour Effect
Esholt Hall	High	Moderately Effective Pathway	Medium Risk	High	Moderate Adverse Effect
Home Farm Industrial Park (Home Farmhouse and Home Farm Cottage)	High	Moderately Effective Pathway	Medium Risk	High	Moderate Adverse Effect
Low Ash Farm	High	Ineffective Pathway	Low Risk	High	Slight Adverse Effect
St Paul's Church	High	Ineffective Pathway	Low Risk	High	Slight Adverse Effect
Church Lane	High	Ineffective Pathway	Low Risk	High	Slight Adverse Effect
Bottom Farm	Medium	Moderately Effective Pathway	Low Risk	Low	Negligible Effect
Apperley Bridge Railway Station	Medium	Ineffective Pathway	Negligible Risk	Medium	Negligible Effect
Nunwood House	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
Crow Tree House	Medium	Ineffective Pathway	Negligible Risk	High	Negligible Effect
JCT600 Head Office	Medium	Ineffective Pathway	Negligible Risk	Medium	Negligible Effect

8.0 SUMMARY

A qualitative odour risk assessment has been undertaken for Esholt STF considering twenty-eight process activities across two separate areas on site and potential odour effect on ten receptors. The assessment has been based on a Source-Pathway-Receptor approach and is primarily based upon professional judgement.

The site has been separated into two separate sections, the sludge treatment area and the digested sludge area, with the digested sludge area comprising of the export dewatering facility area and the conditioning area. The source odour potential has been derived by determining an overall odour potential for each area given the separate locations on site and nearby receptors. Consideration has been given to existing site operation for odour mitigation and source dispersion, and combined with receptor location and meteorological conditions, a pathway effectiveness has been determined for each sensitive receptor. This has allowed, with the use of risk matrices, a receptor specific likely odour effect to be determined.

The qualitative odour risk assessment for Esholt STF has indicated that two receptors considered sensitive are exposed to a moderate adverse odour effect with the remaining eight receptors exposed to either a slight adverse or negligible adverse odour effect. The two receptors exposed to a moderate adverse odour effect are Esholt Hall and Home Farm Industrial Park, located to the north-east of the site with both receptors representing residential receptors. YW has not received any odour complaint from these.

All sensitive receptors to the south of the STF are considered to have a negligible odour effect, attributed to the receptor distance from the site and subsequent ineffective odour pathway. This assessment supports Yorkshire Water's view that complaints received from Apperley Bridge area close to the river and Greengates traffic junction are attributed to another source.

The site-specific odour survey has highlighted that whilst the digested sludge cake is stored in a partially covered barn or outside, it represents a low odour potential source due to the low odour emission rate. However, the cake storage pad has been considered a medium risk odour offensiveness due to the surface area occupied by the cake. The digested sludge cake emissions are typical of those observed on other sites which do not generate odour risk or complaints and as long as the process is healthy and sludge cake stockpiling is managed effectively, would not be considered a future risk of odour at surrounding receptors.

Whilst raw sludge cake was observed on site, the odour survey did not highlight it is a significant odour source and was comparable to the low odour emissions observed from the digested sludge cake.

Sniff testing from the odour survey highlighted that whilst cake odours were observed local to the cake pad, these were secondary to the odours coming from the compost area. No cake odours were observed downwind of the cake pad supporting the theory that if the process is healthy and

sludge cake stockpiling is managed effectively, would not be considered a future risk of odour at surrounding receptors.

For the overall site, it is considered that Esholt STF does not have an adverse odour effect on its surrounding receptors. However, based on the significant number of odour complaints received by the local environmental health officer, these complaints need to be investigated and determined if the STF is a contributing factor or if emissions are attributed to sewage emissions.

Appropriate levels of monitoring of the STF should be undertaken to ensure a healthy process is maintained and that there is no deterioration in odour emissions from the site.

Based on this assessment, it is considered that no additional odour mitigation is currently required above the existing measures already observed at the STF to reduce the risk of odour impact at surrounding receptors. YW have committed to an odour improvement plan for the STF that will improve containment and treatment of sludge emissions.

8.1 APPENDIX A – DETAILED ASSESSMENT

Table 12: Likely Magnitude of Odour Effect at the Specific Receptor Location

Source	Odour Offensiveness	Mitigation/Control	Source Odour Potential
Sludge Treatment Area			
Sludge screen feed tank	High risk – Sludge imports	Low Risk – Covered and extracted process	Low
Consolidation Tank 5	High Risk – Imported sludge cake	High Risk – Open to atmosphere	High
Huber Screens	High risk – Indigenous sludges, sludge imports	Medium Risk – Covered without extraction process	Medium
Screening Skips	Medium Risk – Screenings	High Risk – Open to atmosphere	High
Mixed Sludge Tanks	High risk – Indigenous sludges, sludge imports	Low Risk – Covered and extracted process	Low
Sludge Cake Reception Wagon	High Risk – Imported sludge cake	High Risk – Open to atmosphere	High
Sludge Cake Reception Unit	High Risk – Imported sludge cake	Medium Risk – Covered process, open shutter hatch during filling event.	High
SAS Storage Tanks x 2	Medium Risk - SAS Sludge	High Risk - Open to atmosphere	Medium
Drum Thickeners x 4	Medium Risk - SAS Sludge	Low Risk - Covered and extracted process	Low
SAS Transfer Tanks x 2	Medium Risk - SAS Sludge	High Risk - Open to atmosphere	Medium
Thickener Liquor Sump x 1	Medium Risk - SAS Liquors	High Risk - Open to atmosphere	Medium

Source	Odour Offensiveness	Mitigation/Control	Source Odour Potential
THP Feed Silo	High risk – Indigenous sludges, sludge imports	Low Risk – Covered and extracted process	Low
THP Feed Hopper	High risk – Indigenous sludges, sludge imports	Low Risk – Covered and extracted process	Low
Dewatering Centrifuge	High risk – Indigenous sludges, sludge imports	Medium Risk – Covered without extraction process	Medium
Liquor Pumping Station	High Risk – Sludge liquors	High Risk – Open to atmosphere	High
Degassing Tanks	Medium Risk – Digested sludges	Low Risk – Covered and extracted process	Low
Degassing Tanks Ventilation Stack	Medium Risk – Digested sludges	Medium Risk – Ventilation stack with no treatment	Medium
OCU 1 (Imports)	High Risk – Imported sludge cake	Medium Risk – Ventilation stack with no treatment	High
OCU 2 (Mixed Tanks)	High risk – Indigenous sludges, sludge imports	Medium Risk – Ventilation stack with no treatment	High
OCU 3 (THP Feed)	High risk – Indigenous sludges, sludge imports	Medium Risk – Ventilation stack with no treatment	High
OCU 4 (SAS Thickener)	Medium Risk - SAS	Low Risk – extracted and treated	Low
Digested Sludge Area (Consisting of Export and Condition areas)			
Dewatering Feed Tanks	Medium Risk – Digested sludges	High Risk – Open to atmosphere	Medium
Centrifuges	Medium Risk – Digested sludges	Medium Risk – Covered without extraction process	Medium

Source	Odour Offensiveness	Mitigation/Control	Source Odour Potential
Centrate Sump	Medium Risk – Digested sludges	High Risk – Open to atmosphere	Medium
Sludge Cake Export Barn	Medium Risk – Digested sludge cake	Medium Risk – Partially contained enclosure	Medium
Leachate Pumping station	Medium Risk – Digested sludge liquors	High Risk - Open to atmosphere	Medium
Conditioning Cake Pad	Medium Risk - Digested sludge cake	High Risk - Open to atmosphere	Medium
Liquor balancing tanks	Medium Risk – Digested sludge liquors	High Risk – Open to atmosphere	Medium

Table 13: Pathway Effectiveness Assessment

Receptor Name	Distance from Site (m)	Distance Risk	Direction From Installation	Wind Direction Frequency	Main Odour Source	Source Dispersion Risk	Pathway Effectiveness	Notes
Residential properties attached to Esholt Hall	115	Medium	NE	16.5%	Main Treatment Area	Medium	Moderately Effective Pathway	
Home Farm Industrial Park (Home Farm House and Home Farm Cottage)	283	Medium	NE	16.5%	Main Treatment Area	Medium	Moderately Effective Pathway	
Low Ash Farm	636	Low	SW	4.7%	Main Treatment Area	Medium	Ineffective Pathway	Pathway considered ineffective due to the significant distance from source and not in the prevailing wind direction.

Receptor Name	Distance from Site (m)	Distance Risk	Direction From Installation	Wind Direction Frequency	Main Odour Source	Source Dispersion Risk	Pathway Effectiveness	Notes
St Paul's Church	673	Low	NW	8.3%	Main Treatment Area	Medium	Ineffective Pathway	Pathway considered ineffective due to the significant distance from source and not in the prevailing wind direction.
Church Lane	685	Low	NW	8.3%	Main Treatment Area	Medium	Ineffective Pathway	Pathway considered ineffective due to the significant distance from source and not in the prevailing wind direction.
Bottom Farm	455	Low	S	6.2%	Digested Sludge Area	High	Moderately Effective Pathway	

Receptor Name	Distance from Site (m)	Distance Risk	Direction From Installation	Wind Direction Frequency	Main Odour Source	Source Dispersion Risk	Pathway Effectiveness	Notes
Apperley Bridge Railway Station	431	Low	S	6.2%	Digested Sludge Area	High	Ineffective Pathway	Pathway considered ineffective due to the significant distance from source and not in the prevailing wind direction.
Nunwood House	444	Low	E	43.2%	Digested Sludge Area	High	Moderately Effective Pathway	
Crow Tree House	860	Low	E	43.2%	Digested Sludge Area	High	Ineffective Pathway	Pathway considered ineffective due to the significant distance from source.
JCT600 Head Office	591	Low	SE	6.9%	Digested Sludge Area	High	Ineffective Pathway	Pathway considered ineffective due to the significant

Receptor Name	Distance from Site (m)	Distance Risk	Direction From Installation	Wind Direction Frequency	Main Odour Source	Source Dispersion Risk	Pathway Effectiveness	Notes
								distance from source and not in the prevailing wind direction.

8.2 APPENDIX B – BOUNDARY SURVEY RESULTS

(Snapshot taken from Yorkshire Water Esholt STF Odour Sampling Report, H&M Environmental Ltd, June 2021)

2.11 Boundary Survey Results

The boundary surveys were taken at the points shown in Figure 3 below:

Figure 3: Boundary Survey Points

Table 12: Boundary Survey Results 10.00 to 10.30 AM Monday 24th May

		H_2S	TVOC	NH_3	Odour	Comments
		ppm	ppm	ppm		
	Cake Area					
1	Entrance to Cake Area	0.004	<0.1	ND	Distinct	Strong Compost, faint cake
2	Exit from Cake Area	0.003	<0.1	ND	Faint	Faint Cake Odour
3	Centrifuge Feed Tank	0.003	<0.1	ND	Distinct	Localised Digested Sludge Odour
4	Tank ?	0.002	<0.1	ND	Distinct	Compost Odour
5	Entrance to Cake Pad	0.003	<0.1	ND	Strong	Compost Odour
6	North edge of Cake Pad	0.002	<0.1	ND	Strong	Compost odour
7	East edge of Cake Pad	0.003	0.1	ND	Distinct	Cake Odour
	THP Digester Area					
8	Gate to THP Area	0.002	<0.1	ND	No Odour	
9	By Power House	0.002	<0.1	ND	No	

		H_2S	TVOC	NH_3	Odour	Comments
		ppm	ppm	ppm		
					Odour	
10	North of Control Room	0.002	<0.1	ND	No Odour	
11	SPC Area	0.001	<0.1	ND	No Odour	
12	By Liquid Import Point	0.004	<0.1	ND	Strong	Tanker Discharge
13	SW Corner	0.002	<0.1	ND	Distinct	Downwind of compost plant
14	Southern Boundary	0.002	<0.1	ND	Distinct	Downwind of compost plant

Table 13: Boundary Survey Results 13:00 to 13:30PM Monday 24th May

		H_2S	TVOC	NH_3	Odour	Comments
		ppm	ppm	ppm		
	Cake Area					
1	Entrance to Cake Area	0.003	<0.1	ND	Distinct	Strong Compost, faint cake
2	Exit from Cake Area	0.002	<0.1	ND	Faint	Faint Cake Odour
3	Centrifuge Feed Tank	0.004	<0.1	ND	Distinct	Localised Digested Sludge Odour
4	Tank ?	0.002	<0.1	ND	Distinct	Compost Odour
5	Entrance to Cake Pad	0.004	<0.1	ND	Strong	Compost Odour
6	North edge of Cake Pad	0.002	<0.1	ND	Strong	Compost odour
7	East edge of Cake Pad	0.003	0.1	ND	Distinct	Cake Odour
	THP Digester Area					
8	Gate to THP Area	0.002	<0.1	ND	No Odour	
9	By Power House	0.002	<0.1	ND	No Odour	
10	North of Control Room	0.002	<0.1	ND	No Odour	
11	SPC Area	0.001	<0.1	ND	No Odour	Readings taken around perimeter
12	By Liquid Import Point	0.005	<0.1	ND	Strong	Tanker Discharge
13	SW Corner	0.002	<0.1	ND	No Odour	Downwind of Digesters
14	Southern Boundary	0.003	<0.1	ND	No Odour	Downwind of Degassing Tank

Table 14: Boundary Survey Results 09.00 to 10.00 AM Wednesday 2nd June

		H_2S	TVOC	NH_3	Odour	Comments
		ppm	ppm	ppm		
	Cake Area					
1	Entrance to Cake Area	0.004	<0.1	ND	No Odour	Upwind of Cake Area
2	Exit from Cake Area	0.003	<0.1	ND	No Odour	Upwind of Cake Area
3	Centrifuge Feed Tank	0.004	<0.1	ND	Faint	Localised Digested Sludge Odour
4	Tank	0.004	<0.1	ND	Faint	Localised Digested Sludge Odour
5	Entrance to Cake Pad	0.003	<0.1	ND	Faint	Downwind of Cake Area
6	North edge of Cake Pad	0.002	<0.1	ND	No Odour	Upwind of Cake Area
7	East edge of Cake Pad	0.003	<0.1	ND	No Odour	Upwind of Cake Area
	THP Digester Area					
8	Gate to THP Area	0.004	<0.1	ND	No Odour	Upwind of THP Area
9	By Power House	0.004	<0.1	ND	No Odour	Upwind of THP Area
10	North of Control Room	0.003	<0.1	ND	No Odour	Upwind of THP Area
11	SPC Area	0.002	<0.1	ND	No Odour	Upwind of THP Area
12	By Liquid Import Point	0.003	<0.1	ND	No Odour	No Tanker
13	SW Corner	0.002	<0.1	ND	No Odour	Downwind of THP Area
14	Southern Boundary	0.002	<0.1	ND	No Odour	Downwind of THP Area

Table 15: Boundary Survey Results 12.30 to 13.30 AM Wednesday 2nd June

		H_2S	TVOC	NH_3	Odour	Comments
		ppm	ppm	ppm		
	Cake Area					
1	Entrance to Cake Area	0.003	<0.1	ND	No Odour	Upwind of Cake Area
2	Exit from Cake Area	0.003	<0.1	ND	No Odour	Upwind of Cake Area
3	Centrifuge Feed Tank	0.004	<0.1	ND	Distinct	Localised Digested Sludge Odour
4	Tank	0.003	<0.1	ND	Distinct	Localised Digested Sludge Odour
5	Entrance to Cake Pad	0.004	<0.1	ND	Faint	Downwind of Cake Area
6	North edge of Cake Pad	0.002	<0.1	ND	No Odour	Upwind of Cake Area
7	East edge of Cake Pad	0.003	<0.1	ND	No Odour	Upwind of Cake Area
	THP Digester Area					
8	Gate to THP Area	0.003	<0.1	ND	No Odour	
9	By Power House	0.003	<0.1	ND	No Odour	
10	North of Control Room	0.002	<0.1	ND	No Odour	
11	SPC Area	0.002	<0.1	ND	No Odour	Readings taken around perimeter
12	By Liquid Import Point	0.003	<0.1	ND	No Odour	No Tanker
13	SW Corner	0.002	<0.1	ND	No Odour	Downwind of THP Area
14	Southern Boundary	0.003	<0.1	ND	No Odour	Downwind of THP Area

Appendix 9 Noise Impact Assessment

TECHNICAL NOTE

Job Name: Yorkshire Water Environmental Permitting, Esholt

Job No: 331001762

Note No: 100.2101/ACO01

Date: June 2021

Prepared By: Matthew Barlow

Subject: **Esholt STF – Noise and Vibration Risk Assessment**

1. Introduction

1.1. Stantec (UK) has been commissioned by Yorkshire Water (YW) to undertake a noise and vibration risk assessment to support a permit application for the Esholt Sludge Treatment Facility (STF).

1.2. YW already holds a permit for a variety of activities at Esholt. However, due to changes in the interpretation of the environmental permitting regulations, it has been agreed by YW and the Environment Agency that a variation to an existing permit is required to add Schedule 5.4 Part A(1)(b)(i) for AD treatment activities.

1.3. This technical note summarises the results of our review of the activities included with the permit with regards to statutory guidance relating to noise and vibration.

2. EA Permitting Requirements - Noise

2.1. When applying for a permit, the Environment Agency may require a noise management plan to be submitted if:

- They consider there may be a risk of noise and vibration pollution beyond the site boundary; or
- A noise impact assessment has been prepared as part of a risk assessment.

2.2. The findings of any noise impact assessment should be considered as part of the wider environmental risk assessment.

2.3. If a noise and vibration management plan is required, it should be prepared following the guidance in Environmental Permitting: H3 part 2 Noise Assessment and Control[1].

DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Reviewed	Approved
331001762/100.2101/ACO01	Final	June 2021	MB	PESL	PD

T: +44 1173 327 840 E: bristolqueensquare@stantec.com

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/298126/LIT_8291_337647.pdf

Guidance on Risk Assessments

2.4. Risk assessments for permitting purposes should be undertaken in accordance with the Guidance on the preparation of risk assessments[2] which details a procedure for undertaking a risk assessment of a site.

Horizontal Guidance Note for Noise Part 2 – Noise Assessment and Control

2.5. This guidance provides supplementary information to assist Applicants in preventing and minimising emissions of noise and vibration.

2.6. The assessment methodology is based primarily on the requirements detailed in BS4142:1997 Method for rating industrial noise affecting mixed residential and industrial areas. This standard has been superseded by BS4142:2014+A1:2019, but the principles of the assessment methodology remain broadly similar.

2.7. The guidance document also provides an overview of the application of Best Available Techniques (BAT) to sites and processes.

Requirements for Quantitative Noise Impact Assessments

2.8. The information requirements of the EA with regards to what must be submitted if an assessment uses computer modelling or spreadsheet calculations are detailed in guidance 'Noise impact assessments involving calculations or modelling'[3]. This requirement is not applicable in this instance as a qualitative review methodology has been selected.

3. Best Applicable Techniques (BAT)

3.1. In addition to the BAT detailed in the Horizontal Guidance Note for Noise Part 2, further information on BAT is detailed in the 'Commission Implementing Decision (EU) 2018/1147 of 10 August 2018'[4]. With respect to noise, section 1.4 states:

> ***BAT 17****. In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to set up, implement and regularly review a noise and vibration management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:*
>
> *1. A protocol containing appropriate actions and timelines;*
>
> *2. A protocol for conducting noise and vibration monitoring;*
>
> *3. A protocol for response to identified noise and vibration events, e.g. complaints;*
>
> *4. A noise and vibration reduction programme designed to identify the source(s), to measure/estimate noise and vibration exposure, to characterise the contributions of the sources and to implement prevention and/or reduction measures.*
>
> *Applicability*
>
> *The applicability is restricted to cases where a noise or vibration nuisance at sensitive receptors is expected and/or has been substantiated*
>
> ***BAT 18.*** *In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to use one or a combination of the techniques given below.*

[2] https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit

[3] https://www.gov.uk/guidance/noise-impact-assessments-involving-calculations-or-modelling

[4] https://www.legislation.gov.uk/eudn/2018/1147

	Technique	Description	Applicability
a.	*Appropriate location of equipment and buildings*	*Noise levels can be reduced by increasing the distance between the emitter and the receiver, by using buildings as noise screens and by relocating building exits or entrances.*	*For existing plans, the relocation of equipment and building exits or entrances may be restricted by a lack of space or excessive costs.*
b.	*Operational measures*	*This includes techniques such as:* *(i) inspection and maintenance of equipment;* *(ii) closing of doors and windows of enclosed areas, if possible;* *(iii) equipment operation by experienced staff;* *(iv) avoidance of noisy activities at night, if possible;* *(v) provisions for noise control during maintenance, traffic, handling and treatment activities.*	*Generally applicable.*
c.	*Low-noise equipment*	*This may include direct drive motors, compressors, pumps and flares.*	
d.	*Noise and vibration control equipment*	*This includes techniques such as:* *(i) noise reducers;* *(ii) acoustic and vibrational insulation of equipment;* *(iii) enclosure of noisy equipment;* *(iv) soundproofing of buildings.*	*Applicability may be restricted by a lack of space (for existing plants).*
e.	*Noise attenuation*	*Noise propagation can be reduced by inserting obstacles between emitters and receivers (e.g. protection walls, embankments and buildings).*	*Applicable only to existing plants, as the design of new plants should make this technique unnecessary. For existing plans, the insertion of obstacles may be restricted by a lack of space.* *For mechanical treatment in shredders of metal wastes, it is applicable within the constraints associated with the risk of deflagration in shredders.*

4. Project Proposals

4.1. Reference should be made to Section II of the full permit application for a technical description of the site activities covered by the permit variation application.

5. Noise and Vibration Risk Assessment

5.1. A preliminary noise risk assessment has been undertaken based on information provided by YW.

5.2. In considering the risks associated with the operations covered by the permit application, the following site-specific factors have been considered:

- The proximity and sensitivity of nearby receptors
- The existing environmental sound climate at the receptors
- The operational characteristics of the source
- The historical lack of noise complaints arising in respect of the operations carried out under the scope of the current permit variation.

Noise and Vibration Sensitive Receptors

5.3. The sensitivity of a particular receptor depends on a variety of factors, but the following table provides examples of the types of receptors likely to be considered either high, medium or low sensitivity.

Table 1: Summary of Receptor Sensitivity

Sensitivity to Noise and Vibration	Description	Example Receptor
High	Receptors where people or operations are particularly sensitive to noise or vibration	Residential, including private gardens Quiet outdoor areas used for recreation Theatres/Auditoria/Studios Schools and Nurseries during the daytime Hospitals/residential care homes Places of worship
Medium	Receptors where noise or vibration may cause some distraction or disturbance	Offices Retail areas and other commercial developments Bars/Cafes/Restaurants where external noise may be intrusive Sports ground where quiet conditions are necessary (e.g. tennis, golf, bowls)
Low	Receptors where distraction or disturbance from noise and vibration is minimal	Industrial areas Sports ground with no specific requirement for quiet conditions Night clubs

5.4. For the purposes of this assessment, noise and vibration sensitive receptors are considered to be any existing occupied premises within 1km of the site which may be adversely affected by noise or vibration and has a high sensitivity. Receptors beyond this distance are unlikely to be significantly affected by noise or vibration from Esholt STF.

5.5. In this instance the following receptors have been identified. Where appropriate, receptors have been grouped where they are within the same area.

Table 2: Noise and Vibration Sensitive Receptors

Receptor Reference	Receptor Description	Receptor Type	Approximate Distance from Site Boundary (m)
A	Esholt Hall (Residential) / Esholt Hall (Conference Centre)	Residential / YW Staff Training Centre	140 - 170
B	Home Farm Industrial Park and Cottages	Commercial/Residential	258
C	Low Ash Farm	Residential	700
D	Church Lane, Esholt	Residential / Place of Worship	700
E	Bottom Farm	Residential	450 (950 from main noise sources)
F	Nunwood House	Residential	450 (950 from main noise sources)

5.6. Due to the nature of the sources present on site, the distance between the identified receptors and the site boundary, vibration from the operations at the site is unlikely to have an impact and is considered to be low risk. Vibration is therefore not considered further.

Existing Environmental Sound Climate

5.7. The site lies in a predominantly rural area. Strategic noise mapping data provided by Defra[5] does not cover this area, and there are no planning applications in the immediate vicinity which include environmental sound survey data.

5.8. In the absence of detailed environmental sound surveys, the existing environmental sound climate is assumed to be low.

Operational Characteristics

5.9. The sources of noise associated with the permit include:

- The movement of vehicles to the sludge unloading area associated with the transportation of sludge and sludge cake.
- The operation of plant items including the CHP engine located in a container, conveyors, induced draft fans associated with odour extraction, rotating screens, compressors, waste gas burner and air-cooled radiators.

5.10. Typically, the main sources of noise would be the operation of the CHP (engine and exhaust), air-cooled radiators and waste gas burner.

5.11. All of the activities described within the permit variation application are existing and will continue to operate in the same manner as their established use (e.g. hours of operation and load). There are no changes to activities or additional plant or equipment included as part of the permit variation.

Risk Matrix

5.12. Based on the above, Table 3 details a review of the information detailed in the Preliminary Noise Risk Assessment.

5.13. The combined assessment of the proposals in noise and vibration terms is that the probability of exposure and consequence are both low, with the overall risk level being low.

5.14. As there have been no noise complaints associated with Esholt STF, and there are no significant changes proposed to the existing installation, BAT 17 as defined in 'Commission Implementing Decision (EU) 2018/1147 of 10 August 2018' is not considered to be applicable.

5.15. On the basis of the qualitative risk assessment carried out above and reported in Table 3, and in light of the operating history of the plant, no further controls are considered necessary in respect of the permitted operations. Site management practices included within YW's Environmental Management Systems (EMS), which include provisions for noise control and plant maintenance, will continue to be applied; no specific permit Noise Management Plan is considered necessary at this time. In the event of material changes to the local noise environment, or location or sensitivity of nearby receptors, or should substantiated complaints arise, this position should be reviewed as part of normal site management reviews and controls.

[5] https://www.gov.uk/government/publications/strategic-noise-mapping-2019

Table 3: Risk Matrix

Hazard	Receptor	Pathway	Risk Management Techniques	Probability of Exposure	Consequence	Overall Risk
Noise: CHP	Residential / Place of Worship / Commercial	Airborne	The equipment is containerised in a high performance acoustically treated enclosure and designed for external applications. Good maintenance of plant to ensure that excessive noise levels are not generated, under Operations & Maintenance contract. Regular checks of noise mitigation measures fitted to items of plant. Where repair or replacement is required, the plant will, where possible, be taken out of service until repair or replacement of parts has been undertaken.	Unlikely - The risk management actions will prevent significant impact at nearest receptors	Mild – Minor nuisance impacts	Low
Noise: CHP and Boiler Exhausts			Enclosure mounted high performance exhaust silencer with elevated stack vent point. Good maintenance of plant to ensure that excessive noise levels are not generated, under Operations & Maintenance contract Regular checks of noise mitigation measures fitted to items of plant. Where repair or replacement is required, the plant will, where possible, be taken out of service until repair or replacement of parts has been undertaken.	Unlikely - The risk management actions will prevent significant impact at nearest receptors	Mild – Minor nuisance impacts	Low
Noise: Digesters (Gas Mix Compressors)			Compressors on the gas mixing are potentially noisy but are located in acoustic enclosures and/or have integrated acoustic controls. Good maintenance of plant to ensure that excessive noise levels are not generated, under Operations & Maintenance contract Regular checks of noise mitigation measures fitted to items of plant. Where repair or replacement is required, the plant will, where possible, be taken out of service until repair or replacement of parts has been undertaken.	Unlikely - The risk management actions will prevent significant impact at nearest receptors	Mild – Minor nuisance impacts	Low
Noise: Fans on air cooled radiators			Fans of a low noise specification and subject to regular checks and maintenance. Good maintenance of plant to ensure that excessive noise levels are not generated from equipment breakdown or wear and tear (e.g. fan motor bearing failure), under Operations & Maintenance contract.	Unlikely - The risk management actions will prevent significant impact at nearest receptors	Mild – Minor nuisance impacts	Low
Noise: Waste Gas Burner			Waste gas burner operates only when CHPs are unavailable. Good maintenance of plant to ensure that excessive noise levels are not generated from equipment breakdown or wear and tear (e.g. fan motor bearing failure), under Operations & Maintenance contract.	Unlikely - The risk management actions will prevent significant impact at nearest receptors	Mild – Minor nuisance impacts	Low
Noise: Vehicular movements around site			Vehicles will be screened from receptors for the majority of their operations. Due to the layout of this area, vehicle movements would be transient and typically associated with passing movements only.	Unlikely - The risk management actions will prevent significant impact at nearest receptors	Mild – Minor nuisance impacts	Low
Noise: Air Mix Compressors			Good maintenance of plant to ensure that excessive noise levels are not generated, under Operations & Maintenance contract Regular checks of noise mitigation measures fitted to items of plant. Where repair or replacement is required, the plant will, where possible, be taken out of service until repair or replacement of parts has been undertaken.	Unlikely - The risk management actions will prevent significant impact at nearest receptors	Mild – Minor nuisance impacts	Low
Noise: THP			Potential for noise from steam venting. Occurs intermittently. Good maintenance of plant to ensure that excessive noise levels are not generated, under Operations & Maintenance contract Regular checks of noise mitigation measures fitted to items of plant. Where repair or replacement is required, the plant will, where possible, be taken out of service until repair or replacement of parts has been undertaken.	Unlikely - The risk management actions will prevent significant impact at nearest receptors	Mild – Minor nuisance impacts	Low

Appendix 10 Odour Management Plan

Esholt Sludge Treatment Facility Odour Management Plan

January 2023

YorkshireWater

Stantec

Document Control

Document Control Ref:	Version 3_FINAL
Document Location:	IMS > Level 3 Site Specific Manuals > Energy & recycling Assets > Esholt > Conditioning and CHP
Document Custodian:	IMS Team
Review Period:	This OMP will be updated following completion of the abatement review as detailed in the proposed improvement programme. It will then be reviewed every year, and in the event of operational changes or persistent odour events or complaints.

Document Revision History

Version	Date	Revised By	Reviewed By	Amendment Details
1	June 2021	Antony Saunders (Stantec)	Ed Sutherland	Version 1
2	January 2023	Antony Saunders (Stantec)		Inclusion of SAS assets

Project details

Project number	33100176-100-2101-7
Unique document reference	41527729
Project name	Esholt STF Permit Application
Date	January 2023

Client details

Client name	Yorkshire Water
Client address	Western House Halifax Road Bradford West Yorkshire BD6 2SZ

Document details

Document title	Esholt Sludge Treatment Facility Odour Management Plan
Document version	V3_FINAL
Report author	Antony Saunders
Report reviewed by	
Report approved by	
Report by	Stantec Stantec House Kelburn Court Birchwood Warrington WA3 6UT

Contents

1 Introduction

This Odour Management Plan (OMP) for Esholt sludge treatment facility (STF) has been developed by Stantec on behalf of Yorkshire Water Services Ltd (YW). YW have developed this OMP as a live working document that forms part of the operational management system of the site. The OMP demonstrates how odours shall be managed and controlled to prevent odour impacts from activities during normal operation and also during abnormal events.

The OMP has been developed to meet the Environment Agency's (EA) H4 Odour Management Guidance.

The OMP has been prepared in support of the permit variation for Esholt STF.

These activities fall under Environmental Permit EPR/ DP3192ZP.

The OMP provides sufficient detail to allow operators and maintenance staff to understand clearly the operational procedures for both normal and abnormal conditions. It is intended to be used as a reference document by operational staff on a day-to-day basis. The OMP includes the following:

- A description of the site and catchment, including sources of odour on the site, and location of sensitive receptors;
- A brief history of received complaints and measures taken to date;
- YW Operation and Management (O and M) procedures for the site, including good housekeeping measures to minimise odour generation and release;
- The mitigation procedures which should be implemented when foreseeable situations that may compromise the ability to prevent and minimise odorous releases occur. These can include both breakdowns and external conditions such as extreme weather;
- An Action Procedure for complaints;
- An odour risk assessment identifying any odorous or potentially odorous areas of the works and immediate and longer-term actions required to eliminate odour complaints; and
- The management and operator training requirements and records with respect to odour.

1.1 Yorkshire Water Odour Management

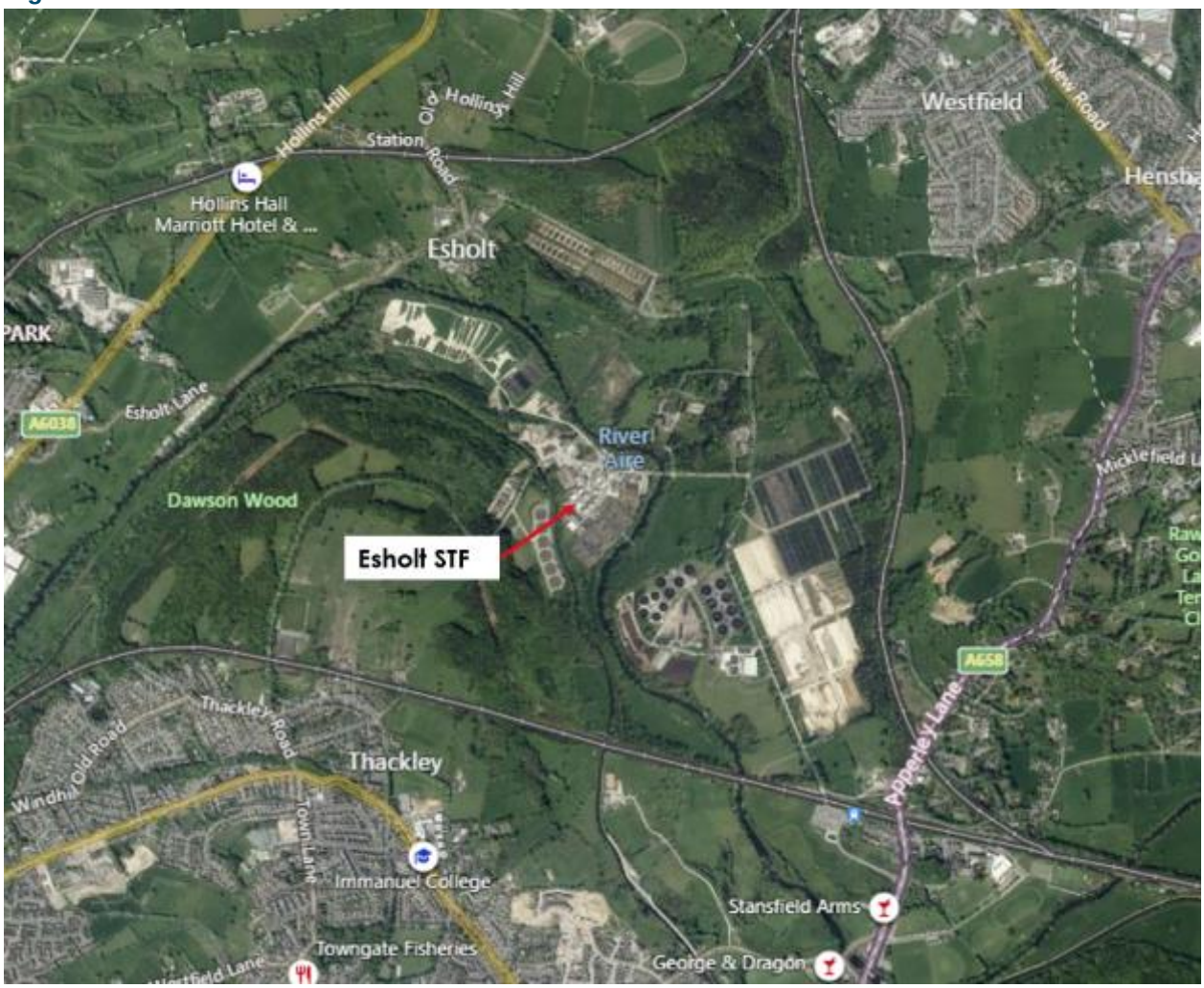
YW acknowledges that high levels of odour arising from wastewater and sludge treatment are not acceptable and that reasonable measures must be taken to minimise any inconvenience to the general public. YW does not operate under a single defined odour exposure standard. Each site is considered individually taking into account the relevant legislation and local authority's conditions. Site specific factors such as site history with regard to odour complaints, potential future encroachment by residential or business developments, and the presence of particularly odour sensitive receptors within the vicinity of the works / facility are also taken into consideration.

2 Site Information

2.1 Site Location

Esholt STF is located within the boundary of Esholt WwTW. The site is located approximately 4 km south-west of Leeds Bradford Airport with the River Aire passing adjacent to the STF. The site is primarily surrounded farmland and grass land to the north, east and west with residential areas towards in all directions beyond the local farmland. The works location is highlighted in Figure 1.

Figure 1 Esholt STF Site Location



2.2 Site Receptors

Esholt STF is surrounded predominantly by farmland with residential and commercial receptors located further away (Figure 2 – 4, Table 1). To the north of the site is primarily a boundary of grassland followed by residential receptors and Esholt village. To the East of the works is grassland and farmland followed by Little London village. To the south of the works is farmland followed by Apperley Bridge Town consisting of a higher density of residential and commercial properties. To the west of the works is predominantly grassland with residential areas further away.

Esholt WwTW has received odour complaints through the local environmental health officer and the Environment Agency highlighting 2 main complainant areas located at the Apperley Bridge area close to the river and Greengates traffic junction. These complaints have not been attributed to any one source.

Figure 2 Location of Sensitive Receptors (Residential)

Figure 3 Location of Sensitive Receptors (Commercial / Industrial)