Blue Phoenix Group

Blue Phoenix UK

Extension of Sheffield Site

CIRIA C736
Containment Systems Risk Assessment

Volume 1
Main Text and Appendices A, B, and C

Ref: P22053-SMCE-ZZ-XX-RP-C-0100
Date: November 2023 (Revised 03.01.2024)

STIRLINGMAYNARD
CONSULTING ENGINEERS
Stirling House Rightwell Bretton Peterborough PE3 8DJ
Tel 01733 262319 Fax 01733 331527
email enquiries@stirlingmaynard.com www.stirlingmaynard.com

Client: Blue Phoenix UK
CIRIA C736 – Containment Systems Risk Assessment
Extension to Sheffield Site

Blue Phoenix – Extension of Sheffield Site

CIRIA C736
Containment Systems Risk Assessment

Authorisation

Version	Comments	Date
P01	1st Issue	30.11.23
P02	Minor revision to correct typo in risk assessment table on page 12	03.01.24

Doc No: P22053-SMCE-ZZ-XX-RP-C-0100		Version: P01	Status: S4	Date 30.11.23
Prepared by:	H D West BSc CEng MICE Managing Director	Reviewed by:	AN Dugmore BEng CEng MICE Director	
Signed:	H.D. West	Signed:	[signature]	
Date:	03.01.24	Date:	03.01.24	

Client: Blue Phoenix UK
CIRIA C736 – Containment Systems Risk Assessment
Extension to Sheffield Site

Contents

Appendices

Client: Blue Phoenix UK
CIRIA C736 – Containment Systems Risk Assessment
Extension to Sheffield Site

1. Introduction

1.1. The risk assessment relates to the extension of an existing Incinerator Bottom Ash processing plant operated by Blue Phoenix (BPL) at Beeley Wood Recycling Village, Clay Wheels Lane, Sheffield.

1.2. Raw Incinerator Bottom Ash (IBA) is processed on site to create Incinerator Bottom Ash Aggregate (IBAA) in various size fractions, along with by-products which include ferrous and non-ferrous metals, and small amounts of unburnt waste.

1.3. The site is located at OS National Grid Reference SK 32197 92064, What3Words: bigger.patch.below.

1.4. A site location plan (P22053-SMCE-ZZ-XX-DR-C-0002) along with the existing site layout (P22053-SMCE-ZZ-XX-DR-Z-1005), and the proposed site layout (P22053-SMCE-ZZ-XX-DR-Z-1004) are included in appendix A.

1.5. Note that the proposed site layout drawing referred to above encompasses the entire site layout including a new process building within the existing operational area. This risk assessment relates to the new IBAA storage pad and attenuation lagoon to the east of the existing operational area shown on drawings P22053-SMCE-ZZ-XX-DR-C-0102 and 0105, also contained in appendix A.

1.6. The existing operational site is circa 1.97ha. The site includes hardstanding for storing raw IBA and processed IBAA, a process building, an attenuation lagoon in the south-west corner of the site, along with welfare facilities and car parking.

1.7. The extended site to the east of the existing operational site is circa 0.92ha in area, and approximately 145m long by 65m wide typically. The existing site is level, comprising concrete roadways and concrete ground bearing floor slabs which remain from the previous industrial buildings that occupied the site before they were demolished. The northern-east boundary of the site borders railway land, part of the historic Woodhead line, linking Sheffield and Stocksbridge. The north-west boundary links to the existing Blue Phoenix operational area. The south-west boundary borders an on-site roadway shared between the site leaseholders, and the south-east boundary is currently derelict land with no specific use at present.

1.8. The extended site will comprise:

1.8.1. Concrete hardstanding built on top of the existing concrete slab construction to at as a storage pad, predominantly for processed IBAA, but with flexibility to store raw IBA as necessary. The storage pad is to be constructed to falls so that surface water collected on the pad flows to an attenuation lagoon.

1.8.2. A reinforced concrete attenuation lagoon and associated catchpits, designed and constructed to liquid containing standards, and set into the ground so as to collect run-off from the concrete storage pads.

1.8.3. Two new weighbridges.

1.8.4. A new drainage system to discharge attenuated run-off to the nearby public sewer on Clay Wheels Lane, via a connection to the existing on-site drainage system.

1.8.5. Dust suppression system and associated pipework.

1.8.6. Ducts to suit telemetry and power required as part of the extension.

1.8.7. Signage and road markings.

1.9. This risk assessment document is intended to identify the requirements for provision of primary and secondary containment to prevent the inventory stored on the site, (principally surface water run-off contaminated by raw and processed IBA) causing contamination of the environment.

1.10. The risk assessment covers the extended area only. The remainder of the site is intended to continue to operate under the existing permit rules.

1.11. The risk assessment follows guidance given in CIRIA report C736, and utilises data provided from a phase 1 geo-environmental desk study prepared in connection with the proposed development, a coal mining risk assessment, along with various phase 2 intrusive investigations. This data is included as appendices C and D following.

2. CIRIA C736 Risk Assessment

2.1. The site will require an extension to the Existing Environmental Permit. As part of the process of obtaining this it is necessary to demonstrate that the construction of the site extension will provide adequate containment to prevent inventory stored on the site from polluting the underlying ground or other potential receptors. To do this a risk assessment is required in accordance with the guidance given in CIRIA C736 - Containment Systems for the Prevention of Pollution.

2.2. This document is intended to represent an appropriate assessment of the risks associated with the inventory relating to IBA and IBAA to be stored at the proposed extended site at Clay Wheels Lane, Sheffield.

2.3. This assessment is intended to identify the design interventions needed to provide sufficient containment of the inventory to prevent pollution of the site or surrounding areas.

2.4. CIRIA C736 provides guidance on the measures site operators can take to minimise the risk of pollution from leaking or burning substances stored on site.

2.5. The guidance is divided into 3 parts.

2.5.1. Part 1 gives guidance on risk assessment, containment options and containment capacity.

2.5.2. Part 2 gives guidance on how existing installations can be considered.

2.5.3. Part 3 gives guidance on containment systems.

2.6. The recommended risk assessment method is a source, pathway, receptor model.

2.7. The design of the new storage pad and associated infrastructure is intended to provide containment to prevent the source finding a pathway to sensitive receptors which it could harm.

3. Sources

3.1. The principal source (inventory) is rainwater run-off or run-off from dust suppression operations from stored materials comprising raw IBA or processed IBAA. Appendix B gives some general background information on the nature of IBA/IBAA.

3.2. As well as run-off from rainfall and dust suppression, CIRIA C736 also identifies the possibility that firefighting water could be a potential source of contamination.

3.2.1. Although firefighting water is a potential risk, it is highly unlikely to be relevant to an IBA processing plant, because the raw IBA is the bottom ash from an incinerator, which has already been burnt. Apart from isolated pockets of unburnt material, IBA is not flammable, therefore the risk of pollution by firefighting water is negligible.

3.2.2. Vehicle fires are possible. The means by which firefighting water is contained on the site to prevent it from harming the environment is identified in the risk assessment.

3.3. Finally, it is possible that diesel, other oils, or hydraulic fluids could leak from the loading shovels that will operate on the new storage pad, or indeed from vehicles delivering IBA or collecting IBAA, or from re-fuelling operations.

3.4. In summary the inventory for the purposes of this risk assessment comprises:

3.4.1. Surface water run-off due to rainfall and dust suppression activities that might be contaminated with silt, dissolved salts, and other materials.

3.4.2. Firefighting water.

3.4.3. Diesel, oils, and hydraulic fluids leaking from the vehicles that operate on the site, or spillage that occurs whilst re-fuelling vehicles or from catastrophic failure of diesel storage tanks.

4. Pathways

4.1. The pathways to consider in the context of CIRIA C736 are:

4.1.1. Pathways to buried services.

4.1.1.1 Leaching through containment system to buried supply services.

4.1.2. Pathways in respect to Controlled Waters and Ground Contamination

4.1.2.1 Surface run-off / overland flows

4.1.2.2 Leaching through containment systems affecting groundwater and ground beneath the site

4.1.2.3 Leaching through containment systems into below ground drainage pipework.

5. Receptors

5.1. The receptors to consider in connection with a CIRIA C736 risk assessment are:

5.1.1 Potable water supplies

5.1.2 Nearest watercourse - River Don

5.1.3 Ground below site including groundwater.

6. Site Hazard Assessment

6.1. Expanding on the preliminary conceptual model developed in the phase 1 desk study, the risks to human health, and controlled waters posed by the inventory stored on the site have been assessed as outlined in the following tables.

6.2. The tables consider Source Hazard, Pathway Hazard, and Receptor Hazard, to determine the overall site hazard rating in accordance with sections 2.3 and 2.4 along with box 2.1 of CIRIA C736.

Client: Blue Phoenix UK
CIRIA C736 – Containment Systems Risk Assessment
Extension to Sheffield Site

Site Hazard based on Source-Pathway Receptor Model							
Potential Source	**Potential Pathway**	**Potential Receptor**	**Source Hazard**	**Pathway Hazard**	**Receptor Hazard**	**Site Hazard in relation to potential source, pathway, and receptor**	**Justification**
Item 3.4.1 Contaminated surface water run-off	Item 4.1.1.1 Leaching through containment system to buried supply services	Item 5.1.1 Potable water supplies	Moderate	Low	Moderate	Low	There are no water supply pipelines underneath the proposed storage pad that could be affected.
Item 3.4.2 Firefighting Water	Item 4.1.1.1 Leaching through containment system to buried supply services	Item 5.1.1 Potable water supplies	Moderate	Low	Moderate	Low	There are no water supply pipelines underneath the proposed storage pad that could be affected.
Item 3.4.3 Diesel, oils, and hydraulic fluids leaking from the vehicles that operate on the site, or spillage that occurs whilst re-fuelling vehicles or from catastrophic failure of diesel storage tanks.	Item 4.1.1.1 Leaching through containment system to buried supply services	Item 5.1.1 Potable water supplies	High	Low	High	Low	There are no water supply pipelines underneath the proposed storage pad that could be affected.

Client: Blue Phoenix UK
CIRIA C736 – Containment Systems Risk Assessment
Extension to Sheffield Site

Site Hazard based on Source-Pathway Receptor Model							
Potential Source	**Potential Pathway**	**Potential Receptor**	**Source Hazard**	**Pathway Hazard**	**Receptor Hazard**	**Site Hazard in relation to potential source, pathway, and receptor**	**Justification**
Item 3.4.1 Contaminated surface water run-off	Item 4.1.2.1 Overland flow to nearby surface water bodies (controlled waters)	Item 5.1.2 Controlled watercourse River Don	Moderate	Low	Low	Low	The source hazard is moderate due to potential contaminants including heavy metal ions dissolved in the inventory. The river Don is located circa 250m from the site, albeit downhill in the valley. Even with a catastrophic failure of the containment, the risk of overland flow to the river Don via any overland route is low. Therefore, the pathway hazard is low. The receptor hazard is low because the river Don would significantly dilute any contamination meaning the effect on the receptor would be negligible. Discharge of surface water run off from IBA processing sites to watercourse is permitted at many BPL sites. Therefore, site hazard rating is low.

Site Hazard based on Source-Pathway Receptor Model							
Potential Source	**Potential Pathway**	**Potential Receptor**	**Source Hazard**	**Pathway Hazard**	**Receptor Hazard**	**Site Hazard in relation to potential source, pathway, and receptor**	**Justification**
Item 3.4.2 Firefighting Water	Item 4.1.2.1 Overland flow to nearby surface water bodies (controlled waters)	Item 5.1.2 Controlled watercourse River Don	Moderate	Low	Low	Low	The source hazard is moderate due to foams and other contaminants in firefighting water. Vehicle fires could occur on site, or possibly fuel tank fires. IBA and IBAA is not flammable, hence the quantities of firefighting water that could be used on the site are low because the risk of a large fire is minimal. Even with catastrophic failure of the containment system overland pathways to the nearest watercourse are unlikely to be viable because of distance from site and quantity of inventory. The pathway risk is therefore low. Significant dilution of firefighting water would occur if any of the inventory reached the river Don. The receptor hazard is therefore low. The site hazard rating is low.

Site Hazard based on Source-Pathway Receptor Model							
Potential Source	**Potential Pathway**	**Potential Receptor**	**Source Hazard**	**Pathway Hazard**	**Receptor Hazard**	**Site Hazard in relation to potential source, pathway, and receptor**	**Justification**
Item 3.4.3 Diesel, oils, and hydraulic fluids leaking from the vehicles that operate on the site, or spillage that occurs whilst re-fuelling vehicles or from catastrophic failure of diesel storage tanks.	Item 4.1.2.1 Overland flow to nearby surface water bodies (controlled waters)	Item 5.1.2 Controlled watercourse River Don	High	Low	High	Low	The source hazard is high because fuel oils, other hydrocarbons and hydraulic fluids create a high risk of pollution. The pathway hazard is low risk, because the quantity of such sources used or stored on site is very low in comparison to the distance to the watercourse. It is almost inconceivable that this inventory would reach the river Don by any overland route. The receptor hazard is high because hydrocarbon pollution of a watercourse represents a serious environmental incident. The site hazard is low, because although the environmental consequences are high there is no viable overland route to the watercourse and the quantities that could escape the containment system are extremely low.

Site Hazard based on Source-Pathway Receptor Model							
Potential Source	**Potential Pathway**	**Potential Receptor**	**Source Hazard**	**Pathway Hazard**	**Receptor Hazard**	**Site Hazard in relation to potential source, pathway, and receptor**	**Justification**
Item 3.4.1 Contaminated surface water run-off	Item 4.1.2.2 Leaching through containment systems affecting groundwater	Item 5.1.3 Ground beneath site including groundwater	Moderate	Low	Moderate	Low	The source hazard is moderate due to the potential for heavy metal ions and other contaminants in surface water run-off from storage areas. The main storage pad will be laid to falls so that run-off is directed to flow to the attenuation lagoon. The attenuation lagoon will be designed and constructed to water retaining standards, and it is intended that the watertightness of the tank will be validated as part of the construction process. The pathway risk is therefore low. The receptor hazard is moderate because the inventory does contain agents that may contaminate the ground. However typically the inventory is allowed to be discharged into open watercourses at processing sites, so the levels of contamination caused by any inventory that did leach through the containment system is likely to be low level.

Site Hazard based on Source-Pathway Receptor Model							
Potential Source	**Potential Pathway**	**Potential Receptor**	**Source Hazard**	**Pathway Hazard**	**Receptor Hazard**	**Site Hazard in relation to potential source, pathway, and receptor**	**Justification**
Item 3.4.2 Firefighting Water	Item 4.1.2.2 Leaching through containment systems affecting groundwater	Item 5.1.3 Ground beneath site including groundwater	Moderate	Low	Moderate	Low	The source hazard is moderate due to the nature of firefighting water that could include foams. Quantities of firefighting water will however be very low because IBA is not flammable. Fire risks relate to stored fuel tanks, vehicle, and plant fires, which will require limited quantities to deal with. The main storage pad will be laid to falls so that run-off is directed to flow to the attenuation lagoon. The attenuation lagoon will be designed and constructed to water retaining standards, and it is intended that the watertightness of the tank will be validated as part of the construction process. The pathway risk is therefore low. The receptor hazard is moderate because of the possible effects of the inventory on ground and groundwater beneath the site. If the containment system were to fail any contamination would be very limited and localised to the immediate site area. The site hazard is therefore low.

Site Hazard based on Source-Pathway Receptor Model							
Potential Source	**Potential Pathway**	**Potential Receptor**	**Source Hazard**	**Pathway Hazard**	**Receptor Hazard**	**Site Hazard in relation to potential source, pathway, and receptor**	**Justification**
Item 3.4.3 Diesel, oils, and hydraulic fluids leaking from the vehicles that operate on the site, or spillage that occurs whilst re-fuelling vehicles or from catastrophic failure of diesel storage tanks.	Item 4.1.2.2 Leaching through containment systems affecting groundwater	Item 5.1.3 Ground beneath site including groundwater.	High	Low	Moderate	Low	The nature of diesel, other oils and hydraulic fluids is such that the source hazard is high. As far as oil storage is concerned, the diesel would be stored in accordance the Control of Pollution (Oil Storage) Regulations. Compliance with this through provision of appropriate bunds and drip trays would effectively prevent any pathway to a sensitive receptor. The pathway hazard in relation to stored oils and the like is therefore low. Leakage of fuels and other fluids from vehicles operating on the site would involve very small quantities and be controlled by use of spill kits and drip trays where vehicles are parked. The pathway hazard is therefore low. Receptor hazard is moderate because whilst the potential of harm from these agents is high, the quantities that could feasibly reach a sensitive receptor are extremely low. The site hazard is therefore low.

Site Hazard based on Source-Pathway Receptor Model							
Potential Source	**Potential Pathway**	**Potential Receptor**	**Source Hazard**	**Pathway Hazard**	**Receptor Hazard**	**Site Hazard in relation to potential source, pathway, and receptor**	**Justification**
Item 3.4.1 Contaminated surface water run-off	Item 4.1.2.3 Leaching through containment systems into below ground drainage pipework	Item 5.1.2 Controlled watercourse or other water bodies.	Moderate	Low	Low	Low	The nature of IBA / IBAA is such that run-off from storage pads must be considered a moderate source hazard. There are existing drainage systems below the site, but under the new storage pad these will be covered over by the containment system, so that surface water from the new pad area cannot enter the drainage system. If the containment system fails very small quantities of run off could enter the site drainage system via pipe joints, former gullies, broken pipes, and the like, and ultimately be discharged to a watercourse. The pathway hazard is considered low as it is unlikely to carry the inventory in significant quantities. The receptor hazard is moderate because run-off from IBA/IBAA storage areas, does contain agents that could cause environmental harm if they reach the receptor. However, the dilution effect from the watercourse, means that any such harm is unlikely to be measurable. The site hazard is therefore low.

Client: Blue Phoenix UK
CIRIA C736 – Containment Systems Risk Assessment
Extension to Sheffield Site

Site Hazard based on Source-Pathway Receptor Model							
Potential Source	**Potential Pathway**	**Potential Receptor**	**Source Hazard**	**Pathway Hazard**	**Receptor Hazard**	**Site Hazard in relation to potential source, pathway, and receptor**	**Justification**
Item 3.4.2 Firefighting Water	Item 4.1.2.3 Leaching through containment systems into below ground drainage pipework	Item 5.1.2 Controlled watercourse or other water bodies.	Moderate	Low	Moderate	Low	The source hazard is moderate due to the nature of firefighting water that could include foams. Quantities of firefighting water will however be very low because IBA is not flammable. Fire risks relate to stored fuel tanks, vehicle, and plant fires, which will require limited quantities to deal with. There are existing drainage systems below the site, but under the new storage pad these will be covered over by the containment system, so that surface water from the new pad area cannot enter the drainage system. If the containment system fails very small quantities of run off could enter the site drainage system via pipe joints, former gullies, broken pipes, and the like, and ultimately be discharged to a watercourse. The pathway hazard is considered low as it is unlikely to carry the inventory in significant quantities. The receptor hazard is moderate because run-off from IBA/IBAA storage areas, does contain agents that could cause environmental harm if they reach the receptor. However, the dilution effect from the watercourse, means that any such harm is unlikely to be measurable. The site hazard is therefore low.

Client: Blue Phoenix UK
CIRIA C736 – Containment Systems Risk Assessment
Extension to Sheffield Site

Site Hazard based on Source-Pathway Receptor Model							
Potential Source	**Potential Pathway**	**Potential Receptor**	**Source Hazard**	**Pathway Hazard**	**Receptor Hazard**	**Site Hazard in relation to potential source, pathway, and receptor**	**Justification**
Item 3.4.3 Diesel, oils, and hydraulic fluids leaking from the vehicles that operate on the site, or spillage that occurs whilst re-fuelling vehicles or from catastrophic failure of diesel storage tanks.	Item 4.1.2.3 Leaching through containment systems into below ground drainage pipework	Item 5.1.2 Controlled watercourse or other water bodies.	High	Low	Moderate	Low	The nature of diesel, other oils and hydraulic fluids is such that the source hazard is high. As far as oil storage is concerned, the diesel would be stored in accordance the Control of Pollution (Oil Storage) Regulations. Compliance with this through provision of appropriate bunds and drip trays would effectively prevent any pathway to a sensitive receptor. The pathway hazard in relation to stored oils and the like is therefore low. Leakage of fuels and other fluids from vehicles operating on the site would involve very small quantities and be controlled by use of spill kits and drip trays where vehicles are parked. The pathway hazard is therefore low. Receptor hazard is moderate because whilst the potential of harm from these agents is high, the quantities that could feasibly reach a sensitive receptor are extremely low. The site hazard is therefore low.

6.3. Summary of Site Hazard Assessment

6.3.1. From the above assessment it is considered that the main risks are associated with use of diesel on site, firefighting water, and from surface water run-off contaminated by heavy metals, chlorides, and sulphates from raw and processed IBA.

6.3.2. The overall site hazard rating is considered **low.**

6.3.3. Stored oils such as diesel create a high site hazard, but this will be mitigated by provision of their own containment system in compliance with the Control of Pollution (Oil Storage) Regulations. The overall site hazard is therefore not affected by the storage of oils on site.

7. Frequency of Loss of Containment

7.1. Containment of Inventory at the site (excluding stored oils such as diesel) will be provided by the RCC pavement from which the storage pads are constructed and the reinforced concrete attenuation lagoon.

7.2. The risk of failure of these structures must be considered separately.

7.3. **RCC Paving**.

7.3.1. The concrete pavement upon which raw and processed IBA will be stored will be constructed from circa 230mm thick C40/50 Roller compacted concrete, underlain by a 200mm thick Cement Bound Granular sub-base.

7.3.2. The concrete paving will be unreinforced and will have joints on an approximate 4m by 4m grid.

7.3.3. The paving is laid by asphalt paving plant and compacted in a similar manner to asphalt. Joints in the paving are saw-cut and filled with bitumen spray before final compaction takes place. The RCC pavement is therefore effectively impermeable.

7.3.4. The pavement will be laid to falls to direct surface water run-off to the attenuation lagoon. Therefore, inventory will not be held on the RCC pavement and will flow towards the attenuation tank. If the attenuation tank filled up entirely the perimeter kerbs and designed falls would prevent inventory overflowing from the storage pad onto other areas.

7.3.5. The ground underneath the proposed storage area comprises impermeable paving in the form of concrete ground slab, underlain by dense sand. Geotechnical investigations undertaken using cable percussive borehole techniques reached refusal at a depth of just 1.65m. A coal mining investigation detected no voids and only a very thin (20cm) seam of coal. The ground underneath the proposed storage pad appears to be stable.

7.3.6. The risk of catastrophic failure of the RCC containment system is low. Areas of wear may occur, and bays of concrete may require periodic replacement, but this would be unlikely to significantly affect the containment provided by the RCC paving.

7.3.7. The frequency of loss of containment provided by the pavement is considered Medium, with reference to table 2.3 of CIRIA C736.

7.4. Attenuation Tank

7.4.1. The attenuation tank will be of reinforced concrete construction designed and constructed in accordance with EN 1990, EN 1991, and EN 1992 along with the relevant UK National Annexes. The attenuation tank design will comply with the relevant parts of Eurocode relating to liquid retaining and containment structures.

7.4.2. The concrete specification along with designed cover to reinforcement will ensure a design life of 50+ years for the tank. The specification considers high exposure classes for concrete in connections such as chlorides and sulphates in the ground.

7.4.3. The design includes additional reinforcement to ensure that crack widths in the concrete fall within appropriate limits for structures intended to retain liquids.

7.4.4. The tank is buried in the ground and the walls and base designed to resist lateral earth pressure and surcharge loadings from the earth retaining side when the tank is empty as well as reversal of stresses when the tank is full of water. The walls of the tank will be protected from vehicular and plant impact by safety barriers.

7.4.5. Catastrophic failure of the tank is highly unlikely within a 50-year design life, so it is inconceivable that a sudden high-volume release of inventory from the tank could occur.

7.4.6. Even during maintenance operations such as de-silting it is highly unlikely that the tank would be damaged to the extent that significant loss of containment will occur. This can be justified because unlike liners such as rubber membranes often used for similar tank installations, concrete is not vulnerable to puncture or fracture.

7.4.7. Low level leakage of inventory is more likely, but measures are in place through design and construction validation to minimise the risk of leakage.

7.4.8. To minimise risk of leakage of the structure, movement joints will not be provided. All construction joints will contain hydrophilic waterstop which will expand in contact with water effectively providing a full seal at construction joints.

7.4.9. As part of the construction process water testing is specified to ensure that the tank is leak free.

7.4.10. There will be no penetrations through the tank walls, hence no risk of leakage through penetrations. The tank will be emptied by pumping.

7.4.11. The tank will not be subject to large settlements because the ground pressures applied by the tank to the foundation soil will be low which minimises the risk of ground settlement causing stresses in the tank walls which could lead to cracking and therefore low-level leakage.

7.4.12. The structure will act as a rigid box capable of resisting ground movements without excessive cracking or risk of rupture.

7.4.13. For most of its operational life the tank will be largely empty. It has been designed to attenuate run-off from a 1% AEP rainfall event with 40% allowance for climate change. Over a 50-year service life there is a 39.5% probability of 1 or more 1% AEP rainfall events occurring, although the chance of more than one such event occurring over a 50-year period is just 8.9%. By comparison one might expect between 20-30No. 50% AEP (1 in 2-year) rainfall events over a 50-year service life, but the rainfall volume for a typical 50% AEP event is only about 40% of that of a 1% AEP event. These figures suggest that even after taking account of the 40% climate change allowance, most of the time the attenuation tank is likely to be virtually empty. Hence it will rarely be subject to the structural design effects that the design standards dictate, and there will rarely be sufficient inventory stored in the tank to create a serious risk of harm should a failure occur.

7.4.14. The design and construction of the attenuation tank is considered to have a Low frequency of loss of containment in accordance with table 2.3 of CIRIA C736.

8. Site Risk Rating

8.1. Box 2.2 of CIRIA C736 defines the overall site risk rating based upon the Site Hazard rating and the Frequency of Loss of Containment

8.2. RCC Paving

8.2.1. The site hazard rating is low (L).

8.2.2. The frequency of loss of containment is medium (M)

8.2.3. The site risk rating is therefore **LOW**.

8.3. Attenuation Lagoon

8.3.1. The site hazard rating is low (L)

8.3.2. The frequency of loss of containment is low (L)

8.3.3. The site risk rating is therefore **LOW**.

9. Containment Classification System and Implications for Design

9.1. Section 2.6.1 of C736 suggests that a class 1 containment system is required for the RCC paving.

9.1.1. The RCC paving will be treated as "catchment area construction" as table 10.2 of CIRIA C736. It is a transfer system directing inventory to the attenuation lagoon. The form of construction is "rigid pavement".

- The rigid pavement will comprise 200mm thick RCC paving laid on 230mm cement bound sub-base over capping and finally the existing impermeable concrete ground surface. This complies with the 4th row of table 10.2 of CIRIA C736 to provide class 1 containment.

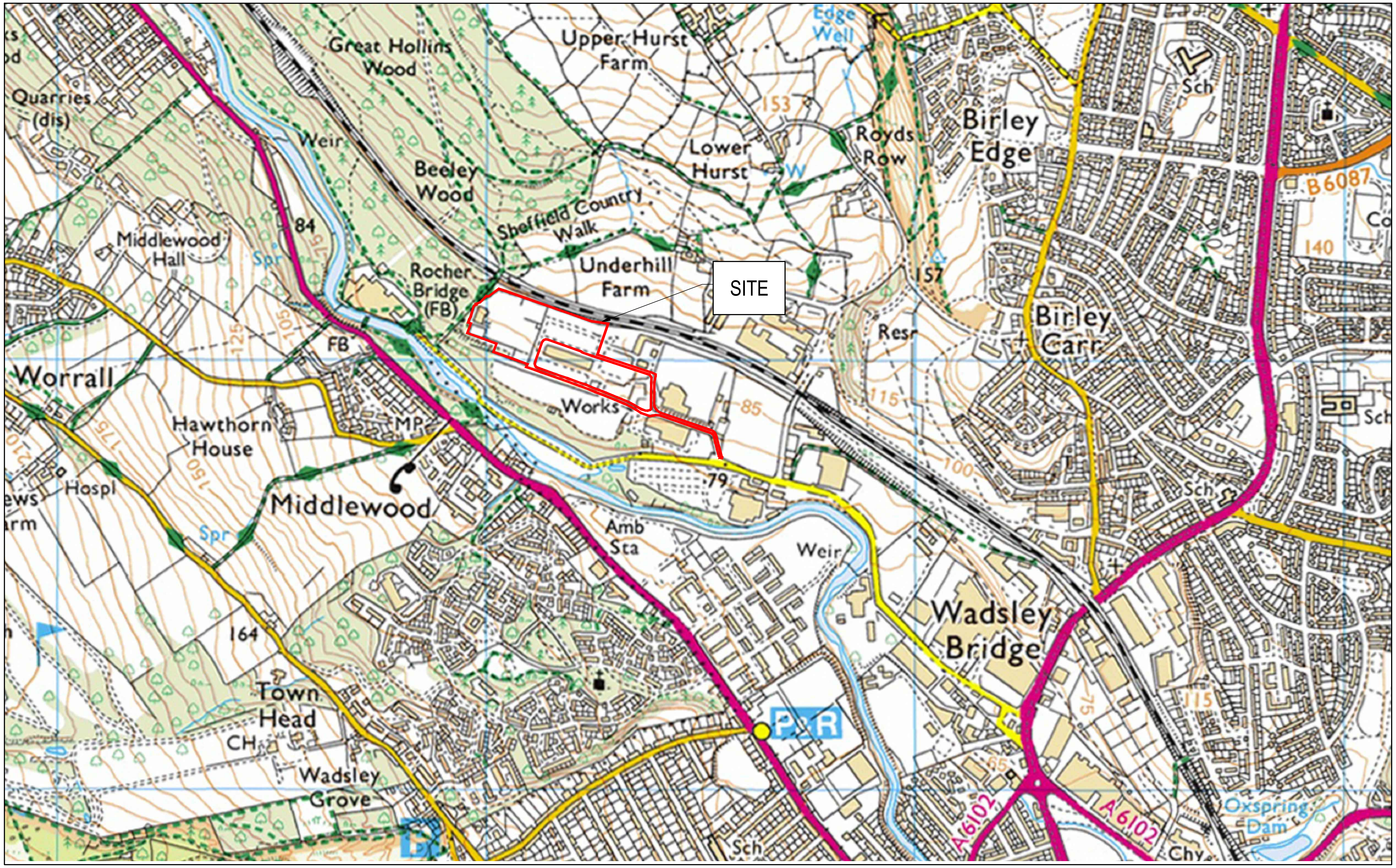
9.2. For the attenuation tank CIRIA C736 suggests a class 1 containment system is needed, providing a base level of integrity.

9.2.1. The attenuation tank and associated intake works will be designed and constructed in accordance with CIRIA C736 chapters 7 and 9. No further measures will be needed to meet the class 1 containment requirements this risk assessment suggests is required.

Appendix A

Location Plan and Proposed Site Layout

N



0 100 200 300 400 500 Metres

REV	DATE	DESCRIPTION	DRW	CHK
P01	10.05.22	Issued for Information	SA	RME
P02	13.09.22	Site boundary extended.Boundary adjusted to show temporary access road. Issued for Planning.	SA	RME
P03	22.11.22	WORK IN PROGRESS - PROJECT ON HOLD	SA	RME
P04	25.08.23	Site boundary revised. Issued for Comment.	SA	RME
P05	12.10.23	Issued for Comment	SA	RME
P06	10.11.23	Issued for Tender	SA	RME

KEY

Site Boundary

Temporary Access Road

NOTES

1. This drawing to be read in conjunction with all relevant drawings, Specification and M&E drawings.

Client
BLUE PHOENIX

Project Title
IBA RECYCLING FACILITY
CLAY WHEELS LANE
SHEFFIELD

Drawing Title
SITE LOCATION PLAN

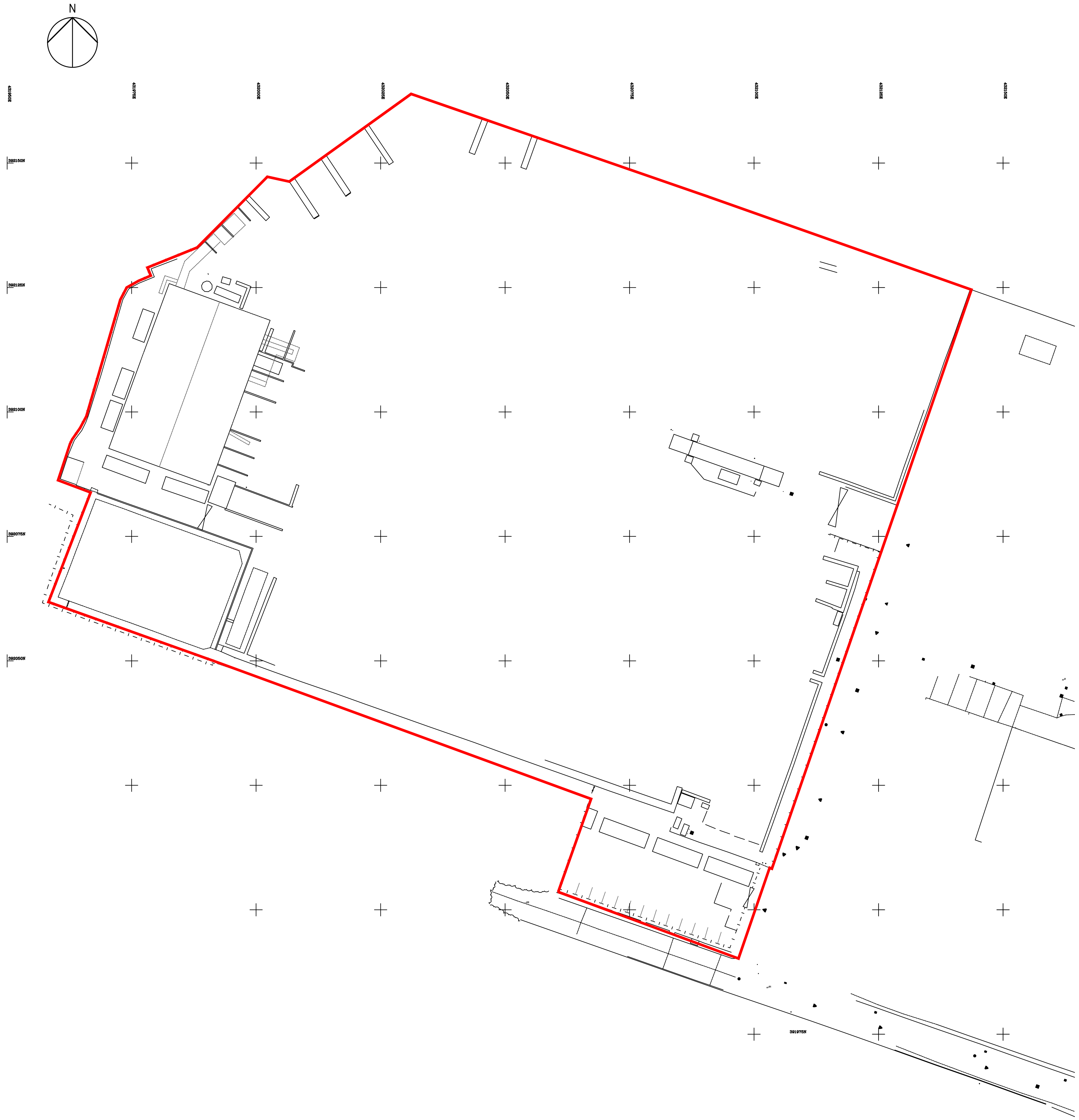
Job No.	Originator	Zone	Level	Type	Role
P22053	SMCE	ZZ	XX	DR	Z

Drawing No. 0002
Revision P06

Drawn	Checked	Date	Scale	Size
SA	RME	10.05.22	As Shown	A3

Purpose Of Issue: FOR TENDER
Status: D2

STIRLINGMAYNARD
CONSULTING ENGINEERS
Stirling House Rightwell Bretton Peterborough PE3 8DJ
Tel 01733 262319 Fax 01733 331527
email enquiries@stirlingmaynard.com www.stirlingmaynard.com



REV	DATE	DESCRIPTION	DRW	CHK
P01	12.07.23	ISSUED FOR PLANNING	SA	RME

KEY

Existing Site Boundary

Client
BLUE PHOENIX

Project Title
IBA RECYCLING FACILITY
CLAY WHEELS LANE
SHEFFIELD

Drawing Title
EXISTING SITE LAYOUT

Job No.	Originator	Zone	Level	Type	Role
P22053	SMCE	ZZ	XX	DR	Z

Drawing No. 1005

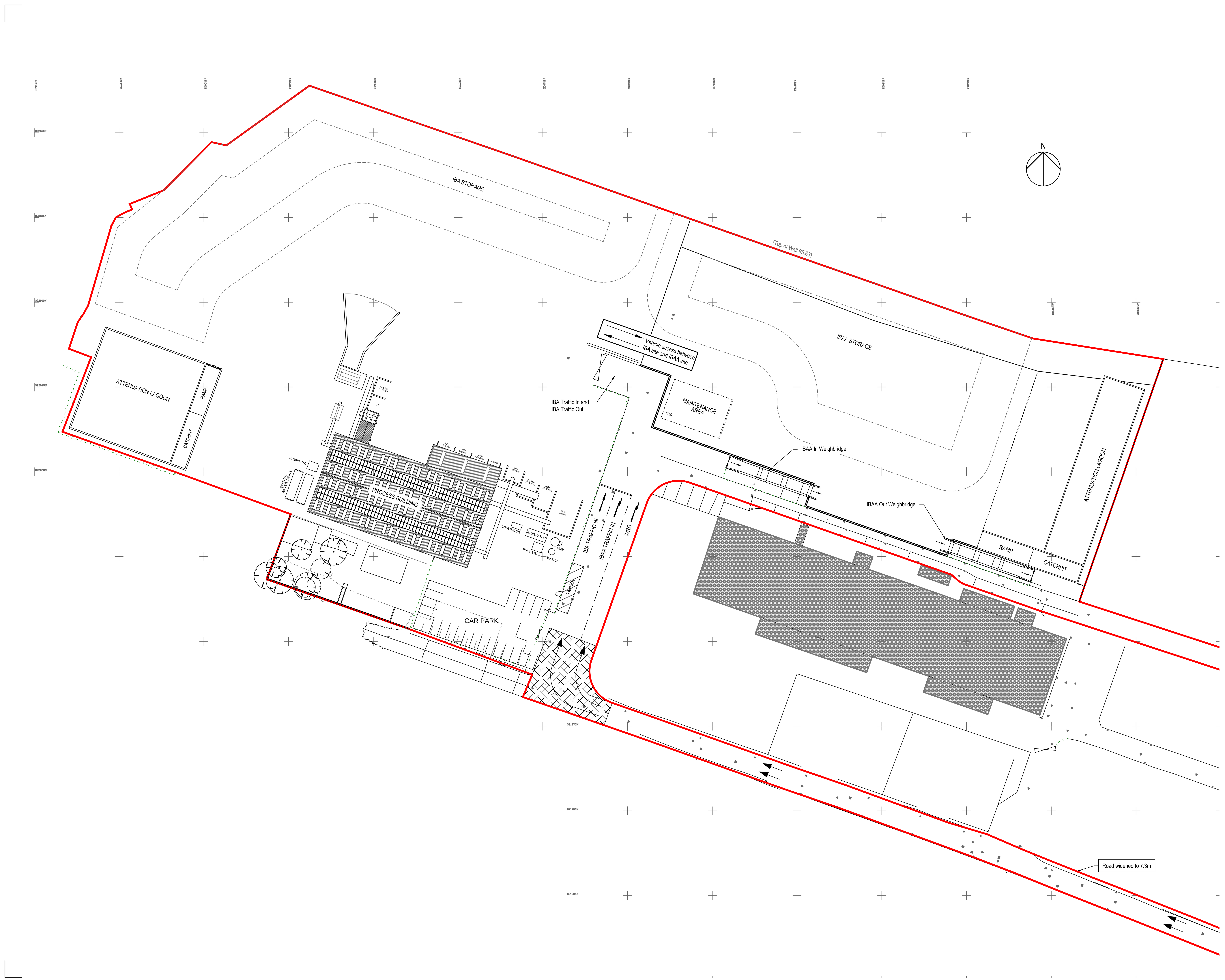
Revision P01

Drawn	Checked	Date	Scale	Size
SA	RME	12.07.23	1:500	A1

Purpose Of Issue: FOR INFORMATION

Status: S2

STIRLINGMAYNARD
CONSULTING ENGINEERS
Stirling House Rightwell Bretton Peterborough PE3 8DJ
Tel 01733 262319 Fax 01733 331527
email enquiries@stirlingmaynard.com www.stirlingmaynard.com



REV	DATE	DESCRIPTION	DRW	CHK
P01	17.03.23	ISSUED FOR PLANNING	SA	RME
P02	27.06.23	SOLAR PANELS ADDED TO PROCESS BUILDING	SA	RME

KEY

Site Boundary

Client
BLUE PHOENIX

Project Title
IBA RECYCLING FACILITY
CLAY WHEELS LANE
SHEFFIELD

Drawing Title
SITE PLAN

Job No.	Originator	Zone	Level	Type	Role
P22053	SMCE	ZZ	XX	DR	Z

Drawing No. 1004

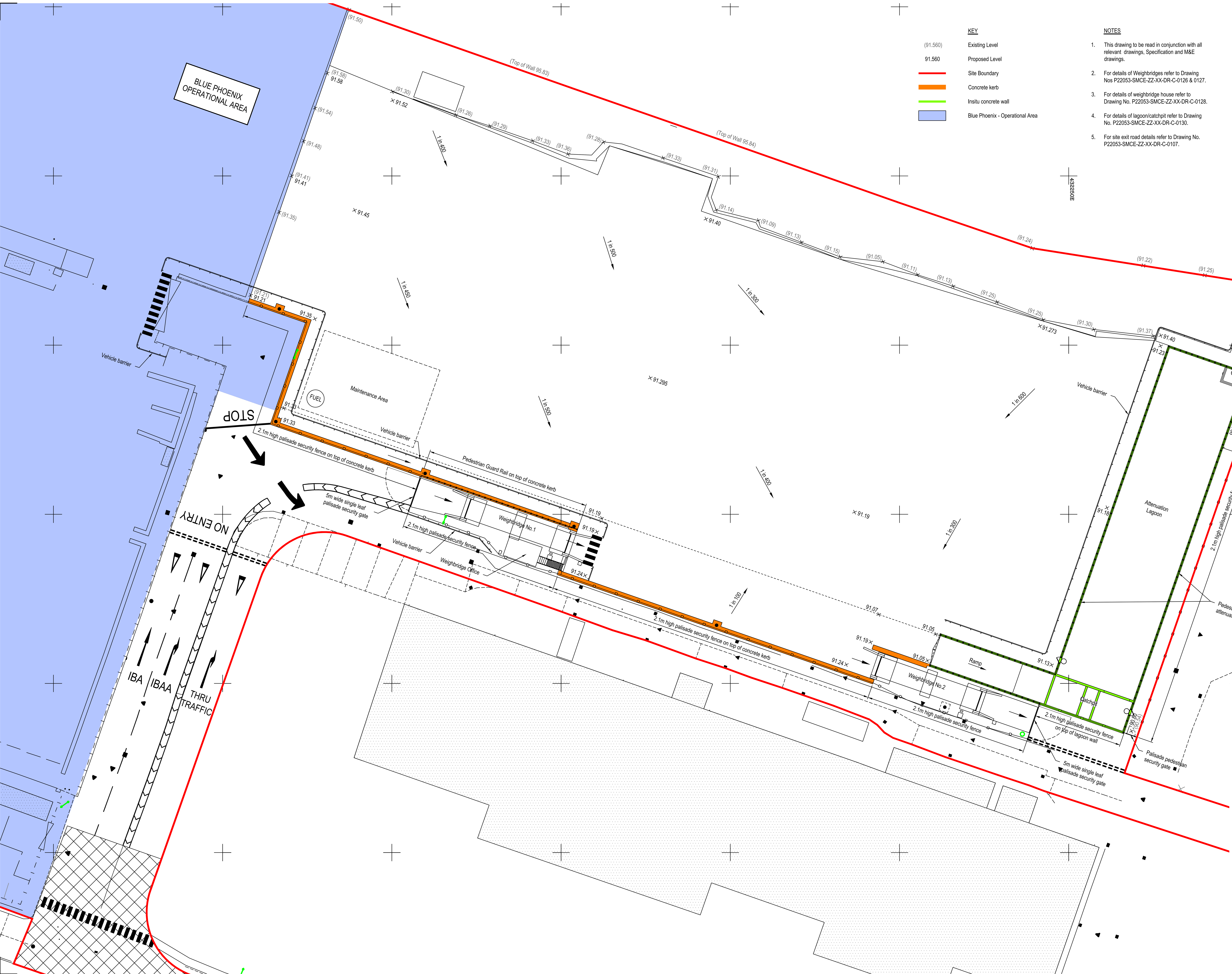
Revision P02

Drawn	Checked	Date	Scale	Size
SA	RME	09.03.23	1:500	A1

Purpose Of Issue
FOR COMMENT

Status
S3

STIRLINGMAYNARD
CONSULTING ENGINEERS
Stirling House Rightwell Bretton Peterborough PE3 8DJ
Tel 01733 262319 Fax 01733 331527
email enquiries@stirlingmaynard.com www.stirlingmaynard.com



KEY

(91.560)	Existing Level
91.560	Proposed Level
(red line)	Site Boundary
(orange line)	Concrete kerb
(green line)	Insitu concrete wall
(blue area)	Blue Phoenix - Operational Area

NOTES

1. This drawing to be read in conjunction with all relevant drawings, Specification and M&E drawings.
2. For details of Weighbridges refer to Drawing Nos P22053-SMCE-ZZ-XX-DR-C-0126 & 0127.
3. For details of weighbridge house refer to Drawing No. P22053-SMCE-ZZ-XX-DR-C-0128.
4. For details of lagoon/catchpit refer to Drawing No. P22053-SMCE-ZZ-XX-DR-C-0130.
5. For site exit road details refer to Drawing No. P22053-SMCE-ZZ-XX-DR-C-0107.

REV	DATE	DESCRIPTION	DRW	CHK
P01	15.08.22	Issued for Comment	SA	RME
P02	31.08.22	Issued for Planning	MNS	RME
P03	13.09.22	Site layout updated. Site boundary extended. Boundary adjusted to show temporary access road. Issued for Planning	SA	RME
P04	22.11.22	WORK IN PROGRESS - PROJECT ON HOLD	SA	RME
P05	06.07.23	Layout updated for Phase 1 works. Drawing title revised.	SA	RME
P06	11.08.23	Layout updated	SA / JF	RME
P07	25.08.23	Layout updated. Drawing scale changed. Notes added. Issued for Comment.	SA / JF	RME
P08	12.10.23	Issued for Comment	SA	RME
P09	10.11.23	Issued for Tender	COP	RME

NOTES

1. This drawing to be read in conjunction with all relevant drawings, Specification and M&E drawings.

Client
BLUE PHOENIX

Project Title
IBA RECYCLING FACILITY
CLAY WHEELS LANE
SHEFFIELD

Drawing Title
PHASE 1
IBAA AREA

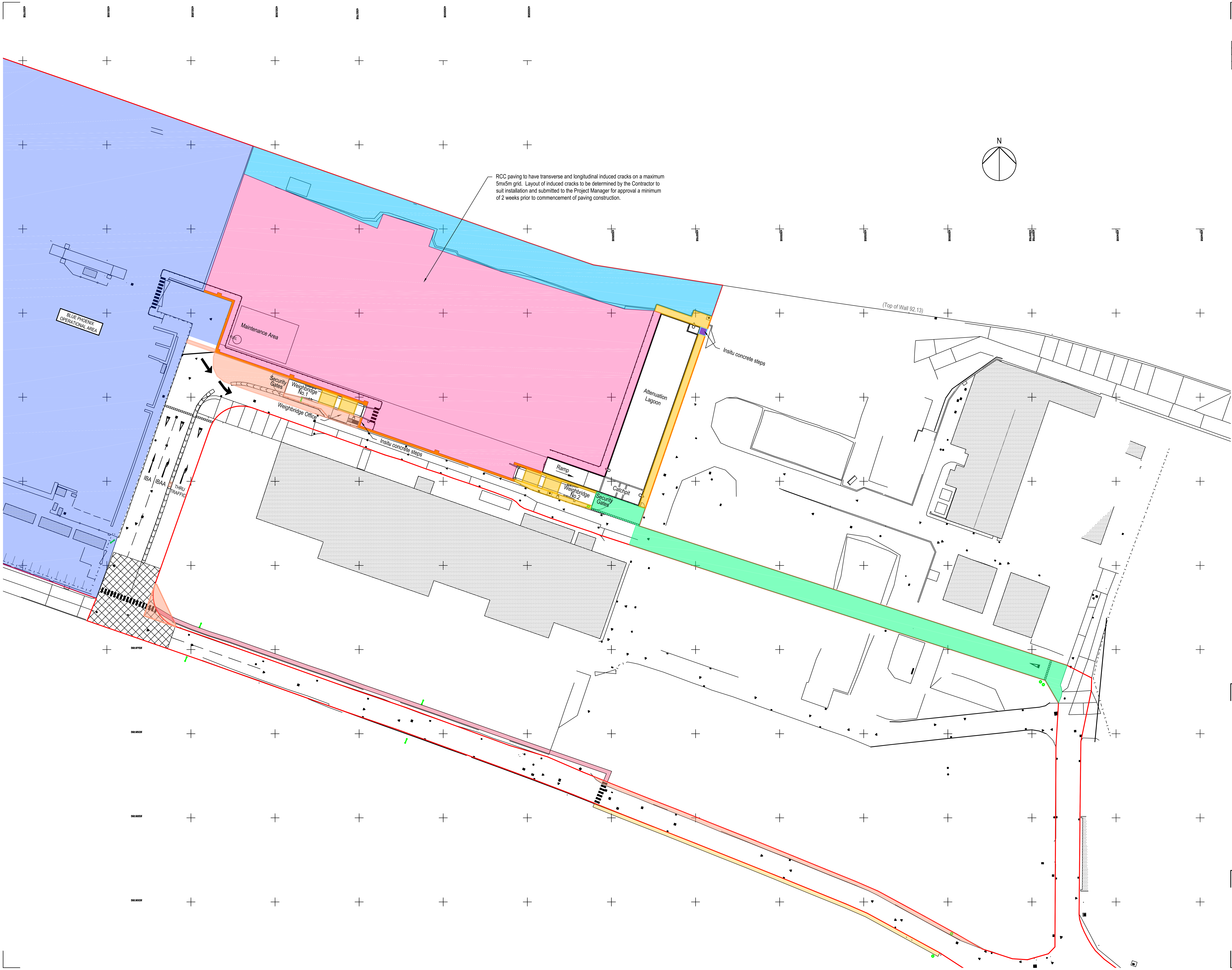
Job No.	Originator	Zone	Level	Type	Role
P22053	SMCE	ZZ	XX	DR	C

Drawing No. 0102 — Revision P09

Drawn	Checked	Date	Scale	Size
SA	RME	20.07.22	1:250	A1

Purpose Of Issue: FOR TENDER — Status: D2

STIRLINGMAYNARD
CONSULTING ENGINEERS
Stirling House Rightwell Bretton Peterborough PE3 8DJ
Tel 01733 262319 Fax 01733 331527
email enquiries@stirlingmaynard.com www.stirlingmaynard.com



REV	DATE	DESCRIPTION	DRW	CHK
P01	25.08.23	Issued for Comment	SA	RME
P02	12.10.23	Issued for Comment	SA	RME
P03	10.11.23	Issued forTender	SA	RME

NOTES

1. This drawing to be read in conjunction with all relevant drawings, Specification and M&E drawings.

KEY

- Blue Phoenix - Operational Area
- Operational Area: Roller Compacted Concrete Paving
- Existing area cleared, levels retained
- Roller Compacted Concrete Paving
- Reinforced Concrete Paving
- Footpath Construction
- Insitu Concrete Steps
- Footpath Designated by Painted Lines on Existing Slab
- Slab Edge Detail for Southern Site Boundary

Client
BLUE PHOENIX

Project Title
IBA RECYCLING FACILITY
CLAY WHEELS LANE
SHEFFIELD

Drawing Title
PHASE 1
PAVING LAYOUT

Job No.	Originator	Zone	Level	Type	Role
P22053	SMCE	ZZ	XX	DR	C

Drawing No. 0105
Revision P03

Drawn	Checked	Date	Scale	Size
SA	RME	03.08.23	1:500	A1

Purpose Of Issue: FOR TENDER
Status: D2

STIRLINGMAYNARD
CONSULTING ENGINEERS
Stirling House Rightwell Bretton Peterborough PE3 8DJ
Tel 01733 262319 Fax 01733 331527
email enquiries@stirlingmaynard.com www.stirlingmaynard.com

Appendix B
Likely impacts of IBA or IBAA on the Inventory

STIRLINGMAYNARD
CONSULTING ENGINEERS

Client: Blue Phoenix UK
CIRIA C736 – Containment Systems Risk Assessment
Extension to Sheffield Site

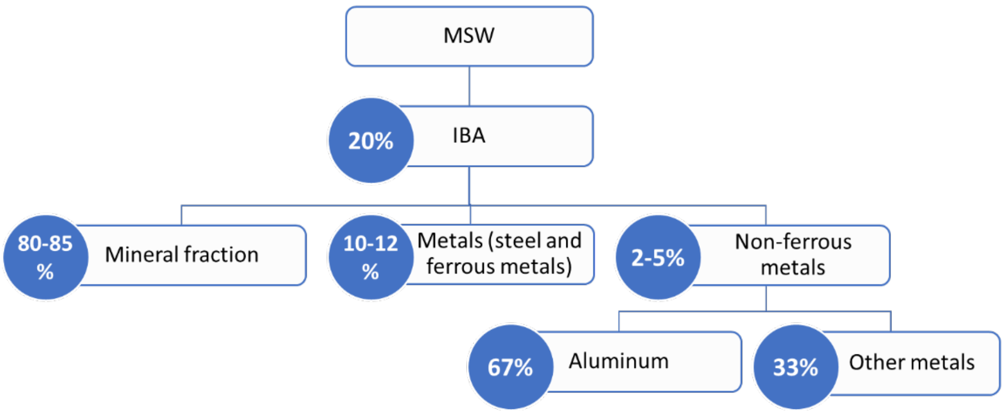
1. Background Notes Regarding IBA and IBAA

1.1. The following paragraphs provide general background information regarding the properties of IBA and IBAA and how it is likely to affect the inventory.

1.1.1. IBA is composed of inert, non-combustible material left over from the incineration of municipal solid waste (MSW) in waste to energy plants.

1.1.2. A Confederation of European Waste to Energy (CEWEP) factsheet suggests that composition of bottom ash is typically:

- Mineral fraction: 80-85%
- Metals: 10-12%
- Non-ferrous metals: 2-5%



1.1.3. IBA and IBAA are classified as non-hazardous waste materials following a curing period of 2-3 months in open conditions. Following processing IBAA can be used for a variety of construction purposes, such as general granular fill, sub-base, or aggregate for cement bound granular materials.

1.1.4. The processing of IBA requires an Environmental permit.

1.1.5. IBA contains a broad range of particle sizes, typically between 0.02mm and 10mm, which normally accounts for 60-90% by weight. The larger particles normally include materials such as pieces of glass, and ferrous and non-ferrous metals. The finer factions contain most of the soluble salts and potentially leachable heavy metals, whilst the coarsest fractions mainly consist of synthetic ceramics such as bricks, tiles, and glass.

1.1.6. The main elements of IBA expressed as oxides are SiO_2, CaO, Fe_2O_3, Na_2O, Al_2O_3, P_2O_5, MgO, K_2O, TiO_2, and SO_3. Typically, fresh IBA is understood to be alkaline with a pH between 10 and 13.

1.1.7. Potentially toxic metals such as Cd, Cr, Cu, Ni, Pb, and Zn may be found in IBA due to their presence in MSW, and these may leach out of the material due to the presence of chlorides.

1.1.8. Higher concentrations of chlorides and potentially toxic metals (e.g., Cr, Cu, Hg, Mo, Pb, Sb, Zn) have been reported as detected for smaller IBA particles, namely fractions under 4 mm.

1.1.9. Data suggests lead (Pb) can be present in quantities up to nearly 14,000mg/kg in IBA, and zinc (Zn) up to nearly 8,000mg/kg. Safe exposure limits to these materials are well below these values, so it seems reasonable to conclude that if heavy metals leach out of IBA in significant quantities, there would be harm to the environment and potential risks to human health. Data also suggests that Chloride content of IBA could be up to 7% by weight, and sulphate content over 2% by weight.

1.1.10. As the IBA ages, under natural weathering conditions the pH reduces, which means that after 2 to 3 months weathering the material stabilises so that the propensity for heavy metals to leach out of the material is reduced, enabling the material to be classified as non-hazardous.

1.1.11. Despite stabilisation of the material, there are environmental concerns regarding IBA related to the potential contamination of vulnerable recipient compartments, such as water bodies and groundwaters, ultimately affecting the inhabiting biological communities.

1.1.12. In the UK there is a legal requirement to obtain an environmental permit for waste and groundwater activities when IBAA is used in building a road sub-base, building a structural or construction platform, or in pipe bedding. However, the regulatory authorities (EA) will not normally take enforcement action when this is done without a permit provided the requirements as set out the Regulatory Position Statement (RPS 247, updated 24th January 2023) are complied with. The guidance includes limiting the quantities in which IBA can placed as a function of proximity to a water body.

1.1.13. An IBA processing plant will store fresh IBA externally for a significant time before it is processed. At the time of processing, the risk of leaching out of heavy metals will be significantly reduced, more so when the processed material is sold and placed elsewhere. The fact that the material needs to be aged before it can be classified as non-hazardous means that IBA stored at an IBA processing plant could represent a significant environmental risk if released.

1.1.14. As already suggested it is considered that the source of contamination ("the inventory") is surface and dust suppression water run-off that is potentially contaminated by the IBA is it percolates through the material and across hardstanding where IBA is stored.

1.2. Blue Phoenix monitor water samples collected from their storage lagoons as required by their various Environmental Permits

The table below provides test data provided by Blue Phoenix on samples of water collected from their attenuation lagoon at a typical site and compares the results to UK drinking water quality standards and EQS Freshwater specific pollutants and priority hazardous substances. Minimum, maximum, and average test values are given in the table. Figures in red exceed either UK drinking water standards, or EQS for freshwater.

Test		Max	Min	Average	UK Drinking Water (mg/l u.n.o)	EQS Freshwater (Guidance at www.gov.uk) (mg/l u.n.o.)
pH		8.2	7.1	7.6	6.5 to 9.5	N/A
Suspended solids	mg/l	770	47	256	N/A	N/A
Biochemical Oxygen Demand	mg O_2/l	190	4	54	N/A	N/A
Chemical Oxygen Demand	mg O_2/l	1000	96	354	N/A	N/A
Chloride	mg/l	7700	1400	4866	250	250
Ammonium	mg/l	850	0.059	43.6	0.5	N/A
Sulphate	mg/l	860	1	508	250	400
Arsenic	mg/l	0.11	0.0036	0.0225	0.01	0.05
Cadmium	mg/l	0.0034	0.00008	0.00077	0.005	N/A
Copper	mg/l	1.3	0.019	0.397	2	0.001
Mercury	mg/l	0.0018	0.0005	0.00075	0.001	N/A
Nickel	mg/l	0.27	0.017	0.062	0.02	0.05
Lead	mg/l	0.014	0.00025	0.00285	0.01	N/A
Zinc	mg/l	0.42	0.013	0.096	5	0.008
Chromium	mg/l	1.1	0.011	0.1	0.05	0.005
Iron	mg/l	20	0.02	1.11	0.2	1
Antimony	mg/l	0.029	0.0064	0.0156	0.005	N/A
Selenium	mg/l	0.075	0.036	0.049	0.01	N/A

1.2.1. The above data shows that concentrations of various agents exceed UK drinking water standards and EQS Freshwater standards.

1.2.2. pH

- The measured pH of lagoon water is between 7.1 and 8.2. UK drinking water standards allow between 6.5 and 9.5, hence there would be no adverse impact from accidental release of run-off into the water environment due to its pH.

1.2.3. Suspended solids, BOD, and COD

- Typical suspended solids, BOD, and COD are similar to crude sewage. Accidental release of water into the environment has the potential to cause environmental harm.

1.2.4. Chloride Content

- The average chloride content is nearly 20x greater than that permitted by UK drinking water and EQS, however, it is noted that the typical chloride content of sea water is about 4 times the average chloride content given by sampling of lagoon water.
- In the context of drinking water and EQS standards it is acknowledged that the chloride content has the potential to cause harm to sensitive receptors.

1.2.5. Sulphate

- Sulphate content is between 1 and 860 mg/l with an average of 500mg/l. This exceeds UK drinking water and EQS standards but is not dissimilar to sulphate content of typical UK natural groundwater samples.
- In the context of drinking water and EQS standards it is acknowledged that the chloride content has the potential to cause harm to sensitive receptors.

1.2.6. Heavy Metals

- Heavy metals are routinely tested for in the lagoon water at Blue Phoenix sites. Sampling demonstrates that concentrations may exceed the limits required for freshwater EQ standards and UK drinking water standards.

Therefore, a potential risk of environmental harm exists from heavy metals carried in solution in the run-off from IBA and IBAA storage areas.

STIRLINGMAYNARD
CONSULTING ENGINEERS

Client: Blue Phoenix UK
CIRIA C736 – Containment Systems Risk Assessment
Extension to Sheffield Site

APPENDIX C
GEO-ENVIRONMENTAL AND COAL MINING STUDIES

1 Geo-environmental and Coal Mining Studies

a. Investigations have been undertaken by Blue Phoenix to establish the existing site condition. Reports obtained are included as appendix D to provide background context.

b. A phase 1 Geo-environmental desk study reference JAD/C5146/11280 dated August 2022 was prepared by Brownfield Solutions. This provides useful background information and provides a preliminary conceptual model for the development, which has been used in preparing this specific risk assessment.

c. The main findings of the preliminary geo-environmental assessment are:

    i. The overall risk to human health from on-site soils contamination is considered low.

    ii. The risk from off-site sources of contamination is considered low

    iii. The risk from permanent ground gases is considered low to moderate

    iv. The overall risk to controlled waters is considered low.

    v. Intrusive investigations will be required to confirm the above assessed levels of risk, and determine remedial requirements, if any.

d. A coal mining risk assessment was commissioned and delivered by Brownfield Solutions in their report reference LC/C5146/11290 dated August 2022. The key findings of this risk assessment were:

    i. The risk from recorded historic coal mine workings was considered low.

    ii. A moderate to high risk is present from unrecorded shallow mine workings, particularly in connection with a known adit that passes underneath the existing operational area of the site.

    iii. An intrusive investigation was recommended comprising rotary boreholes to depths of 30 to 40 metres, concentrated in the vicinity of the proposed process building. Additionally, two boreholes were recommended for completeness where the new IBA/IBAA storage pad is to be constructed, although the risks associated with this part of the site was considered low. These two boreholes were undertaken in November 2023. Preliminary findings were that no evidence of voids or workings was encountered and only a very thin seam of coal circa 20cm in thickness was detected. No significant groundwater was detected.

e. In August 2022 an intrusive investigation (reference MS/C5146/11462 and included in appendix D) was delivered by Brownfield Solutions. The investigation covered the whole site, including the existing operational area. In the area where the IBAA storage pad will be constructed, there cable percussive boreholes (CP01, CP01A and CP01B) were attempted, along with a window sampling borehole WS02.

i. CP01 – Concrete cored to a depth of 0.22m, then abandoned due to the presence of suspected asbestos in the made ground immediately below the oversite slab.

ii. CP01A – 0.3m thickness of existing oversite concrete overlying 1.35m thickness of yellow sand, becoming very dense. Borehole terminated at a depth 1.65m due to being unable to chisel through strata.

iii. CP01B – 0.22m thick oversite concrete overlying yellow sand. Borehole terminated at 1.55m depth due to refusal.

iv. WS02 – 0.22m thick oversite concrete overlying made ground. Hole terminated with concrete obstruction at 0.25m depth.

f. Overall based on the samples that were obtained testing of made ground at the site did not reveal any exceedances of heavy metals, PAH's, petroleum hydrocarbons, BTEX or MBTE compounds. A fragment of chrysotile asbestos cement was detected in CP01, and chrysotile asbestos fibres were encountered in a stockpile of waste material, which has subsequently been dealt with by the landlord, and was in any case outside of the area to be developed by BPL and the permit boundary.

Client: Blue Phoenix UK
CIRIA C736 – Containment Systems Risk Assessment
Extension to Sheffield Site

APPENDIX D

GEO-ENVIRONMENTAL REPORTS